

Ruminant Nutrition: Dairy 1

W390 Milk production response to incremental levels of crude glycerol on diets of grazing dairy cows. R. Echeverria, A. Mackinnon, J. Rotulo, and P. Chilibraste*, *Universidad de la Republica, EEMAC, Paysandu, Uruguay.*

An experiment was carried out to determine milk production response of Holstein dairy cows to incremental levels of crude glycerol in the diet. The experiment was conducted between June 15 and July 31 of 2009 at the Experimental Station M. A. Cassinoni, Agronomy Faculty, Republic University, Uruguay. A complete randomized block design was set up and a repeated measurement in time model used to analyze the data. Thirty six autumn-calving dairy cows were blocked by parity, days in milk, milk production and body weight and randomly allocated to one of the following treatments: T0 = control diet, T1= 0.72 kg of glycerol/cow/day and T2= 1.44 kg of glycerol/cow/day. Control diets were based on grazing of a daily strip of oat plus 5 kg DM of a commercial concentrate (18.2% CP, 14% FDA, 25% NDF and 7.3% ASH) offered half at each milking. The crude glycerol (3.5% humidity, 6.9% ash, 1.5% fat and 17% methanol) was mixed with the concentrate just before each milking session. Cows body weight and milk production at the beginning of the experiment were 585±57, 576±67, 564±49 and 24.4±3.2, 24.9±4.3, 26±3.1, for T0, T1 and T2, respectively. Cows fed glycerol (T1 and T2) produced 2.15 L extra milk than control cows (T0=23.5 L; $P < 0.05$). Milk production of glycerol fed cows was not significantly different (25.4 vs. 25.9 for T1 and T2, respectively). A marginal response of 2.6 L extra milk per kg extra of glycerol was obtained with a supplementation of 0.72 kg of glycerol/cow/day. Milk response to crude glycerol in this experiment was higher than responses obtained with other energy sources which open opportunities to the use of this byproduct on diets of dairy cows.

Key Words: crude glycerol, dairy cows, milk production

W391 Nutrient balances in California dairy farms. 2. Factors associated with feed conversion and nitrogen utilization efficiencies. A. R. Castillo¹, N. Silva del Rio², and N. St-Pierre³, ¹*University of California Cooperative Extension, Merced*, ²*University of California Cooperative Extension, Tulare*, ³*The Ohio State University, Department of Animal Sciences, Columbus.*

The aim of this survey was to study dietary factors associated to nitrogen utilization efficiency and feed conversion in lactating cows on commercial farms. Forty dairies in Merced, California (mean 787 ± 592 lactating cows/farm) were characterized based on the total salt (TS) in drinking water (mean 560 ± 343 TS mg/L) and 3.5% fat-corrected milk yield/cow (MY) (mean 31.8 ± 5.2kg/d). TS were estimated by oven drying (105°C, 24 h), and MY and fat content on DHIA information. Duplicated samples of Total Mixed Rations (TMR) were collected on 2 non-consecutive days and wet chemistry analyzed. TMR nutrient content per farm (% DM, NDF, ADF, Lignin, N, Fat, Ash, non-fiber carbohydrates [NFC]), was analyzed for each production group (n = 118). CP balance (CPB) was estimated according to the NRC, 2001. DMI per farm was calculated for each lactating group based on the total daily amount of TMR supplied, divided by the number of cows in each feeding group, and corrected by estimated refusal. Pearson correlation analysis was used to study the linear association of feed conversion (FC = MY/DMI) and nitrogen utilization efficiency (NUE = N milk/N intake), and TS, MY, DMI, TMR nutrient content, number of TMR/dairy for lactating cows, and cow number/dairy. A correlations table shown results were only $r > 0.30$ and $P < 0.05$ are reported. FC and NUE were

positively associated to MY, NFC and number of TMR/dairy, and both were negatively associated to CPB. FC and NUE were also negatively associated to dietary NDF and N concentrations, respectively. FC and NUE were high and positive correlated.

Table 1. Correlation table: factors associated with FC and NUE

| | MY | %NDF | %N | %NFC | CPB | TMR/dairy | FC |
|-----|--------|--------|---------|--------|---------|-----------|--------|
| FC | 0.88** | -0.33* | ns | 0.37* | -0.35* | 0.39** | - |
| NUE | 0.70** | ns | -0.64** | 0.55** | -0.70** | 0.36** | 0.86** |

ns = non-significant, * $P < 0.05$, ** $P < 0.01$.

Key Words: dairy farms, feed conversion, nitrogen utilization efficiency

W392 Effects of glucose, propionate, insulin and gut peptides on neuropeptide mRNA concentrations in the ovine hypothalamus. A. E. Relling^{1,3}, K. Lee¹, S. C. Loerch¹, and C. K. Reynolds², ¹*The Ohio State University*, ²*University of Reading, UK*, ³*Universidad Nacional de La Plata, Argentina.*

The effects of glucose, propionate, or hormones of splanchnic origin on appetite regulating neuropeptides in the hypothalamus of ruminants have not been described. Therefore, the objective of the present study was to measure the effect in vitro of glucose, propionate, insulin, cholecystokinin (CCK), glucagon-like peptide-1 (GLP-1), or polypeptide YY (PYY) on hypothalamic mRNA concentrations for neuropeptide Y (NPY), agouti-related peptide (AgRP), and proopiomelanocortin (POMC). In an incomplete block design, hypothalamic tissue from market lambs was obtained at slaughter and immediately incubated in culture media for 2 h at 36°C. Treatments included a control Dulbecco's Modified Eagle Medium (DMEM) containing 1 mM glucose (n=8) or DMEM with the following additions: 10 mM glucose (n=8), 1 mM propionate (n=4), 1 nM insulin (n=4), 120 pM GLP-1 (n=4), 100 pM PYY (n=4), 80 pM CCK (n=4), or 10 mM glucose plus 1 nM insulin (n=4). The abundance of mRNA for NPY, AgRP, and POMC was measured using quantitative reverse transcriptase PCR, and normalized to peptidylprolyl isomerase B mRNA expression in the same sample. Dunnett's mean separation was performed to compare treatment means to the control using mixed model procedures testing the random effects of lamb and block, and the fixed effects of treatment. There was a 4-fold increase in POMC mRNA concentration for the media containing glucose plus insulin ($P < 0.05$), but NPY or AgRP mRNA concentration was not affected. There were no effects observed for the other treatments ($P > 0.20$). Results of the present study suggest insulin is required for effects of glucose on hypothalamic POMC expression in sheep. Therefore, it is likely that the effect on the neuropeptides that regulate dry matter intake are due to additive effects of multiple signals, not solely changes in single hormone and metabolite concentrations.

Key Words: hypothalamic neuropeptides, gut peptides, insulin

W393 Relationship between prolamins content and in situ starch digestibility of barley grain. M. Oba¹, D. Gibb², and T. McAllister², ¹*University of Alberta, Edmonton, AB, Canada*, ²*Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.*

The objective of this study was to evaluate the relationship between prolamins content and in situ digestibility at various incubation times for barley grain. Forty lots of barley grain samples were obtained from

an agronomic study evaluating effects of seeding and fertilization rates at two locations in Alberta (Beaverlodge and Lacombe). Barley grain was ground through 6-mm screen of the Wiley mill before in situ incubation. In situ digestibility of starch was determined after 0, 3, 6, and 24 h of incubation in the rumen of three non-lactating cows fed a 75% concentrate diet. Barley grain samples from Beaverlodge contained more prolamin than those from Lacombe (2.6 ± 0.1 vs. $1.3 \pm 0.1\%$; $P < 0.001$). However, barley grain from Beaverlodge was greater in 6-h in situ digestibility compared with those from Lacombe (60.1 ± 1.1 vs. $56.7 \pm 1.1\%$; $P < 0.05$). Prolamin content of barley grain (% dry matter) was not correlated to in situ starch digestibility at 0-h ($r = 0.15$), 3-h ($r = -0.17$), or 6-h ($r = 0.19$) of incubation, but was positively correlated to 24-h in situ digestibility ($r = 0.37$; $P = 0.05$). Prolamin content of barley grain was not correlated to in situ DM digestibility at any incubation time. These results indicate that growing environment potentially affects prolamin content of barley grain, but that prolamin in barley grain may not negatively affect starch digestion in the rumen.

Key Words: barley grain, starch digestibility, prolamin

W394 Effect of crude glycerin supplementation on the performance of dairy cows under high altitude tropical conditions. L. Mestra¹, Y. Avellaneda*¹, P. Medina¹, G. Garcia¹, C. Ariza-Nieto¹, D. Cifuentes¹, D. Galindo¹, J. Palomino¹, and G. Afanador^{1,2}, ¹CORPOICA, Bogota, Colombia, ²Universidad Nacional de Colombia, Bogota, Colombia.

This study evaluated the effect of crude glycerin (10% moisture, 87% glycerol and <0.5% methanol) supplementation on dairy cow performance under grazing conditions during the first stage of lactation. The experiment was carried out at the Colombian Corporation for Agricultural and Livestock Research located at 2650 above mean sea level. Pastures of *Pennisetum clandestinum* + *Lolium perenne* (cutting age, 45 days) sward were grazed by cows in a strip-grazing system. Cows had access to corn silage and an energy-protein nucleus (22.1% CP and 2.0 Mcal/kg NEMilk) which offer was adjusted according to the expected lactation curve. A total of 12 Holstein cows were randomly assigned to three glycerin levels (0, 300, 500 ml/day). Cows were individually weighed every other month. Feed intake and milk production were recorded daily. Additionally milk samples were collected at 0, 90 and 150 days of the study to determine fat, protein and lactose content. Data were analyzed as a completely randomized design with repeated measures over time using the MIXED procedure of SAS (Ver. 9.0, SAS Institute, Cary, NC, USA). Glycerin level did not affect productive performance ($P > 0.05$) of the dairy cows, although cows supplemented with 300 and 500 ml/day increased milk production by 10% and 6.3%, respectively compared to control group. Body weight gain was higher in cows supplemented with glycerin at 300 ml/d (0.108 kg/d) when compared to cows without glycerin (0.067 kg/d). The percentage of lactose was higher ($P < 0.05$) in milk of cows supplemented with crude glycerin compared to control group (4.8% vs. 4.4%). At the end of the experiment (150 days) milk fat showed a tendency ($P = 0.095$) to be higher in the group of cows supplemented with glycerin (3.7%) compared to the control group (3.1%). Thus, it can be concluded that there is a trend in the improvement of milk quality of cows supplemented with crude glycerin.

Key Words: glycerin, dairy cow, milk quality

W395 Effect of the germinated corn on feed intake, milk production, milk quality and blood metabolites of lactating cows. B. W. Kim*¹, J. W. Ju¹, J. K. Choi², and J. S. Shin¹, ¹Kangwon National University, Chuncheon, Kangwon-Do, South Korea, ²Dae Han Feed Company, Incheon, South Korea.

This study was conducted to evaluate the effect of germinated corn on the feed intake, milk production, milk quality and blood metabolites of lactating cows. Five lactating cows were randomly assigned to 3 replicates of 3 treatments to determine the effects of feeding 0 (control), 10 (T1), 20% (T2) of the germinated corn in partial replacement of alfalfa hay and commercial concentrate in the diet. The trial lasted for 3 months. The feed intake was not significantly affected. However, the lactating cows fed on the germinated corn consumed more feed: 21.5kg in T1 and 21.7kg in T2 than those in the control (20.9 kg). The T1 and T2 resulted in a 5.8 and 11.1% increase in milk production, respectively, compared to the control ($P < 0.05$). The feed efficiency improvements were observed in treatments with germinated corn by 3.0 and 7.4% in T1 and T2, respectively. No significant difference was found in milk fat and lactose contents, but milk protein and solid-not-fat contents were higher in T1 and T2. The somatic cell counts were significantly lower for the cows fed on the germinated corn (78.67×10^3 /mL in T1 and 79.68×10^3 /mL) than those fed the control diet (158.33×10^3 /mL). Thus, these findings indicate that germinated corn can be useful as feed supplementation for increasing milk production and milk quality of lactating cows.

Key Words: germinated corn, feed intake, lactating cows

W396 Influence of hypocalcemia on plasma biochemical parameters, lipid mobilization, and liver lipid infiltration in cows. W. G. Chamberlin*, J. R. Middleton, J. N. Spain, G. C. Johnson, and M. R. Ellersieck, University of Missouri, Columbia.

This study was conducted to evaluate the effects of calcium status at calving on plasma metabolites and liver lipid infiltration in Holsteins. One hundred multiparous Holsteins were assigned to one of two groups 1) hypocalcemic (n=51; ionized calcium [iCa] <1.0 mmol/L) or 2) normocalcemic (n=49; iCa >1.0 mmol/L) based on whole blood iCa concentrations at calving. Cows were blocked by parity and calving date (3.5 for hypocalcemic, 2.8 for normocalcemic). Blood samples were collected to measure iCa, NEFA, and serum chemistry profiles at -14d, calving, 3d, 7d, 14d, 21d, and 35d. Liver biopsies were collected from 22 cows (8 hypocalcemic and 14 normocalcemic) on the day of calving, and 7 and 35 days postpartum for analysis of lipid infiltration in the hepatocytes. Data are reported as LSMeans \pm SE. On day 0, [iCa] differed with hypocalcemic cows having lower whole blood [iCa] (0.88 ± 0.01 mmol/L) versus normocalcemic cows (1.08 ± 0.01 mmol/L; $P < 0.0001$). Hypocalcemic cows also had lower mean total plasma calcium concentrations on day 0 than normocalcemic cows (7.03 ± 0.08 mg/dl vs. 8.20 ± 0.08 mg/dL; $P < 0.0001$). Hypocalcemic cows had lower plasma phosphorus levels on days 0 (3.96 ± 0.16 mg/dL), 7 (5.33 ± 0.17 mg/dL), 14 (5.10 ± 0.18 mg/dL), and 21 (5.75 ± 0.18 mg/dL) versus normocalcemic cows on days 0 (4.7 ± 0.17 mg/dL; $P = 0.002$), 7 (5.81 ± 0.17 mg/dL; $P = 0.05$), 14 (5.67 ± 0.18 mg/dL; $P = 0.03$), and 21 (6.28 ± 0.18 mg/dL; $P = 0.04$). Hypocalcemic cows had significantly higher mean NEFA concentrations on days 0 (1034.4 ± 61.04 uEq/L) and 21 (613.42 ± 61.42 uEq/L) versus normocalcemic cows on days 0 (823.17 ± 62.65 uEq/L; $P = 0.01$) and 21 (444.67 ± 63.48 uEq/L; $P = 0.02$). Hypocalcemic cows also had more lipid in the hepatocytes on day 35 ($17.33 \pm 3.36\%$) than normocalcemic cows ($6.98 \pm 2.6\%$; $P = 0.02$). No differences were detected between groups for total or direct bilirubin concentration, gamma glutamyl transferase or aspartate aminotransferase activity ($P > 0.05$). These data provide evidence of an association between calcium status at calving, fat mobilization, and liver lipid infiltration.

Key Words: transition, hypocalcemia, liver

W397 Effects of a low energy diet prepartum on subclinical ketosis in dairy cows. L. A. Vickers^{*1}, D. M. Weary¹, D. M. Veira², and M. A. G. von Keyserlingk¹, ¹*Animal Welfare Program, University of British Columbia, Vancouver, British Columbia, Canada,* ²*Agriculture and Agri-Food Canada, Agassiz, British Columbia, Canada.*

Despite decades of research the dairy industry remains challenged with high rates of disease after calving, often attributed to prolonged periods of negative energy balance (NEB). In an effort to reduce NEB it is common practice to provide an energy dense diet 3 wks before calving, but this may lead to over consumption of energy and actually increase the risk of metabolic disease post-partum. The aim of this trial was to compare the metabolic status of transition cows on a traditional pre-calving diet ($NE_L=1.45$ Mcal/kg) versus a low energy, high forage diet ($NE_L=1.34$ Mcal/kg). Cows were randomly assigned to either the control diet (cows were switched to the close up ration 3 wks prepartum) or the treatment diet (cows remained on the low energy diet until parturition). After parturition, all cows were fed a common lactation diet ($NE_L=1.65$ Mcal/kg). Treatment groups were balanced for parity, previous 305-day milk production and body condition score. DMI was measured daily from 3 wks before to 2 wks after calving for 78 multiparous Holstein cows. Blood BHBA was measured daily for 10 d after calving. The MIXED procedure in SAS was used to test the fixed effect of treatment on BHBA for each day postpartum, and on DMI in the prepartum and the postpartum period. Cows on the low energy diet prepartum had lower BHBA levels than did control cows (0.48 ± 0.03 vs. 0.65 ± 0.03 mmol/L; $P < 0.0001$). Using a threshold of $1.0 \leq BHBA \leq 1.4$ mmol/L, fewer cows on the low energy diet prepartum were diagnosed as having subclinical ketosis compared to cows on the control diet (4.8% vs. 20.6%; $\chi^2=7.17$, $P=0.007$). Cows on the low energy diet had lower DMI compared to the cows on the close up diet (13.57 ± 0.09 kg/d vs. 16.45 ± 0.12 kg/d; $P < 0.05$) and consumed slightly less DM in the first 2 wks postpartum (18.64 ± 0.41 vs. 17.65 ± 0.40 kg/d; $P < 0.05$). Feeding a low energy diet before calving can reduce the risk of subclinical ketosis.

Key Words: transition diets, intake, subclinical ketosis

W398 Impacts of maternal selenium supply and nutritional plane on offspring intestinal vascularity. R. D. Yunusova^{*}, A. M. Meyer, T. L. Neville, K. A. Vonnahme, C. J. Hammer, J. J. Reed, D. A. Redmer, L. P. Reynolds, and J. S. Caton, *Center for Nutrition and Pregnancy, Department of Animal Sciences, North Dakota State University, Fargo.*

Objectives were to investigate the effects of maternal nutritional plane and Se supply during gestation on offspring intestinal vascularity. Rambouillet ewe lambs ($n=82$ in Exp. 1, $n=84$ in Exp. 2; approximately 240 d of age; 52 kg BW at breeding) were allocated to a 2×3 factorial. Treatments included dietary Se (adequate Se [ASe, 9.5 (Exp.1) or 11.5 (Exp. 2) $\mu\text{g}/\text{kg}$ BW] or high Se [HSe, 81.8 (Exp. 1) or 77.0 (Exp. 2) $\mu\text{g}/\text{kg}$ BW]) initiated at breeding and nutritional plane (60% [RES], 100% [CON], and 140% [HIGH] of requirements) initiated at d 50 (Exp. 1) or d 40 (Exp. 2) of gestation. Ewes were fed pelleted diets and housed individually indoors. At parturition, lambs were immediately removed and fed artificial colostrum for the first 20 h followed by ad libitum milk replacer. At 180 ± 2 d (Exp. 1) and 20 d (Exp. 2) of age lambs were euthanized and tissues were harvested. Collected jejunal tissues were perfusion fixed with Carnoy's solution, paraffin embedded, and vascular structures were visualized microscopically. Data were analyzed for effects of Se supply, nutritional plane, and their interaction. In Exp. 1, capillary area density (% tissue) was greater ($P=0.08$) in 180-d old offspring from ewes fed HSe compared with ASe (15.3 vs. $13.8 \pm 0.6\%$,

respectively). In addition, area per capillary (μm^2) was greater ($P \leq 0.09$) in CON compared with RES. In Exp. 2, capillary surface density ($\mu\text{m}/\mu\text{m}^2$) was greater ($P \leq 0.05$) in 20-d old offspring from ewes fed CON than RES. Maternal nutritional plane tended ($P \leq 0.11$) to alter total small intestinal vascularity (mL), with lambs from CON being greater than RES. Area per capillary was affected by the interaction of Se \times nutritional plane ($P=0.09$). In offspring from ewes fed ASe, RES had greater area per capillary than CON and HIGH, whereas area per capillary was not affected by nutritional plane in HSe offspring. In conclusion, maternal Se supply and nutritional plane during gestation resulted in measurable changes in offspring intestinal vascularity at both 20 and 180 d of age. Additional work is needed to determine impacts on intestinal function and nutrient uptake.

Key Words: intestine, maternal nutrition, selenium

W399 Performance of high-yielding dairy cows supplemented with fat or concentrate under hot and humid climates. U. Moallem^{*1}, G. Altmark², H. Lehrer¹, and A. Arieli², ¹*Agriculture Research Organization, Bet Dagan, Israel,* ²*Faculty of Agriculture, Hebrew University, Rehovot, Israel.*

Multiparous Israeli-Holstein mid-lactation cows were used to examine the effects of energy source under hot and humid conditions on performance, metabolic heat production (MHP) and efficiency. Cows ($n=42$) were individually fed and assigned into 3 groups: 1) control - were fed a lactating-cow ration (1.75 Mcal NEL/kg DM); 2) HG - supplemented with 0.825 kg/d per cow of ground corn grain (2.7% of diet); 3) HF - supplemented with 0.300 kg/d per cow of calcium salts of fatty acids (1.5% of diet). Indirect MHP was calculated as: metabolizable energy intake - (energy output in milk + energy retention in body-mass + energy for maintenance). Data were analyzed as repeated measurements using the PROC MIXED procedure of SAS. Mean daily maximum ambient temperature, relative humidity and temperature-humidity index (THI) were 31.5°C , 86.6% and 76.8, respectively. DMI was lower in HF and HG than in controls, and milk yields were higher in the control group than in HG. Milk-fat percentage was 0.38 units higher and fat yields were 11% greater in HF than in HG. Fat-corrected milk (FCM) yield was 5.5% higher in HF than in HG, but not than in control. Body weight gain (kg/d) of the HG cows tended to be higher than that of the others. Efficiency of conversion of DM or energy intake to milk and FCM was higher in HF than in other groups; however, when taking the energy retention in body-mass into account, no difference in energy utilization between HF and HG were observed. Indirect MHP was similar in HG and HF cows, and lower than in controls. HF cows channeled more metabolizable energy for milk production (43.1, 40.5 and 41.6% for HF, HG and control groups, respectively). In contrast, HG cows directed more energy for body-mass retention (1.89, 0.53, and 0.99% for HG, HF and control, respectively). In conclusion, increasing the energy density in diets of heat-stressed mid-lactation cows over 1.75 Mcal/kg DM was not effective in enhancing production; however, HF increased the efficiency for milk production. Moreover, HF cows prioritized milk-fat production, whereas HG cows channeled more energy for body-mass retention.

Key Words: heat stress, fat supplementation, energy partitioning

W400 Concentrations of plasma metabolites and hormones in periparturient Holstein cows fed two sources of fat. C. Caldari-Torres², E. D'Agosto¹, M. C. Perdomo¹, C. R. Staples¹, and L. Badinga^{*1}, ¹*University of Florida, Gainesville,* ²*Virginia Tech, Blacksburg.*

This study examined the effect of feeding diets enriched in saturated fatty acids (SFA; RBF Cargill, 91% saturated fat, 1.5% of DM) or linoleic acid (LA, Prequel 21, Virtus Nutrition, 63% n-6 FA, 1.8% of DM) to transition Holstein cows (n = 18) on plasma metabolites and hormones related to energy metabolism. Dietary treatments were initiated at approximately 28 d prior to calculated calving date and continued through 49 d postpartum. Blood samples were collected weekly beginning 1 wk before estimated calving date through 7 wk postpartum. Plasma NEFA concentration increased ($P < 0.01$) between wk 1 before ($231 \pm 88 \mu\text{eq/L}$) and wk 1 after parturition ($829 \pm 80 \mu\text{eq/L}$) and returned to pre-calving concentrations by wk 7 postpartum ($404 \pm 80 \mu\text{eq/L}$). Blood NEFA concentrations in cows consuming the LA-enriched diet tended to be lower ($P = 0.06$) than those receiving the SFA-supplemented diet at wk 3 and 4 postpartum. Blood glucose concentrations were consistently greater ($P < 0.01$) across wk in cows fed the LA-enriched diet compared to those consuming the SFA-supplemented diet. Concentrations of plasma insulin were only numerically greater for cows fed additional LA (0.73 vs. 0.67 ng/mL). Mean peripheral concentration of IGF-I decreased ($P < 0.01$) from $130.8 \pm 14.7 \text{ ng/mL}$ at 1 wk before calving to $60.9 \pm 13.4 \text{ ng/mL}$ at 2 wk after calving, and then increased to $119.8 \pm 13.4 \text{ ng/mL}$ by wk 7 postpartum. Pre- and postpartum plasma IGF-I concentrations were greater ($P < 0.01$) in Holstein cows fed the LA-enriched diet than those consuming the isocaloric control diet supplemented with SFA. Plasma IGF-I concentration at wk 7 postpartum was positively correlated ($r = 0.58$, $P < 0.01$) with conception rate to first insemination. Results indicate that peripartum supplementation of LA may improve the metabolic status and increase the risk of pregnancy of early postpartum dairy cows.

Key Words: fat, hormone, cattle

W401 Weaning dairy cows to a new diet: The effectiveness of a gradual dry-off procedure. K. L. Proudfoot*, D. M. Weary, and M. A. G. von Keyserlingk, *University of British Columbia, Vancouver, British Columbia, Canada.*

Gradual dietary transitions for animals are typically favored over abrupt switches. However, a common method to end the lactation of a dairy cow (i.e. dry-off) is to abruptly switch cows from a high to low energy diet. Gradual weaning at dry-off may be beneficial, but no work has assessed if it is equally effective at reducing milk output. Here we assessed the effect of a gradual versus abrupt switch from a lactating cow diet (60:40 forage:concentrate ratio) to grass hay on dry matter intake (DMI) and milk yield. Four pens of 6 cows were followed for 14d. Cows were paired, with one cow from each of 2 treatments based on parity and previous milk yield. During the first 2d (baseline) both treatments were fed the same lactation diet of 60% forage. Cows on the gradual treatment were switched to a diet 10% higher in forage every 2d until d9; cows on the abrupt treatment were switched directly to 100% forage on d9. Each cow had access to one feed bin that recorded DMI. Data were summarized into 5 periods: Four 2-d periods before treatments were switched to 100% forage and one 4-d period following the switch (d10 to 14). Differences between treatments were tested using Proc Mixed in SAS with the feed bin was the experimental unit and period as a repeated measure. The model included pair, pen, period, treatment and period \times treatment interaction. No baseline differences were detected between cows on the gradual and abrupt treatment for milk yield (15.5 ± 1.2 vs. $14.8 \pm 1.2 \text{ kg/d}$, $P = 0.74$) or DMI (18.0 ± 0.5 vs. $17.7 \pm 0.5 \text{ kg/d}$, $P = 0.67$). The gradual increase in % forage resulted in treatment \times period interactions for both milk yield ($P < 0.01$) and DMI ($P < 0.01$); as % forage in the diet increased cows on the gradual treatment produced less milk and had lower DMI than did the cows

on the abrupt treatment. After both groups were switched to the 100% forage diet no differences were detected between cows on the gradual and abrupt treatment for milk yield (9.3 ± 0.9 vs. $7.5 \pm 0.9 \text{ kg/d}$, $P = 0.17$) or DMI (10.4 ± 0.4 vs. $10.2 \pm 0.4 \text{ kg/d}$, $P = 0.64$). These results indicate that a gradual dietary transition at dry-off is as effective at reducing DMI and milk yield as an abrupt switch in diet.

Key Words: dry-off, weaning

W402 Effects of feeding different levels of guar meal on performance of Holstein dairy cows. A. Vatandoust¹, A. A. Naserian^{*2}, F. Boldaj¹, and S. Zerhdaran¹, ¹*University of Gorgan, Gorgan, Iran,* ²*University of Mashhad, Mashhad, Iran.*

Eight multiparous (n = 2) early lactating Holstein cows were used in a 4 \times 4 Latin square design to determine effects of different levels of guar meal on the performance of dairy cows. Treatments were including 4 levels of guar meal: T1) 0, T2) 4, T3) 8, T4) 12% of DM that substitute to soybean meal. Treatments effect on DMI (kg/d) were not significant ($P > 0.05$). Milk yield were increased for cows fed T2 compared with other treatments (43.392, 46.480, 44.100 and 43.080, respectively) ($P < 0.05$). Milk fat (%) was increased for T2 compared with T3 and T4 ($P < 0.05$), but had no difference between T1 and T2 ($P > 0.05$). Milk protein was not influenced by treatments ($P > 0.05$). Treatments effect on pH were significant ($P < 0.05$), cows fed T2 had lower pH than control (6.58 vs. 6.36). It was concluded that substitution 4% of soybean meal with guar meal had the best effect on performance.

Table 1. Effects of different levels of guar meal on DMI, rumen pH, milk yield and composition

| | T1 | T2 | T3 | T4 | SE | P-value |
|-------------------|---------|---------|---------|---------|-------|---------|
| DMI (kg/d) | 26.805 | 26.975 | 26.717 | 26.968 | 0.445 | >0.05 |
| Milk yield (kg/d) | 43.392b | 46.480a | 44.100b | 43.080b | 0.806 | <0.05 |
| Milk Fat (%) | 3.717ab | 4.101a | 3.380b | 3.424b | 0.162 | <0.05 |
| Milk protein (%) | 2.803 | 2.592 | 2.688 | 2.715 | 0.110 | >0.05 |
| rumen pH | 6.588a | 6.367b | 6.381ab | 6.406ab | 0.070 | <0.05 |

T1, T2, T3 and T4= levels of guar meal (0, 4, 8 and 12% of DM respectively). SE= standard error of means.

Key Words: guar meal, lactating Holstein cow, soybean meal

W403 Feed sorting and feeding behavior of transition dairy cows fed glycerol as a replacement for corn. E. R. Carvalho*, N. S. Schmelz, H. White, and S. S. Donkin, *Purdue University, West Lafayette, IN.*

Feed sorting is a natural behavior of dairy cows that can result in inconsistencies in nutritive value of a TMR. The objective of this work was to study the effects of glycerol on the feed sorting and feeding behavior of transition dairy cows. Twenty-six multiparous Holstein cows were paired by expected calving date and fed diets containing either high moisture corn or glycerol from -28 through +56 days relative to calving (DRTC). Glycerol was included at 11.5 and 10.8% of the ration DM for the pre- and post-partum diets, respectively. Cow activity was continuously videotaped for 24 h on -17, -10, +8, +15 and +50 DRTC. Feeding behavior was evaluated for 1 h intervals at 0, 1, 5.5, and 11 h relative to feed delivery and feed sorting was determined during the next 24-h period by measuring the particle size distribution of feed consumed at 4, 8, 12 and 24 h post feeding. The TMR at feeding and

at each time post feeding was size separated across 18, 9, and 1.18 mm screens and a bottom pan to yield long, medium, short, and fine particles, respectively. Adding glycerol to the prepartum diet increased ($P \leq 0.05$) the DM% retained as long particles and reduced ($P \leq 0.05$) short and fine particles but did not change the medium particles ($P \geq 0.05$). Feed intake did not differ ($P \geq 0.05$) between diets and was 14.7 ± 0.4 and 20.2 ± 0.5 kg/d for the pre- and post-partum intervals, respectively. Glycerol increased ($P \leq 0.05$) the preference for long particles during the prepartum period (17.8 vs. 9.2%, glycerol vs. control) and increased ($P \leq 0.05$) sorting against short (37.3 vs. 42%, glycerol vs. control) and fine particles (13.6 vs. 17.9%, glycerol vs. control). There was no effect of glycerol on preference for medium particles ($P \geq 0.05$). There was no effect ($P \geq 0.05$) of diet on feed sorting after parturition as well as on feeding behavior during the whole study. The data indicate that although glycerol in transition diets has no effect on overall DMI, there is increased preference for long particles that occurs during the prepartum interval.

Key Words: glycerol, sorting, transition cows

W404 Impact of climate on chemical composition and in vitro organic matter digestibility of semi-arid barley grain varieties determined by gas production technique. E. Abdi Ghezalje^{1,2}, M. Danesh Mesgaran^{*1}, H. Nasiri Moghaddam¹, H. Fazeli³, and A. R. Vakili¹, ¹Ferdowsi University of Mashhad, Iran, ²East Azarbaijan Research Center for Agriculture and Natural Resources, Tabriz, Iran, ³Animal Science Research Institute, Karaj, Iran.

The objective of this study was to investigate the effect of three semi-arid climates (cold, moderate and warm with the annual temperature range of -20 to 22 , -2 to 24 , and 2 to 35°C respectively) on crude protein (CP), starch (ST), soluble sugar (SC), bulk density, acid detergent fiber (ADF) and organic matter digestibility (OMD) of sixteen barley grain varieties obtained in year 2008 (10 samples per each variety). Samples were ground (1 mm) and the chemical compositions were determined as proposed by standard methods. Three ruminally fistulated sheep (49.5 ± 2.5 kg) were used as rumen liquor donor for gas production technique. The animals were fed 0.8 kg DM alfalfa hay and 0.5 kg DM concentrate (165 g CP/kg of DM). Rumen fluid was collected before the morning feeding and strained through 4 layers of cheesecloth into a CO_2 -filled flask. In vitro incubation of the samples was done using a manual pressure transducer technique. Approximately 200 mg of each sample was weighed into 120 ml serum bottles ($n=4$). The bottles were pre-warmed at 39°C before the injection of 30 ml rumen fluid-buffer mixture into each bottle followed by incubation in a water bath at 39°C . Gas produced were recorded at 72 h after the incubation. These data were used to estimate the organic matter digestibility of the samples. Starch content of cold region varieties was significantly ($P < 0.05$) higher (65.65%) than those of warm region (55.29). The samples obtained from the warm climate had the highest amount of crude protein (11.68%), while it was the lowest (10.57%) in the cold region samples. Soluble sugar contents of moderate climate varieties was more than the cold and warm climate samples and the differences were significant ($P < 0.001$). Varieties of the cold and warm climates had the highest (80.03%) and the lowest (78.03%) organic matter digestibility ($P < 0.05$), respectively.

Key Words: barley grain, climate, digestibility

W405 Effect of flax oil and flax hulls on mRNA abundance of antioxidant enzymes and lipogenic-related genes in the mammary gland of dairy cows. M. F. Palin^{*}, H. V. Petit, D. Beaudry, C. Côrtes, N. Gagnon, P. Lacasse, and C. Benchaar, *Dairy and Swine Research and*

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Flax oil is a good source of n-3 fatty acids and flax hulls are rich in plant lignans which are strong antioxidants. Flax lignans induce the expression of peroxisome proliferator-activated receptor gamma (PPARG) in 3T3-L1 adipocytes and feeding rats with flax seed upregulates hepatic expression of antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPX). In this study, we determined the effect of dietary flax oil and/or flax hulls on mRNA levels of antioxidant enzymes (CAT, GPX1, GPX3, SOD1, SOD2 and SOD3) and lipogenic-related genes (acetyl-Coenzyme A carboxylase alpha (ACACA), fatty acid synthase (FASN), lipoprotein lipase (LPL), PPARG1, PPARG2, stearoyl-CoA desaturase (SCD) and sterol regulatory element binding transcription factor 1 (SREBP1c)) in the mammary gland of dairy cows. Eight Holstein cows were assigned to 4 dietary treatments in a double 4×4 Latin square design (21-d periods). Treatments were a control diet without flax products (CO), CO with 500 g/d flax oil infused in the abomasum (CO500), CO with 10% flax hulls in the DM (HU) and HU with 500 g/d flax oil infused in the abomasum (HU500). Biopsies of the mammary gland were taken on d 21 of each period. Relative quantitation of gene expression was performed using real-time PCR analyses and the comparative CT method. Addition of flax hulls increased mRNA abundance of ACACA, FASN, LPL, PPARG1, SCD and SREBP1c ($P < 0.05$) genes in the mammary gland and flax oil reduced mRNA abundance of the same genes ($P < 0.05$). The mRNA level of CAT, GPX1, GPX3, SOD1 and SOD3 decreased ($P < 0.05$) with flax oil addition. Flax hulls reduced ($P < 0.05$) mRNA abundance of GPX3, SOD2 and SOD3 genes. In conclusion, flax oil and flax hulls can modulate the expression of genes in the mammary gland of cows. However, contrasting effects were observed with flax oil reducing, while flax hulls increasing mRNA abundance of lipogenic-related genes

Key Words: flaxseed, gene expression, dairy cows

W406 An effective method for total RNA isolation from ruminal contents. P. Wang^{*1,2}, M. Qi², L. B. Selinger¹, T. A. McAllister², and R. J. Forster², ¹University of Lethbridge, Lethbridge, AB, Canada, ²Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB, Canada.

Gene expression analyses including RT-PCR, microarrays and meta-transcriptomics are techniques that could significantly expand our understanding of the rumen microbial ecosystem. The ability to isolate and stabilize representative RNA samples is critical to obtaining reliable results in all of these procedures. In this study, we established an improved RNA isolation method for extracting high quality total RNA from both liquid and solid phases of ruminal contents. This method is based on liquid nitrogen-mortar disruption and acid guanidinium-phenol-chloroform extraction combined with column purification. Yield of total RNA using this procedure was as high as 150 μg per gram of ruminal content. The typical large subunit/small subunit (LS/SS) rRNA ratio ranged from 1.8 to 2.0 with an RNA integrity number (Agilent) greater than 8.5. The rRNA profile associated with solid ruminal contents was more complex than that associated with the fluid, exhibiting broader rRNA peaks with discrete shoulders. This result is consistent with the isolation of both prokaryotic and eukaryotic rRNA from the particle-associated microbial consortia. The addition of RNAprotect reagent (Qiagen) to the samples resulted in partially degraded RNA, with LS/SS rRNA ratio lower than 1.0, and noticeable smearing of the RNA bands upon electrophoresis. We therefore recommend that this reagent not be used for the isolation of RNA from rumen samples. The integrity of total RNA isolated by our optimized procedure was tested by

reverse transcription PCR. We detected three *Fibrobacter succinogenes* S85 glycoside hydrolase transcripts: (*celF*, *cel3* and *xynD*) from RNA isolated from the solid phase of ruminal contents. Our research team is currently applying this new technique to obtain high quality ruminal RNA to characterize the rumen microbiome on a metatranscriptomics level, using next generation sequencing.

Key Words: total RNA, rumen, RNA quality

W407 Supplementation of embryo recipients heifers with rumen bypass fat. H. O. Patino*, J. C. C. Angel, M. M. H. Ramirez, R. M. Gregory, and D. d. Ré, *Universidade Federal de Rio Grande do Sul, Porto Alegre, RS, Brazil.*

Forty-four Angus × Hereford embryo recipients heifers (385 kg average body weight) were used in a completely randomized design to evaluate the effect of bypass fat supplementation on performance and plasma parameters. Embryo recipient heifers were kept in the same paddock of improved native pasture and individually feeding daily with isocaloric energy supplements. The treatments were: functional supplement, with inclusion of 150g of calcium soaps of fatty acids (CSFA)(Megalac-E); energy supplement, without inclusion of calcium soaps and without supplementation. Heifers estrus synchronization was performed using two PGF2 α doses with an interval of 11 days. Seven days after estrus detection embryo transfer was performed. Blood samples were collected on the embryo transfer day and pregnancy confirmation day as well. The supplement type offered did not affect pregnant rate (34%) and plasma insulin concentration (14.1 μ IU/mL; $P > 0.05$). Between the date of embryo transfer and the date of pregnancy confirmation heifers supplemented with CSFA had a 49% increase in ADG in relationship to heifers supplemented with energy supplement and without supplementation (0.90 vs. 0.64 vs. 0.57 kg/day; $P < 0.05$). On embryo transfer day and pregnancy confirmation day heifers supplemented with CSFA had a 17% and 33% increase in plasma cholesterol concentration in relationship to heifers supplemented with energy supplement and without supplementation (171 vs. 147 vs. 147 mg/dL; 198 vs. 154 vs. 143 mg/dL; $P < 0.05$). On embryo transfer day and pregnancy confirmation day heifers supplemented with CSFA had a 48% and 71% increase in plasma progesterone concentration in relationship to heifers supplemented with energy supplement and without supplementation (5.4 vs. 3.6 vs. 3.7 ng/dL; 7.3 vs. 5.8 vs. 4.3 ng/dL; $P < 0.05$). Daily weight gain, plasma cholesterol and progesterone concentration of embryo recipient heifers were increased by inclusion of calcium soaps of fatty acids into energy supplements.

Key Words: progesterone, cholesterol, pregnancy rate

W408 Effects of infusing different doses of free α -linolenic acid to the duodenum on the immune function of lactating dairy cows. P. Sun, J. Q. Wang*, G. Yang, and Khas-Erdene, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

The purpose of this study was to determine the effects of infused a high C18:3 free fatty acid mixture to duodenum on the immune function of dairy cows. A crossover design was adopted and four primiparous Chinese Holstein cows (BW = 476 \pm 6 kg, DIM = 100 \pm 2 d) fitted with duodenal cannulas were divided into two treatments, in which homogenized aqueous mixtures of α -linolenic acid (LNA; 82.4% cis-9, cis-12, cis-15 18:3; 14.7% cis-9, cis-12 18:2; 2.8% cis-9 18:1) or control containing only the emulsifying ingredients were used. The control infusate contained 15 g/d of xanthan gum, 5 g/d sodium alginate, and 25 g/d of Tween 80 in 10 liters of water. Each period lasted 5 wk, during

which two cows received 0, 100, 200, 300, and 400 g/d of LNA for 1 wk each, and the other two cows received only the carrier infusate. Blood was collected at the end day of each infusion amount and concentrations of serum IgA, IgG, IgM, prostaglandin E2 (PGE2) and Th1/Th2 cytokines were determined using bovine ELISA Kit. The results showed that increasing the supply of LNA to the small intestine increased serum IgG and Th1 cytokines including interferon- γ ($P < 0.05$), whereas the concentrations of PGE2 and Th2 cytokines, such as interleukin (IL)-4 decreased ($P < 0.05$) when infused no more than 300 g/d. However, the influence was affected by the higher dose of LNA at 400 g/d as the incidence of diarrhea occurred in some dairy cows. Throughout the whole experiment, no difference was observed in serum IgA and IgM. This study demonstrated that post-ruminal infusion of LNA affected the naïve T lymphocytes and modified the balance of Th1/Th2 type immune response, which suggest immunomodulatory properties of LNA.

Key Words: lactating dairy cow, α -linolenic acid, immune function

W409 Supplementation of methionine hydroxy analog, trace mineral chelates and dietary antioxidants in the diet of dairy cows for milk production, milk composition, and hoof status. G. Conti¹, G. Castillo*³, M. Gallardo², S. Toffano³, and M. Vazquez-Anon³, ¹*University of Veterinary Medicine - Universidad del Litoral, Santa Fe, Argentina*, ²*CICV National Institute for Agricultural and Livestock Technology (INTA), Buenos Aires, Argentina*, ³*Novus International, St. Louis, MO.*

In the Argentinean Central Dairy Region during Fall of 2009, 266 lactating dairy cows in a commercial herd were randomly assigned to a control or a treatment group. The treatment group consisted of a mixed supplementation of methionine hydroxy analog (12 g/head/day; MFP), mineral chelates (2 g/d of Mintrex-Zn (320 mg/d Zn), 2 g of Mintrex-Cu (300 mg/d of Cu), 2 g/d of Mintex- Mn (260 mg/d of Mn)) and dietary antioxidants (5 g/d/h Feedgard) in order to evaluate lactation performance and hoof health response. 266 primiparous and multiparous cows (132 \pm 90 DIM and 2.94 \pm 1.8 lactations) were on trial for a minimum of 90 and maximum of 180 d. Cows were fed twice a day after milking an isoenergetic (1.82 Mcal NEL) and isoproteic (17% CP) diet consisted of 30% corn silage, 30% alfalfa, 20% corn, and 20% soybean meal, and a mixture of vitamins and trace minerals. Minerals were formulated according to NRC 2001. The treatment cows produced 9% more milk (32.6 vs. 29.7 l/d $P < 0.05$), 4% FCM (30.5 vs. 27.8 kg/d; $P < 0.05$), milk fat (1.15 vs. 1.06 kg/d; $P < 0.05$) and protein yield (1.1 vs. 0.99 kg/d; $P < 0.05$) than control cows. There were no differences in milk composition or body condition between treatments. Treatment cows showed fewer hoof injuries ($P < 0.05$) due to lower incidence in heel (49%), white line (46%), and sole (59%) injuries and dermatitis (46%). The locomotion score showed fewer treatment cows with grades 2 to 4 (29.15% vs. 45.7% $P < 0.05$). From this study it can be concluded that the combination of methionine hydroxy analog, chelated trace minerals, and dietary antioxidant significantly improved milk yield and hoof health status

Key Words: methionine and mineral chelates, antioxidant, hoof health status

W410 Effects of *Bacillus subtilis* natto on the immune function of weaned calves. P. Sun, J. Q. Wang*, and H. T. Zhang, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

The effects of *Bacillus subtilis* natto on the immune function of weaned calves were investigated in this study. Twenty-four Holstein male calves

of 7 ± 1 d of age were randomly allotted to three treatments of eight calves. The calves were weaned when their starter intake reached 2% of their body weight. The *Bacillus subtilis* natto including Na type and N1 type was mixed with milk before weaning or mixed with the starter diets directly to the calves after weaning in the two experimental treatments and no *Bacillus subtilis* natto was fed to the control group. The experiment ended on the seventh week after weaning, when blood was collected and IgA, IgE, IgG, IgM and cytokine levels including interleukin (IL)-4, IL-10 and interferon- γ (IFN- γ) were determined in the serum of all the calves. Data were analyzed using the ANOVA procedure of SAS. No difference was observed in serum IgE concentration in the two *Bacillus subtilis* natto supplemented treatments (52.87 and 53.30 mg/L for Na and N1 group) compared to the control (56.37 mg/L). IgA and IgM in the serum of the calves were not different, whereas serum IgG was greater ($P < 0.05$) in the *Bacillus subtilis* natto supplemented calves than in the control calves. Furthermore, calves fed with Na type of *Bacillus subtilis* natto were found to secrete more IFN- γ ($P < 0.05$) but tended to produce less IL-4 ($P < 0.1$) in the serum than the control calves, although serum IL-10 was not affected. This study demonstrated that *Bacillus subtilis* natto did not stimulate IgE-mediated allergic reactions, but induced nonspecific immune responses associated with increased serum IgG and IFN- γ levels in the probiotic-fed calves, which suggests that the probiotic characteristics of *Bacillus subtilis* natto (especially for Na type) benefit the immune function.

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Key Words: *Bacillus subtilis* natto, immune function, calf

W411 Nutrient balances in California dairy farms. 1. Effects of salt content in drinking water and milk yield per cow on nutrient utilization efficiency. A. R. Castillo^{*1}, N. Silva del Rio², and N. St-Pierre³, ¹University of California Cooperative Extension, Merced, ²University of California Cooperative Extension, Tulare, ³The Ohio State University, Department of Animal Sciences, Columbus.

The aim of this survey was to study nutrient utilization efficiency and feed conversion in lactating cows on commercial farms. Forty dairies in Merced, California (mean 787 ± 592 lactating cows/farm) were selected to study the effect of total salt in drinking water (TS) and average milk yield (MY, as 3.5% fat-corrected milk yield/cow) in each dairy farm on TMR nutrient content, feed management, feed conversion ($FC = MY/DMI$) and nitrogen utilization efficiency ($NUE = N \text{ milk}/N \text{ intake}$). Data was analyzed as 2×2 factorial with high TS (HTS) and low TS (LTS), and high MY (HMY) and low MY (LMY) as the main factors. The four treatments were: HTS-HMY, HTS-LMY, LTS-HMY, and LTS-LMY. Levels of TS were, 809 and 307 mg/L for HTS and LTS, respectively. Levels of MY were 35.9 and 27.6 kg/cow per day per dairy farm for HMY and LMY, respectively. The mean TMR nutrient content were: ADF (23.6%), lignin (4.3%), nitrogen (2.8%), fat (4.5%), and ash (8.3%) and not affected by water TS or MY. Differences were observed with TMR NDF content (34% and 36%) and non-fiber carbohydrates (NFC, 36% and 33%) for HMY and LMY, but not affected by water TS. The TMR DCAD content was affected by water TS (HTS=23 and LTS=29 mEq/100 g DM). But, the other variables were different only for H and L milk yield, as follow: FC (HMY=1.5, LMY=1.25), ENU (HMY=0.26, LMY=0.22), cow number/dairy (HMY=1061, LMY=513), TMR/dairy for lactating cows (HMY=3.7, LMY=2.2).

Key Words: dairy farms, feed conversion, nitrogen utilization efficiency

W412 Evaluation of estimated diet energy intake and impact on energy use of the lactating dairy cow. K. J. Clark^{*1}, P. J. Kononoff¹, and L. O. Tedeschi², ¹University of Nebraska-Lincoln, Lincoln, ²Texas A&M University, College Station.

A meta-analytical procedure was used to evaluate the impact of observed intakes of diet net energy for lactation (NE_L) on use of energy by lactating dairy cows. Data from nine nutrition experiments, which included 29 dietary treatments and 778 observations collected at the University of Nebraska-Lincoln Dairy Research Unit, were used. All studies were cross-over designs in which cows were fed diets for either 21 or 28 d periods. Data were analyzed using SAS and a random coefficient model to account for the random effects of different experiments. For each experiment, TMR and fecal samples were collected, dried, ground, and analyzed for DM, CP, ash, NDF, NFC, ether extract (EE) and ADF. Diet concentration of total digestible nutrients (TDN) and NE_L were computed using NRC (2001) equations. Total NE_L use was estimated based on maintenance and lactation requirements plus energy needed to meet observed BW changes. Apparent digestibility of nutrients was estimated based on the concentration of indigestible ADF in the TMR and feces. Apparent digestibility (mean \pm SD) was 61.5 ± 8.3 , 64.0 ± 9.1 , 42.4 ± 13.6 , 88.5 ± 7.5 , and $82.6 \pm 10\%$ for DM, CP, NDF, NFC, and EE, respectively. Mean DMI and 3.5% FCM averaged 23.9 ± 4.7 and 35.4 ± 12.4 kg/d, respectively. The TDN and concentration of NE_L in each diet were estimated to be $65.9 \pm 17.4\%$ and 1.58 ± 0.55 Mcal/kg, respectively. Results suggested NE_L intake was a weak predictor of NE_L use ($R^2 = 0.01$). The resulting regression equation was $y = 32.0 + 0.12 x$; where $y = NE_L$ use (Mcal/d) and $x =$ measured NE_L intake (Mcal/d). Although also poor, DMI served as a better predictor of NE_L use ($R^2 = 0.16$). The resulting regression equation was $y = 12.9 + 0.98 x$; where $y = NE_L$ use (Mcal/d) and $x =$ measured DMI (kg/d). These results suggested the measured NE_L intake of the ration is not a good predictor of NE_L utilization in the animal.

Key Words: energy, lactation, digestibility

W413 Regulation of hepatic gluconeogenic enzymes by dietary glycerol in transition dairy cows. H. M. White^{*}, E. R. Carvalho, and S. S. Donkin, Purdue University, West Lafayette, IN.

Nutritional status is a known regulator of gluconeogenic gene expression. Glycerol can replace corn in diets fed to dairy cow and is linked to increased rumen propionate production. The effect of dietary glycerol on the regulation of gluconeogenic enzymes is unknown. The objective of this study was to examine the effect of glycerol on expression of pyruvate carboxylase (PC), cytosolic phosphoenolpyruvate carboxylase (PEPCK-C), mitochondrial phosphoenolpyruvate carboxylase (PEPCK-M), and glucose-6-phosphatase. Twenty-six multiparous Holstein cows were fed either a control diet or a diet where corn grain was replaced by glycerol from -28 through +56 days relative to calving (DRTC). Liver tissue was collected via percutaneous liver biopsy at -28, -14, +1, +14, +28, and +56 DRTC for RNA analysis. Expression of PC mRNA was increased ($P < 0.05$) by 6-fold at +1 and by 4-fold at +14 DRTC relative to precalving levels. Dietary glycerol did not alter ($P \geq 0.05$) expression of PC mRNA expression. Expression of PEPCK-C was increased ($P < 0.05$) by 2.5-fold at +14 and 3-fold at +28 DRTC compared to +1 DRTC. Overall, dietary glycerol increased ($P < 0.05$) PEPCK-C expression compared to cows fed control diets (2.94 vs. 1.61 ± 0.8 arbitrary units, main effect of glycerol vs. control, respectively). The ratio of PC to PEPCK-C was increased ($P < 0.05$) by 3-fold at +1 DRTC in all cows. There was no effect ($P \geq 0.05$) of diet or DRTC on PEPCK-M or glucose-6-phosphatase mRNA. There were no interactions of dietary treatment and DRTC for any transcript measured. Substituting

corn with glycerol increased the expression of PEPCK-C mRNA during transition to lactation and suggests that dietary energy source alters hepatic expression. The observed increase in PEPCK-C expression with glycerol feeding may indicate regulation of hepatic gene expression by changes in rumen propionate production.

Key Words: glycerol, gluconeogenesis, transition cow

W414 Effects of dietary betaine on milk yield and milk composition of mid-lactating dairy cows. S. E. Peterson^{*1}, J. K. Kinch¹, J. E. Williams¹, M. A. McGuire¹, M. Chahine², and P. Rezamand¹, ¹University of Idaho, Moscow, ²University of Idaho, Twin Falls.

Betaine, naturally found in plants and an oxidative product of choline, is converted to acetate in the rumen, and transferred to the mammary gland where it may be used for milk fat synthesis. The objective of this study was to determine the effect of supplemental dietary betaine on bovine milk yield and milk composition. Eighteen Holstein dairy cows (126 ± 5 DIM) were randomly assigned to a sequence of treatments in a 4x4 Latin square design with four treatments of betaine at 0, 25, 50, and 100 g/d, added to a standard lactation ration. Animals were fed individually using Calan gates, and feed intake and milk yield recorded daily. Each period lasted 16 d with milk sampled on the last day of each period. Milk composition was determined by a standard DHIA laboratory and milk fatty acids were determined by gas chromatography. Data were analyzed using the MIXED procedure in SAS and significance was determined at $P < 0.05$. Dry matter intake was altered (quadratic effect $P = 0.024$) by dietary betaine (18.8, 18.6, 18.4, 19.4 ± 0.98 kg/d for 0, 25, 50, and 100 g betaine/d, respectively). Further, milk yield was increased (quadratic effect $P < 0.001$) by supplemental betaine (22.6, 22.9, 22.4, 24.0 ± 0.89 kg/d for 0, 25, 50, and 100 g betaine /d, respectively). However, no significant effect of dietary betaine was detected on body weight or condition score ($P > 0.08$ for both). Percentages of milk fat, lactose, SNF, and SCC were not altered ($P > 0.29$ for all) whereas milk true protein content was decreased (quadratic effect $P = 0.025$) by betaine supplementation (3.35, 3.27, 3.27, and $3.28 \pm 0.07\%$ for 0, 25, 50, and 100 g betaine/d, respectively). Daily yields of milk protein, fat, or lactose did not differ with betaine supplementation ($P > 0.13$ for all). Further, no significant effect of dietary betaine was detected on milk fatty acid composition. Overall, inclusion of dietary betaine at 100 g/d increased dry matter intake and milk yield but decreased milk protein percent (at all levels of inclusion), whereas milk fatty acid profile remained unaltered. Further studies are needed to determine the optimum rate of supplemental betaine for dairy cows.

Key Words: betaine, milk yield, milk composition

W415 The effect of forage level and lipid supplement on selected strains of rumen bacteria in continuous culture fermenters. P. Gudla^{*1}, A. Ishlak¹, A. A. AbuGhazaleh¹, D. Hastings¹, K. Jones¹, E. Gastal¹, J. Trushenski¹, and S. Ibrahim², ¹Southern Illinois University, Carbondale, ²North Carolina A&T University, Greensboro.

Previous studies have shown that trans fatty acids production in the rumen are influenced by lipid supplements and forage levels. The objective of this study was to evaluate the effects of forage level and lipid supplement on selected strains of rumen bacteria believed to be involved in biohydrogenation. A single-flow continuous culture system consisting of four fermenters was used in a 4×4 Latin square design with a factorial arrangement of treatments, with four 10 d consecutive periods. Treatment diets were: 1) high forage diet (70:30 forage to concentrate; HF), 2) high forage plus lipid supplement (HFL), 3) low forage diet (30:70 forage to concentrate; LF), and 4) low forage plus

lipid supplement (LFL). The lipid supplement was a blend of fish oil and soybean oil added at 1 and 2 g/100g DM, respectively. The forage source was alfalfa pellets. During 10-d incubations, fermenters were fed treatment diets three times daily (45g/d, divided equally between three feedings) as TMR diet. Samples collected at 3 h post morning feeding on d 10 were used for quantitative PCR analysis. Data were analyzed with the PROC MIXED procedure of SAS. The DNA concentrations of *Anaerovibrio lipolytica* and *Butyrivibrio fibrisolvens* vaccenic acid subgroup (Butyrivibrio VA) were affected ($P < 0.05$) by forage level but not lipid supplement. The DNA concentrations of *Anaerovibrio lipolytica* (1.668, 2.597, 0.045 and 0.093 pg/40 ng of total DNA for treatments 1 to 4, respectively) and Butyrivibrio VA (0.324, 0.296, 0.011 and 0.014 pg/10 ng of total DNA) were significantly lower with the low forage diets. The DNA concentrations of *Butyrivibrio fibrisolvens* stearic acid producer subgroup (Butyrivibrio SA) were not affected ($P > 0.05$) by forage level or lipid supplement (149.4, 136.3, 123.2 and 158.3 pg/10 ng of total DNA). In conclusion, lipid supplement had no effects on the tested rumen bacteria and forage level affected both Butyrivibrio VA and *Anaerovibrio lipolytica*.

Key Words: forage level, lipid supplement, bacteria

W416 Changes in the parameter estimates for the linear relationships of milk and milk component yields with dry matter intake of dairy cows during the last decade. J. S. Lee^{*1}, S. Y. Lee^{1,2}, K. S. Ki³, H. S. Kim³, and S. Seo¹, ¹Department of Animal Biosystem Sciences, Chungnam National University, Daejeon, South Korea, ²Institute of Agricultural Science, Chungnam National University, Daejeon, South Korea, ³Dairy Science Division, National Institute of Animal Science, RDA, Cheonan, South Korea.

The parameter estimates from a meta-analysis is heavily dependent on the database used. Due to genetic improvement and changes in management of dairy cows, the parameter estimates of variables may vary with different time frames. The objective of this study is thus to compare the parameter estimates for linear relationships of milk and milk component yields with DMI obtained using data from two different time frames. For the parameter estimates of dairy cows before the year of 2000, previous published equations by others were used. For the data after the year 2007, we developed a database containing experimental observations for DMI and milk yield of dairy cows from the research articles published in the *Journal of Dairy Science (JDS)* from Dec. 2007 until Feb. 2010 (volumes 90 through 93). The database is composed of a total of 427 treatment means from 114 studies. The mean (\pm SD) DMI, BW, milk yield, milk fat yield (MFY), and milk protein yield (MPY) were 22.36 (± 3.54), 637.76 (± 52.49), 34.51 (± 6.88), 1.22 (± 0.26) and 1.07 (± 0.21) kg, respectively. Using a simple linear regression, $MY = 5.875 (\pm 1.601) + 1.281 (\pm 0.071) DMI$ ($R^2 = 0.436$) was obtained. Compared to a previous published equation based on the data published in *JDS* (from volumes 1 through 82), no significant difference was observed for the slope (1.281 vs. 1.378), but the intercept was significantly different (5.875 vs. -1.022; $P < 0.05$). Linear relationships of milk and milk component yields with DMI were also estimated using a random coefficient model with study as a random effect: $MY = 12.678 (\pm 2.382) + 0.998 (\pm 0.106) DMI$, $MFY = 0.348 (\pm 0.112) + 0.039 (\pm 0.005) DMI$, and $MPY = 0.387 (\pm 0.084) + 0.031 (\pm 0.004) DMI$. Compared to the previous parameter estimates using a similar approach with data published in *JDS* (volumes 73 through 83), no significant differences in the estimates of slope and intercept were observed. The results from this study suggest that average milk yield from dairy cows has been significantly increased during the last decade even though response of milk production to an increase in DMI has not been improved.

Key Words: milk yield, dry matter intake, dairy cows

W417 Effects of chemical treatment of whole barley grain with sodium hydroxide on nutrient intake and digestibility in midlactation of Holstein dairy cows. M. Khorashadizadeh*, A. A. Naserian, and R. Valizadeh, *Ferdowsi University of Mashhad, Excellence Center for Animal Science, Faculty of Agriculture, Mashhad, Khorasan Razavi, Iran.*

Nine multiparous midlactation Holstein cows (131.44±9.32 DIM, 30.2±5.14 kg daily milk yield) were fed a total mixed ration supplemented with ground barley grain (control), or whole barley grain treated with sodium hydroxide (10%) and dried in different periods including: dried immediately (0h) or after 48h storage in plastic bags (48h). Sodium hydroxide was used at the level of 3.5% (DM). Each period lasted 3 week; experimental analyses were restricted to the last week of each period. Diets were formulated according to NRC 2001. Cows were housed in tie stalls and fed the TMR two times a day to allow 5 to 10% orts (as-fed basis), and dry matter intake (DMI) was recorded at the last week of each period. Data were analyzed as a 3 × 3 Latin square using the GLM procedure of SAS (2001). The model included effects of diet, period and cow. Least squares means are reported throughout and significance was declared at $P < 0.05$. Diets had no effects on DMI (21.49, 22.35 and 20.19 ± 0.67 kg/d for control, 0h and 48h respectively), CP intake (3.4, 3.55 and 3.41±0.16 kg/d for control, 0h and 48h respectively), NDF intake (7.69, 8.25 and 7.32 kg/d for control, 0h and 48h respectively) but OM intake (20.52, 19.78 and 18.45 ±0.56 kg/d for control, 0h and 48h respectively) and ADF intake (5.24, 5.65 and 4.63 kg/d for control, 0h and 48h respectively) decreased in 48h diet. The digestibility of DM (67.66, 69.22 and 67.77±1.7% for control, 0h and 48h respectively), OM (68.66, 70.22 and 69.22±1.6% for control, 0h and 48h respectively), NDF (59.44, 60.66 and 58.33 ±2.4% for control, 0h and 48h respectively) and CP (68.44, 70.11 and 69.89±1.9% for control, 0h and 48h respectively) were similar between diets, but ADF digestibility (57, 64.77 and 51.44±3.5% for control, 0h and 48h respectively) decreased in 48h diet in comparison with 0h diet; however 0h diet had more NDF digestibility than control diet. The results of the current experiment reveals that chemical treatment of whole barley grain with sodium hydroxide for 48h had negative effects on ADF intake and digestibility

Key Words: sodium hydroxide, whole barley grain, dairy cows

W418 Effect of glucogenic and ketogenic feeding strategies on metabolic status in postpartum transition cows. M. Larsen* and N. B. Kristensen, *Faculty of Agricultural Sciences, Aarhus University, Tjele, Denmark.*

We have previously found that abomasal glucose infusion in postpartum transition cows prevented the characteristic fall in glucose and insulin concentrations. Nine Holstein second lactation cows implanted with permanent indwelling catheters in the major splanchnic blood vessels were used to study the effect of glucogenic and ketogenic feeding strategies on metabolic status in postpartum transition cows. At calving, cows were assigned to 1 of 3 feeding strategies: a glucogenic strategy (GLUCO; 56.5% NaOH treated wheat, 25.8% grass-clover silage and 17.7% concentrate mix), a ketogenic strategy (KETO; 40.5% fodder beets, 25.8% grass-clover silage, 15% NaOH treated wheat and 18.7% concentrate mix) or a keto-glucogenic strategy (MIXED) with 100% alfalfa haylage at the calving day followed by a 6 day gradual shift to the glucogenic diet. Eight hourly sets of arterial, portal vein, and hepatic vein samples were collected starting 30 min before morning feeding at 12 ± 4 days before calving as well as 4, 15, 29 days in milk (DIM). The statistical model included treatment, DIM and treatment × DIM, where DIM within cow was considered as a repeated measure. All treatments were associated

with decreasing ($P < 0.01$) arterial concentrations of glucose and insulin from prepartum to 4 DIM, whereas the β -OH-butyrate concentration did not change ($P = 0.12$). The arterial insulin concentration decreased more ($P = 0.04$) from prepartum to 4 DIM with MIXED as compared to KETO. Concomitantly, the arterial glycerol concentration increased more ($P \leq 0.05$) from prepartum to 4 DIM with MIXED as compared to the other treatments. The portal-arterial (P-A) glucose concentration difference increased ($P < 0.01$) from negative prepartum to positive at 4 DIM with all treatments; however, the positive P-A concentrations difference with KETO at 4 DIM tended ($P \leq 0.10$) to be lower than with the other treatments. In conclusion, the tested feeding strategies induced relatively modest changes in metabolic status in the very early postpartum phase. Thus, the potential for effectively manipulating the metabolic status using farm applicable feeding strategies seems limited.

Key Words: transition, glucose, metabolism

W419 Ruminal degradation dynamics of barley protein meal, corn distiller grains and soybean meal. S. Arriola*, C. Blatcher, M. McGilliard, and M. D. Hanigan, *Virginia Polytechnic Institute and State University, Blacksburg.*

The aim of this study was to determine the ruminal degradation dynamics of barley protein meal (BPM), corn distiller grains (CDG) and soybean meal (SBM). Three ruminally cannulated lactating cows were housed in individual stalls and fed a diet formulated to meet NRC nutrient requirements during a 15 d adaptation period. Five grams of BPM, CDG or SBM were ground through a 2 mm screen, sealed in Dacron bags, dried overnight at 60° C, and weighed. Forty-eight, 24, 16, 8, 4, 2, and 0 h before simultaneous removal, two bags with each feedstuff were placed in the rumen of each of the cows. After removal from the rumen, bags were washed, dried, and analyzed for dry matter (DM), N, and amino acid (AA) content. Ruminal degradation parameters for DM, crude protein (CP) and AA were estimated using the NLIN procedure of SAS. Resulting parameter estimates were analyzed using the MIXED procedure. BPM had the greatest soluble DM and CP fractions (64.8% DM and 76.8% CP), CDG was intermediate (45.1% DM and 40.1% CP), and SBM the lowest (31.8% DM and 13.9% CP). Degradation rates of DM were the greatest for SBM intermediate for BPM and the slowest for CDG. The CP degradation rates were similar between SBM and BPM, but lower for CDG. Finally, rumen undegraded DM was the lowest for BPM (23.9%). Ruminally undegraded DM was lower for SBM (27.4%) than CDG (40.4%). The same pattern was observed for the CP fraction, with BPM having the lowest undegraded CP (11.8%), SBM intermediate values (34.4%) and CDG the greatest (39.3%). In accord with DM and CP, the predicted essential AA percent remaining in the undegraded fraction was the lowest for BPM, as compared to SBM and CDG. These results show that BPM was not as good of a ruminal bypass protein source as SBM and CDG. The high solubility of the BPM was likely due to addition of the solubles to the product and drying conditions used in the pilot plant. The final commercial product may have different characteristics.

Key Words: barley meal, rumen degradation, protein

W420 Effects of storage temperature and pre-mixing on yeast cell viability. M. L. Sullivan*¹, W. K. Sanchez², I. Yoon², and B. J. Bradford¹, ¹Kansas State University, Manhattan, ²Diamond V Mills, Inc, Cedar Rapids, IA.

Active dry yeast (ADY) products are commonly fed in the dairy industry, but little research has been done regarding quality control for such products. The objectives of this study were to measure the effects of

short-term high temperature storage on ADY viability and determine the impact on viability when storing yeast mixed with a vitamin/trace mineral pre-mix (VTM). Commercially available ADY products (n=5) were acquired through normal distribution channels, stored at 4°C upon receipt, and shipped to Medallion Labs for analysis of yeast colony forming units (CFU). ADY were mixed in duplicate with ground corn or VTM to achieve a targeted concentration of 2.2×10^8 CFU/g. One product was omitted due to its low CFU concentration. For each product, samples mixed in corn and VTM were stored at ambient temperature (22°C) while replicates were stored in an incubator at 40°C for 2 wk. Of the 5 products sampled, 2 arrived with CFU concentrations below the product guarantees. Products were mixed based on actual CFU concentration, and mixed samples met the targeted CFU concentration. There were no differences in CFU concentrations between corn and VTM samples immediately after mixing or after storage at ambient temperature. However, high-temperature storage significantly decreased CFU concentration ($P < 0.001$). There was also an interaction ($P = 0.02$) of pre-mix substrate and storage temperature, with VTM maintaining higher CFU concentrations than corn when subjected to high-temperature storage (7.4 vs. 7.1 \log_{10} CFU/g). This could be the result of minerals, such as zinc, that sustained cell wall viability, antioxidant vitamins present in the VTM, or the difference in water activity of the substrates (Corn = 0.51; VTM = 0.45). Results indicated that yeast viability in ADY products was greatly diminished when stored at 40°C for 2 wk, but the reduction was less severe when mixed with a VTM premix.

Key Words: trace mineral, viability, yeast

W421 Replacement of high moisture corn or soy hulls by soy molasses in dairy cow diets. L. L. Bitencourt¹, N. M. Lopes¹, V. A. Silveira¹, G. Pessoa Júnior¹, O. F. Zacaroni¹, G. S. Dias Júnior¹, C. O. Faria⁴, J. R. M. Silva³, R. A. N. Pereira², and M. N. Pereira^{*1}, ¹Universidade Federal de Lavras, Lavras, Brazil, ²Empresa de Pesquisa Agropecuária de Minas Gerais, Lavras, Brazil, ³Instituto Federal de Educação Ciência e Tecnologia do Norte de Minas Gerais, Januária, Brazil, ⁴Better Nature Research, Ijaci, Brazil.

Soy molasses (SM) is the by-product of protein isolation from defatted soy flakes. Two experiments evaluated strategies of feeding SM to dairy cows. The composition of SM (Sementes Selecta SA, Goiânia, Brazil) was (% of DM): 7.9 CP, 0 NDF, 4.1 EE and 10.8 ash. The DM content was 69.5% of as fed. Trial 1 evaluated SM as a replacement for high moisture corn (HMC). Treatments were (% of diet DM): Control with 21.5 HMC, SM1 with 17.2 HMC and 4.5 SM, and SM2 with 12.8 HMC and 9.1 SM. Diets also contained 41.8% corn silage, 5.4% tifton, 19.9% soybean meal, 8.3% whole cottonseed, 16.6% CP, 31.5% NDF, and 6.1% EE. Twenty-four Holsteins were paired blocked based on parity and yield and assigned to a treatment for 28 days, following a standardization period. Data obtained at the end of the standardization was used as covariate in the statistical model. Response variables were measured on the fourth week. Daily milk protein yield was 0.903 kg for Control, 0.871 kg for SM1, and 0.772 kg for SM2 ($P = 0.01$ linear), and milk yield was 30.2, 27.7 and 26.9 kg, respectively ($P = 0.04$ linear). There were no detectable treatment effects upon fat yield ($P = 0.80$), DMI ($P = 0.96$), MUN ($P = 0.97$), plasma glucose ($P = 0.72$), daily excretion of allantoin in urine ($P = 0.55$), and total tract digestibility ($P > 0.54$). Trial 2 evaluated the replacement of soy hulls (SH) by SM. This trial also used 24 cows, in a covariate adjusted randomized block design, with response evaluated on the fourth week after a standardization period. The Control treatment had 11.6% of SH on diet DM. The SM treatment contained 8.4% of SH and 3.3% of SM. Diets also contained 42.2% corn silage, 4.1% tifton, 20.6% soybean meal, 6.9% whole cottonseed, and

11.7% HMC. Milk yield was 27.6 kg for Control and 27.8 kg for the SM treatment ($P = 0.91$). There were no detectable treatment effects on DMI, milk solids content, solids production, MUN, feed efficiency, and milk energy secretion ($P > 0.28$). Replacing HMC with SM did not improve cow performance and replacing SH with SM, in a constant corn starch diet, had no effect on cow performance.

Key Words: soy molasses, sugars, byproducts

W422 Abomasal oligofructose infusion induced hindgut acidosis in Holstein steers. S. R. Mainardi*, B. A. Hengst, S. J. Nebzydoski, L. M. Nemeč, and T. F. Gressley, *University of Delaware, Newark.*

Excessive microbial fermentation of carbohydrates in the large intestine of dairy cattle can result in post-ruminal acidosis which can negatively impact animal health and performance. This study evaluated whether abomasal infusion of a fermentable carbohydrate could be used to induce hindgut acidosis. Six ruminally cannulated Holstein steers were used in a crossover design study with 14-d treatment periods. Steers were fed a lactating cow ration ad libitum. On d 13 steers were treated with 0 (Control) or 1 (Oligo) g/kg BW oligofructose (Beneo P95, Orafit Active Food Ingredients, Tienen, Belgium) pulse-dosed into the abomasum in 1 L water. Fecal samples, blood samples, rectal temperature, heart rate, and respiratory rate were taken at 0, 3, 6, 9, 12, 24, and 48 h relative to the abomasal infusion. Fecal samples were used to determine dry matter (DM) percentage, pH, consistency score (1=liquid to 5=coarse), and volatile fatty acid (VFA) concentrations. Plasma or serum concentrations of metabolites (β -hydroxybutyric acid, blood urea nitrogen, and non-esterified fatty acids) and inflammatory markers (copper, serum amyloid A, and haptoglobin) were determined. There was no effect of treatment on DM intake, rectal temperature, heart rate, respiratory rate, or blood measures ($P > 0.10$). Fecal pH tended to be lower for Oligo than Control steers (6.76 vs. 7.02, $P = 0.06$). Treatment by time interactions were found for fecal score, DM, lactate and acetate ($P < 0.05$), and tended to occur for fecal propionate and butyrate ($P < 0.10$). Fecal score was lower for Oligo than Control steers at 6 and 9 h ($P < 0.01$). Compared to Control steers, fecal DM was reduced in Oligo steers at 6 h but was increased at 9 and 12 h ($P < 0.05$). The greatest difference for all VFAs occurred at 12 h, when concentrations of lactate, acetate, propionate, and butyrate were 0.5, 47, 11, and 4.0 mM in Control steers and 5.2, 76, 15, and 6.8 mM in Oligo steers, respectively. In conclusion, abomasal infusion of 1 g/kg BW oligofructose induced excessive microbial fermentation in the hindgut of steers without causing an acute inflammatory response.

Key Words: acidosis, hindgut, oligofructose

W423 Effect of processing of corn grain on mean particle size, particle distribution and ruminal starch degradability. S. Emanuele*¹, L. Carver¹, L. Davis¹, D. Lundquist¹, and J. Firkins², ¹Quality Liquid Feed, Dodgeville, WI, ²Ohio State University, Columbus.

The objective of this trial was to determine the variability in rumen degradable starch (RDS) among corn samples and develop a regression equation to predict ruminal starch degradability. Eighty-seven corn samples were collected from 60 dairy operations in 11 states. Corn samples consisted of dry, high moisture and steam-flaked corn. Dry corn samples consisted of whole, rolled, crimped or ground samples and high moisture corn consisted of whole, rolled or ground samples. Steam-flaked corn was either rolled or flaked. Samples were collected from October 2008 to February 2009. Samples were analyzed, as-received, by Dairyland Labs, Arcadia, WI for in vitro ruminal and total tract dry matter and starch disappearance. Ruminal dry matter and starch

degradability was measured by a 12-h fermentation in rumen fluid. Total tract dry matter and starch degradability was measured by an 8 h digestion in acid pepsin and lipase enzymes which followed the 12-h ruminal fermentation. The median for RDS was 67.2% with a range of 25.4% to 91.6%. The median for total tract starch degradability was 74.4% with a range of 50.8% to 91.4%. The 12-h RDS was influenced by processing method ($P < 0.07$), being greatest for steam-flaked corn (71.2%) and ground dry corn (66.5%). RDS was influenced by particle size within processing method ($P < 0.05$). RDS varied from 53% to 67% for high moisture corn. The distribution of particle sizes also influenced starch degradability. Samples with a greater percentage of very fine particles tended to have greater starch degradability. RDS for dry corn varied from 50% to 73%. A 12-h ruminal starch degradability for fine ground dry corn can be estimated from mean particle size by the regression equation: $Y = (76.1) + MPS X (-0.0073)$. Based on this data set, ruminal starch degradability is highly variable and influenced by processing method and particle size within processing method. This may lead to an over-estimation of rumen degradable starch (RDS) in the diet if processing method and particle size are not used in equations to predict ruminal starch degradability of corn samples.

Table 1. Effect of corn source and particle size on starch degradability

| Item | Dry Corn | Dry Corn | Dry Corn | HM Corn | HM Corn | HM Corn | SF-Corn | SF-Corn | P-value |
|----------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|
| Processing Method | Crimped | Rolled | Ground | Whole | Rolled | Ground | Flaked | Rolled | |
| Particle Size | Coarse | Medium | Fine | Coarse | Medium | Fine | Medium | Medium | |
| 12-hr Starch Degradability | 48.5b | 56.8ab | 66.5ab | 60.1ab | 58.1ab | 62.1ab | 63.5ab | 71.2a | 0.05 |
| SE | 10.7 | 5.4 | 4.0 | 5.4 | 2.4 | 2.8 | 3.1 | 5.4 | |

LS means with common letter are not different.

Key Words: starch degradability, corn particle size

W424 Comparison of the effects of several nutrients on dairy cow milk fat content. G. Maxin¹, F. Glasser², and H. Rulquin¹, ¹INRA-Agrocampus ouest, Rennes, France, ²INRA, Theix, Saint-Genes-Champanelle, France.

Dietary changes can alter dairy cow milk fat production through modifications in the supply of nutrients. Indeed, several nutrients act as precursors or inhibitors of mammary fat synthesis, and they vary simultaneously following dietary changes. This meta-analysis aims to compare the effects of these nutrients on milk fat content (MFC). The effects of six nutrients were compared: acetate (C2), propionate (C3), butyrate (C4), glucose, trans10,cis12-CLA (CLA) and long-chain fatty acids (LCFA). A database was compiled from the studies involving digestive infusions (or rumen-protected forms) of these nutrients in dairy cows. It contained 142 comparisons between a nutrient infusion and a control. Response models of MFC (in g/100g milk) to the supply of each nutrient (in kg/d) were established. The nutrients differed in their effects on MFC: C2, C4 and LCFA increased MFC whereas C3, glucose and CLA decreased it. To compare the effects of these nutrients on MFC, we had to adjust the response models to in vivo variations in the nutrient supplies, observed following dietary changes. From published data, we estimated the maximal variations in the supply of these nutrients following dietary changes: 1.0 kg/d for C2, 1.0 kg/d for C3, 0.5 kg/d for C4, 1.5 kg/d for glucose, 1.5 g/d for CLA and 1.3 kg/d for LCFA. By applying the response models to these values, we estimated the maximal in vivo responses of MFC (g/100g milk) to the nutrients: +0.25 for C2, -0.48 for C3, +0.40 for C4, -0.43 for glucose, -0.36 for

CLA, and +0.56 for LCFA. The individual responses of the nutrients were moderate and had the same magnitude. These results suggest that several of these nutrients could contribute to the changes in MFC observed following dietary changes.

Key Words: milk fat content, dairy cows, nutrients

W425 Phosphorus feeding for primiparous cows. V. R. Moreira¹, L. K. Zeringue¹, C. Leonardi², and M. E. McCormick¹, ¹Louisiana State University Agricultural Center, Franklinton, ²Louisiana State University, Baton Rouge.

The objective of this study was to evaluate production performance of two groups of 20 primiparous cows fed diets containing either 0.35% or 0.39% ± 0.01% P (DM basis) from 3 to 45 DIM (treatment period). Both groups of cows were fed 0.39% ± 0.01% P thereafter until 110 DIM (carry-over period). Both treatment diets contained 17.7% ± 0.35% CP, 26.8% ± 0.92% NDF, 16.6% ± 0.46% ADF, and 0.76% ± 0.05% Ca as analyzed (average ± standard deviation), and 1.61 Mcal/kg DM as estimated by the NRC (2001) model. Pregnant heifers were brought to the barn at least 20 days before expected calving. Cows were housed in a free-stall barn fit with electronic gates. Close-up TMR containing 0.33% ± 0.03% Ca and 0.28% ± 0.004% P (DM basis) was fed until two days after calving date. Treatments were randomly assigned to cows before the beginning of the experiment. Intake and milk yield were recorded daily. Weekly averages during treatment period (week 3 to 6) and carry-over period (week 7 to 15) were analyzed as repeated measurements using the Mixed procedure (SAS, version 9.2). Dry matter intake was 17.7 and 18.9 kg/cow/d (SEM = 0.45 kg/cow/d) for cows fed 0.35% P and 0.39% P respectively during the treatment period ($P = 0.08$). This difference increased slightly (21.6 vs. 22.9 kg/cow/d, SEM = 0.48 kg/cow/d) during carry-over period ($P = 0.06$). Milk yield was not significantly different, but differences between the two groups were similar to those observed in DMI during both periods (≈ 1.2 kg/cow/d). That was probably a result of greater variability in milk yield (SEM = 1.29 kg/cow/d) than in DMI. Milk yield of cows fed 0.35% P in the diet DM peaked on week 13, 2 weeks later than those cows fed 0.39% P (35.9 vs. 37 kg/cow/d, respectively). Cows from both treatments peaked intake at 14 weeks post-partum with 22.4 and 24 kg/cow/d for diets containing 0.35% P and 0.39% P, respectively. Cow performance was not significantly different between the two levels of P fed during this trial, however, the narrow difference in dietary P between treatments (0.04 percentage units) may warrant further investigation, given the tendency in higher DMI resulted in 1.2 kg/cow/d numerically higher milk yield with 0.39% vs. 0.35% P.

Key Words: phosphorus, dairy, primiparous

W426 Milk production and components of Holstein dairy cows fed diet supplemented with whole barley grain treated with sodium hydroxide. M. Khorashadzadeh^{*}, A. A. Naserian, and R. Valizadeh, Ferdowsi University of Mashhad, Excellence Center for Animal Science, Faculty of Agriculture, Mashhad, Khorasan Razavi, Iran.

To examine the effects of chemical treatments of whole barley grain on milk production and components of dairy cows, 9 multiparous cows (131.44 ± 9.32 DIM, 30.2 ± 5.14 kg daily milk yield) fed a total mixed ration supplemented with ground barley grain (control), or whole barley grain treated with sodium hydroxide (10%) and dried in different periods including: dried immediately (0h) or after 48h storage in plastic bags (48h). Sodium hydroxide was used at the level of 3.5% (DM) of barley grain. Each period lasted 3 week; experimental analyses were restricted to the last week of each period. Diets were formulated according to NRC

2001. Cows were housed in tie stalls and fed the TMR 2 times a day to allow 5 to 10% orts (as-fed basis). Milk production was recorded at the last week of each period and milk samples were collected at the last 2 d of each period. Data were analyzed as a 3 × 3 Latin square using the GLM procedure of SAS (2001). The model included effects of diet, period and cow. Least squares means are reported throughout and significance was declared at $P < 0.05$. Table 1 shows the results of milk production and components. Chemical treatments of whole barley grain increase milk production, but the concentration of fat, protein, lactose, solid not fat (SNF) and milk urea nitrogen (MUN) did not change in diets. The results of the current experiment reveals that chemical treatment of whole barley grain with sodium hydroxide had no significant effects on milk components, but milk production increased when treated whole barley grain included in diets.

Table 1. Effects of chemical treatments of whole barley grain with sodium hydroxide on milk production and components

| parameter | Treatments | | | P-value | SE |
|----------------|------------|---------|--------|---------|------|
| | control | 0h | 48h | | |
| Milk (kg/d) | 26.69a | 27.58ab | 28.16b | 0.04 | 0.37 |
| 4% FCM 1(kg/d) | 23.84a | 24.38ab | 25.47b | 0.02 | 0.39 |
| components | | | | | |
| Fat (%) | 3.3 | 3.24 | 3.36 | 0.66 | 0.09 |
| Protein (%) | 3.01 | 2.96 | 2.99 | 0.93 | 0.05 |
| Lactose (%) | 4.27 | 4.3 | 4.23 | 0.74 | 0.05 |
| SNF (%) | 7.33 | 7.34 | 7.23 | 0.77 | 0.08 |
| MUN (mg/dL) | 15.99 | 15.44 | 15.98 | 0.72 | 0.48 |

¹ Fat-corrected milk = $0.4 \times [\text{milk yield (kg)}] + 15 \times [\text{fat yield (kg)}]$.

Key Words: milk production, whole barley grain, dairy cows

W427 Effects of dietary cobalt supplementation and vitamin B₁₂ injection on lactation performance by dairy cows. M. S. Akins^{*1}, S. J. Bertics¹, M. T. Socha², and R. D. Shaver¹, ¹University of Wisconsin, Madison, ²Zinpro Corporation, Eden Prairie, MN.

The objective of this study was to determine lactation performance of primi- and multiparous dairy cows fed different levels and sources (inorganic and organic) of Co or given weekly vitamin B₁₂ injections. Forty-five primi- and multiparous cows 60 d prepartum were blocked by parity (1 or >1) and expected calving date, then randomly assigned to 1 of 5 treatments in a randomized complete block design. The treatments were: no supplemental Co (Control), 25 mg Co from Co carbonate (CoCarb), 25 mg (LCoGH) or 75 mg (HCoGH) Co from Co glucoheptonate, and Control plus weekly 10 mg vitamin B₁₂ injections (IB12). Cows were on trial until 150 days in milk. Cobalt (ppm DM) in the lactation diet was 1.0, 1.9, 2.3, and 5.2 for Control, CoCarb, LCoGH, and HCoGH, respectively. Far-off, close-up, and lactating diets were 13.8, 15.1, and 18.0% CP and 48.8, 40.2, and 32.9% NDF (DM basis), respectively. Intake was not affected ($P > 0.10$) by treatment and was 19.4 ± 0.5 and 23.1 ± 0.8 kg DM/d for primi- and multiparous cows, respectively. Fat-corrected milk (FCM) was not affected ($P > 0.10$) by treatment for primiparous cows (35.4 ± 1.4 kg/d), but for multiparous cows, CoCarb (42.4 ± 1.7 kg/d) produced less ($P = 0.04$) than LCoGH (47.5 ± 1.8 kg/d). Multiparous cows on IB12 tended to have lower FCM than the mean of LCoGH and HCoGH ($P = 0.10$). Milk yield for primi- ($P = 0.85$) and multiparous cows ($P = 0.21$) on Control did not differ from the mean of CoCarb, LCoGH, and HCoGH. Milk fat percent ($P = 0.048$) and milk urea nitrogen ($P = 0.005$) were greater for primiparous cows on CoCarb than LCoGH. Multiparous cows on IB12 tended (P

$= 0.10$) to have higher milk protein percent than the mean of LCoGH and HCoGH, but protein yield did not differ ($P = 0.73$). Body weight and condition score and calculated energy balance were not affected by treatment ($P > 0.10$). Addition of Co above requirements or vitamin B₁₂ injections did not improve lactation performance, because vitamin B₁₂ status was likely adequate.

Key Words: cobalt, vitamin B₁₂, dairy cow

W428 Carry-over effects reveal that late lactation dairy cows require longer than 30 d to respond to Diamond V Original XP. W. K. Sanchez^{*1}, C. S. Dei¹, J. Miller¹, G. Poppy¹, and N. St-Pierre², ¹Diamond V, Cedar Rapids, IA, ²The Ohio State University, Columbus.

Objectives were to evaluate responses to Diamond V Original XP Yeast Culture (XP) in late lactation dairy cows on commercial farms. Eight Holstein herds in Central California were used to study the effects of feeding a TMR supplemented with 56 g/d XP compared to an unsupplemented Control TMR (C). Herds were paired by test day and milking frequency to form 4 Latin squares with 3 periods of 30 d each, with the extra (final) period being used to estimate carryover effects. A total of 28,690 cows in 37 pens averaging 275 DIM were used in the study. Data were analyzed using a mixed model with the random effects of pair, dairy(pair), dairy × pair × treatment × prior and residual, and the fixed effects of dietary treatments and carryover. Pen was the experimental unit. Carryover effects were evident for milk ($P = 0.0005$), 3.5% FCM ($P = 0.0006$), and milk/DMI ($P = 0.01$). This means that the treatment the herd was on in the prior 30 d affected milk, FCM and milk/DMI response in the subsequent 30 d. Differences in least squares means showed advantages for XP vs. C in milk (31.2 vs. 29.1 kg; $P < 0.05$), FCM (31.4 vs. 30.1; $P = 0.11$), and milk/DMI (1.35 vs. 1.28; $P = 0.12$). No differences in DMI, milk fat % and SCC were observed. The significant carryover effect indicates that XP should be fed longer than 30 d to observe effects in late lactation and cross-over designs used to study the effects of XP (and possibly other rumen modifiers) should have longer than 30-d periods. The biological explanation of this delayed effect is not clear, but results are consistent with other research and field experiences that show a delay in the response of either adding or removing a rumen modifier from the diet.

Key Words: Diamond V XP, lactation, dairy nutrition

W429 Effect of dietary OmniGen-AF on milk somatic cell count and the ability of isolated blood neutrophils to kill pathogens. C. R. Rill^{*1}, T. Lu¹, J. E. Williams¹, B. Hatch¹, B. Shafii¹, P. Rezamand¹, J. Chapman², and M. A. McGuire¹, ¹The University of Idaho, Moscow, ²Prince Agri. Products Inc., Quincy, IL.

Mastitis results from the invasion of pathogens into mammary tissue and is characterized by inflammation and elevated milk somatic cell counts (SCC). Neutrophils are the primary innate defense mechanism for mammary tissue. The purpose of this study was to examine the effect of feeding a commercially available feed additive on SCC and neutrophil killing ability. Sixteen lactating dairy cattle (59-177 DIM; mean 100 ± 10 SEM) were randomly blocked by treatments based on parity, DIM, and milk production. Diets fed were identical with the exception of an experimental mix fed at 227 g/d containing carrier only or carrier plus OmniGen-AF at 56 g/d. Milk samples were collected 3 d before through d 17 of feeding and submitted to a certified lab for milk SCC analysis. Neutrophils from each animal were isolated from blood after 48 d of feeding and evaluated in vitro for their ability to kill three common mastitis causing microorganisms. Somatic cell data were log transformed, and mean differences were analyzed during d 5 through d

17 of initiation to feeding using ANOVA procedures on a relative basis to d -3 through d 4 of feeding. Neutrophil killing differences on d 48 of feeding were also assessed via ANOVA. Daily milk weights were not affected ($P = 0.24$) by OmniGen-AF feeding (31 vs. 35 kg; SEM = 1.84). Mean relative log SCC score was less ($P = 0.0349$) for OmniGen-AF treatment vs. control (0.85 vs. 1.31, respectively; SEM = 0.22). No differences were detected for the ability of neutrophils from control vs. OmniGen-AF fed animals to kill *Staphylococcus aureus* (35 vs 41%) or *Escherichia coli* (98 vs. 97%). However, killing of *Streptococcus uberis* was improved (15 vs. 73%; $P < 0.0001$). These results indicate the feeding of OmniGen-AF to enhance immune function may warrant further investigation.

Key Words: immunity, mastitis, feed additive

W430 Effects of two processed grain sources in preparturient diets on health and performance of Holstein dairy cows during transition period. E. Qashqayi*, H. Amanlou, D. Zahmatkesh, F. Niazi, and N. Aghaziarati, *Zanjan University, Zanjan, Iran.*

In order to evaluate the effect of two processed grain sources on health and performance in the periparturient period, thirty two multiparous Holstein cows averaging 719 ± 31.8 kg body weight (BW) were used in a randomized complete block design and randomly assigned to 1 of 2 treatments. The experimental diets were 1) 13.06% extruded branless wheat (EBW) on a DM basis and 2) 13.06% steam flaked barley (SFB) on a DM basis. The diets were fed as total mixed ration (TMR) and feeding started on average 21 ± 4.06 d prior to expected parturition. After parturition animals received the same lactation diet until 21 d. The results showed that prepartum dry matter intake was higher in cows fed diet 1 (EBW) than in cows fed diet 2 (SFB) (13.7 vs. 11.3 kg, $P < 0.001$) and was also higher in postpartum period (17.46 vs. 16.13 kg, $P < 0.001$). There were no differences in urinary pH and fecal pH, but fecal score in cows fed EBW was higher compared with cows fed SFB during last wk prepartum (3.43 vs. 3.19, $P < 0.05$). BW and body condition score (BCS) were not affected by treatments during periparturient period. Although there were no significant differences between treatments, cows fed the EBW had greater milk yield at 3 week (30.2 vs. 28.4, $P < 0.16$), 1 month (32.7 vs. 30.7, $P < 0.14$) and 2 month (44.2 vs. 44.1, $P < 0.96$). The treatments did not influence serum concentration of glucose, non-esterified fatty acid (NEFA), cholesterol, total protein, albumin, globulin, urea nitrogen, calcium and phosphorous in periparturient cows. Postpartum incidence of retained placenta, milk fever, ketosis, mastitis, dystocia, and metritis were not affected by prepartum diets. There was no effect on parturition condition, calf birth weight and calf condition. Considering higher dry matter intake and performance in EBW group, it appears that feeding extruded branless wheat can be useful in adaptation from gestation to lactation in transition Holstein cows.

Key Words: grain processing, transition period, productivity

W431 Influence of inoculation and storage time on in vitro gas production of high moisture corn. P. C. Hoffman¹, N. M. Esser*¹, R. D. Shaver¹, W. K. Coblenz², M. P. Scott³, A. L. Bodnar³, R. Schmidt⁴, and B. Charley⁴, ¹University of Wisconsin, Madison, ²US Dairy Forage Research Center, Marshfield, WI, ³Iowa State University, Ames, ⁴Lallemand Inc., Milwaukee, WI.

The hydrophobic prolamins (zein) proteins, which encapsulate high moisture corn (HMC) starch, are altered by genetic-maturity origin and fermentation. The effect of protein alteration on in vitro digestibility of HMC has not been thoroughly investigated. To assess influences of protein alteration, as effected by inoculation and storage time, on in vitro

gas production of HMC, quadruplicate samples of two random HMCs (A and B) containing 25.7 and 29.3% moisture were ground (± 900 um), inoculated (I) with or without 600,000 cfu/g of LB 40788 (Lallemand Inc., Milwaukee, WI), ensiled, and stored for 0, 15, 30, 60, 120 and 240 d. The HMCs were re-ground through a 4-mm screen, inoculated with rumen fluid from two cannulated cows fed 35% concentrate. Samples were incubated for 36 h in an in vitro gas production (GP) system fit with wireless transponders. Total, 0-12, 12-24, and 24-36 h GP was evaluated with lag (h) and fractional rate (h^{-1}) estimated using a segmented non-linear model. Total GP of A, AI, B and BI were modestly altered by storage time and HMC (A vs. B). Larger alterations of 0-12 h GP (% of total) were observed for A, AI, B and BI, with 0 and 240 d GP at 52.0, 52.0, 59.4, 59.5 and 58.6, 60.2, 71.9 and 71.6%, respectively. Fractional rates of digestion were faster for corn B, and increased with storage time but were not affected by inoculation. Fractional rates were best correlated ($r = -0.64, 0.58, 0.62, -0.70, 0.64$) to pH, acetate, lactate, prolamin and NH_3 -N contents of HMC and 0-12 h GP was best correlated ($r = -0.73, 0.77, 0.72$) to pH, lactate and NH_3 -N. Lag times were shorter (1 h) for HMC B but lag time was not influenced by storage time or inoculation. Gas production pools, fractional rates and lag time were poorly correlated to ADF, NDF, ADF-CP and NDF-CP. Data suggest genetic-maturity origin and storage time alter in vitro gas production of HMC.

Key Words: high moisture corn, gas production, inoculant

W432 Comparing a 60-d dry period with far-off and close-up diets with a 40-d dry period with a single diet on milk production and body condition score. J. C. Plaizier*, L. Lippins, M. L. Connor, and D. O. Krause, *Department of Animal Science, University of Manitoba, Winnipeg, MB, Canada.*

It has been suggested that reducing the dry period from 60 d to 40 d and feeding a single diet during a short dry period, instead of separate far-off and close-up diets, do not reduce or can increase milk production in the subsequent lactation. This was tested in an experiment with 11 blocks of 2 Holstein dairy cows. Cows were either dried off 60 d or 40 d before the expected calving date. Cows with the 60-d dry period received a far-off diet until 21 d before the expected calving date, and a close-up diet from that day onwards until calving. Cows with the 40-d dry period received the close-up diet during the entire dry period. After calving, all cows received the same lactation diet. On average, the far-off diet contained 1.29 Mcal/kg of Net Energy for Lactation, 12.4% crude protein, and 42.9% neutral detergent fiber. On average the close-up diet contained 1.42 Mcal/kg of net energy for lactation, 12.9% crude protein, and 41.7% neutral detergent fiber. The diet fed to lactating cows contained, on average, 1.71 Mcal/kg of Net Energy for Lactation, 18.1% crude protein, and 33.9% neutral detergent fiber. Diet compositions are on a dry matter basis. Cows with the 40-d dry period had lower milk yields (41.7 vs. 45.0 kg/d), higher milk fat (4.16 vs. 3.80%), and lower milk protein yields (1.34 vs. 1.45 kg/d) during the first 3 mo of lactation than cows with the 60-d dry period. During this period, milk protein content and milk fat yield were not affected by the dry cow management, and averaged 3.40% and 1.75 kg/d, respectively, across treatments. The dry cow management had no effect on body condition scores (1 to 5 scale), which were, on average, 3.45, 3.25, 2.99, 2.79, and 2.76, at drying-off, calving, 3 wk after calving, 6 wk after calving, and 9 wk after calving, respectively. The current study did not show beneficial effects of reducing the dry period from 60 to 40 d and feeding a single diet during the 40-d dry period.

Key Words: dry period, milk production, body condition score

W433 Influence of inoculation and storage time on alteration of the starch-protein matrix in high moisture corn. P. C. Hoffman^{*1}, N. M. Esser¹, R. D. Shaver¹, W. K. Coblenz², M. P. Scott³, A. L. Bodnar³, R. Schmidt⁴, and B. Charley⁴, ¹University of Wisconsin, Madison, ²US Dairy Forage Research Center, Marshfield, WI, ³Iowa State University, Ames, ⁴Lallemand, Inc, Milwaukee, WI.

The fates of hydrophobic prolamin (zein) proteins, which encapsulate corn starch creating vitreous endosperm, have not been investigated in high moisture corn (HMC). To assess influences of inoculation and storage time on hydrophobic proteins in HMC, quadruplicate samples of two random corns (A and B), containing 25.7 and 29.3% moisture were ground (\pm 900 μ m), inoculated (I) with or without 600,000 cfu/g of LB 40788 (Lallemand Inc., Milwaukee, WI), ensiled, and stored for 0, 15, 30, 60, 120 and 240 d. Nutrient composition (CP, prolamin, starch, ADF, NDF), fermentation (pH, lactate, acetate) and protein degradation markers (buffer-soluble CP, NH₃-N) were evaluated. At 0 and 240 d, α , β , γ and δ zein regions were profiled using HPLC. Data were evaluated as a split-split plot using the PROC MIXED procedures of SAS. Inoculation and storage time reduced pH, and altered lactate and acetate contents of HMC. Lactate and acetate contents of A, AI, B and BI at 240 d were 0.40, 0.32, 1.11, 0.73 and 0, 0.35, 0.30 and 0.87% of DM, respectively. Buffer-soluble CP of HMCs increased from 1.5-2.0% of DM at 0 d to > 4.0% of DM at 240 d. Inoculation had no effect on buffer-soluble CP, but increased NH₃-N content of HMC. Corn A contained more prolamin (5.8 vs 4.6 g of prolamin/100 g starch) than corn B. Peak areas for α , γ and δ zein regions were higher for corn A and fermentation (0 vs 240 d) reduced all zein subunits with the exception of 2α and 1δ region. Fermentation reduced (>50%) 27 kDa γ zein which cross links and lies peripheral to α zein. Despite altering lactate and acetate contents, inoculation had no effect on hydrophobic proteins in HMC endosperm. Data suggest altering fermentation acids via inoculation has a minimal effect on hydrophobic proteins in HMC, but hydrophobic proteins in HMC are highly influenced by origin and storage time (proteolysis).

Key Words: high moisture corn, prolamins, inoculant

W434 Amylopectin to amylose ratio in hullless barley in relation to intestinally absorbed protein supply to dairy cattle: A preliminary study. P. Yu^{*}, Z. Niu, and D. Damiran, *Department of Animal and Poultry Science, College of Agriculture and Bioresources, University of Saskatchewan, Saskatoon, SK, Canada.*

The objectives of this study were to investigate the relationship between the amylopectin to amylose ratio in hullless barley and intestinally absorbed protein supply to dairy cattle. The total intestinally absorbed protein supply to dairy cattle was determined according to the DVE/OEB system. The total intestinally absorbed protein supply was contributed from (1) the absorbable fraction of microbial crude protein (AMCP); (2) the absorbable fraction of ruminally undegraded feed protein (ARUP); and a correction factor for endogenous protein lost during the digestion process (ENDP). The results showed that the amylopectin to amylose ratio had no correlation with AMCP ($R = -0.2928$; $P = 0.4816$) and ENDP ($R = 0.1952$; $P = 0.6432$), but it has significant correlation with ARUP ($R = -0.9759$; $P < 0.0001$). The total intestinally absorbed protein supply from hullless barley has significant and negative correlation with the amylopectin to amylose ratio with $R = -0.7807$ ($P = 0.0222$). These results indicated that the amylopectin to amylose ratio in starch granule not only affects starch fermentation and utilization, but also affect protein value in hullless barley.

Key Words: amylopectin to amylose ratio, intestinally absorbed protein supply, hullless barley

W435 Effect of flax hulls in the diet and infusion of flax oil in the abomasum on absorption of the mammalian lignan enterolactone in dairy cows. H. V. Petit^{*1}, C. Côrtes¹, R. Kazama², D. da Silva-Kazama², G. T. D. Santos², L. M. Zeoula², N. Gagnon¹, and C. Benchaar¹, ¹Dairy and Swine R & D Centre, Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada, ²Departamento de Zootecnia, Universidade Estadual de Maringá, Maringá, Brazil.

Six rumen fistulated lactating cows were used in a 6×6 Latin square design to investigate the effects of abomasal infusion of flax oil on absorption of the mammalian lignan enterolactone (EL) in cows supplemented or not with plant lignans. The activity of β -glucuronidase was determined in ruminal fluid, urine, plasma, and milk. Treatments were: flax hulls supplementation (without: CON vs. with 15.9% in the DM: FHU) and 3 amounts of flax oil infused in the abomasum (0, 250 and 500 g/d). Experimental periods consisted of 21 d with 14 d of adaptation. Milk samples were collected twice daily on week 3 and pooled for EL assay. Blood was withdrawn from the jugular vein 6 h postfeeding on d 20. Rumen contents were sampled on d 21 before feeding and 2, 4, and 6 h postfeeding and urine samples were taken 2 h postfeeding. Concentration of EL in ruminal fluid was determined at 0 h (baseline) and on samples pooled for 2, 4, and 6 h. All data were analyzed using the MIXED procedure of SAS according to a 6×6 Latin square design with repeated measurements for enzyme activity. Concentrations of EL in urine, milk, ruminal fluid, and plasma were significantly higher ($P < 0.001$) for cows fed flax hulls while the abomasal infusion of flax oil had no effect ($P > 0.05$). Cows fed FHU tended ($P = 0.06$) to have higher fecal β -glucuronidase activity than those fed CON and flax oil infusion had no effect ($P > 0.10$). There was an interaction ($P < 0.05$) between hulls and oil for β -glucuronidase activity in ruminal fluid before and post-feeding. Cows fed the CON diet with no flax oil had higher ruminal β -glucuronidase activity before feeding than those fed flax hulls with no flax oil and there was no difference among the other treatments. This study suggests that the lower activity of β -glucuronidase in the rumen of cows fed FHU than in that of cows fed CON may result of an inhibitory effect of oil present in flax hulls on the microbial population involved in the absorption of mammalian lignans. Moreover, these data suggest that β -glucuronidase activity in the small intestine is not inhibited by the presence of flax oil.

Key Words: enterolactone, lignans, flax

W436 Evaluating various meal criteria methods for analyzing chewing data. D. D. Maulfair^{*}, G. I. Zanton, and A. J. Heinrichs, *The Pennsylvania State University, University Park.*

When analyzing chewing data collected from cows housed in tie-stalls it is necessary to separate eating bouts into meals using an inter-meal interval or meal criteria. The objective of this study was to improve the existing method of calculating meal criteria by 1) fitting the data with a nonlinear mixed model, which acknowledges that period, treatment, and animal effects are common across the nonlinear profiles and should be accounted for at the time of fitting the nonlinear model and in addition to being used to calculate LSMEANS in proc mixed; 2) producing a meal criterion specific to each treatment at the time of fitting the nonlinear model; 3) making use of as much of the raw data as possible to limit the impact of the choice of bin width. In this study 3 different meal criteria were used to evaluate chewing behavior in lactating dairy cattle; 5 min, 7 min, and a calculated meal criterion based on the chewing data of the study. Eight multiparous, Holstein cows (90 ± 32 days in milk; 4 rumen cannulated) were randomly assigned to replicated 4×4 Latin squares. Cows were fed diets that varied in chop length of dry grass hay. Diet forages and their percentage of diet DM were: corn silage (29.4), hay-

lage (17.6), and grass hay (11.8). Observed meal criteria for the short, medium, long, and extra long diets were 7.6, 13.8, 10.5, and 11.2 min; the interval for the short treatment was less than for the other diets ($P < 0.05$). Eating and chewing time per day and per kg of DMI increased by up to 25.3 min/d and 1.0 min/kg DMI as meal criteria increased, but this did not affect any conclusions about differences between treatments. Number of meals/d decreased by as much as 3.4 as meal criteria increased, but there were no differences between diets in the number of meals/d for any of the meal criteria. It appears that the meal criteria value is not essential to obtain accurate conclusions about ration changes from chewing data collected in tie-stalls, but it does impact the values recorded for treatment means.

Key Words: chewing, meal criteria, particle size

W437 The effect of rumen-protected methionine and choline on reproductive performance of Holstein dairy cows. M. Ardalan*, K. Rezayazdi, and M. Dehghan-Banadaky, *Department of Animal Science, University College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran.*

The objective of this study was to investigate the effect of feeding ruminally protected sources of methionine and choline on the reproductive indices of Holstein dairy cows. Forty Holstein dairy cows (10 cows per treatment = 6 cows in 1st lactation and 4 cows in 2nd lactation) in their first and second lactation were used from 4-week prepartum through 20-week postpartum and randomly assigned to receive one of the following treatments: 18 g/d of rumen protected methionine (RPM), 60 g/d of rumen protected choline (RPC), 18 g/d of RPM + 60 g/d of RPC, and neither supplement (control). Cows were housed in individual tie stalls and cared for under experimental procedures and protocols approved by the veterinary organization of Iran. The forage was 57% of the total DM of dry period diet and 44% of the total DM of lactation diet. Reproductive data were recorded, including days open, days to first estrus, number of pregnant cows and number of services per conception. Statistical analysis of reproductive data was performed using the general linear models procedure (Proc GLM) of SAS and the statistical model included the effects of treatment, parity, and treatment \times parity. The treatments significantly affected services per conception and open days of lactating dairy cows ($P < 0.05$), but did not affect significantly on days to first estrus and number of pregnant cows. RPM+RPC-fed cows had the lowest open days, days to first estrus and services per conception compared with other groups ($P < 0.05$). Parity and treatment

\times parity had not significant effects on the reproductive indices of dairy cows. Results indicate that the supplementation of RPM and RPC can improve reproductive performance of Holstein dairy cows.

Key Words: rumen-protected methionine, rumen-protected choline, reproductive performance

W438 Effects of the source and amount of sulfur in prepartum diets on performance of periparturient Holstein cows. E. Manidari, H. Amanlou, M. Frozanmehr, H. R. Mirzaei Alamouti*, and E. Mahjoubi, *University of Zanjan, Zanjan, Iran.*

Twenty four multiparous Holstein cows (body weight (BW), 687.9 ± 32.33 kg) were used in a completely randomized design and assigned to 3 diets: 1) 0.21% sulfur (control, without sulfur supplementation), 2) 0.41% sulfur (with 0.79% magnesium sulfate) and 3) 0.41% sulfur (with 0.57% magnesium sulfate + rumen protected methionine (25 g/d, Mepron, Degussa Corp., Kennesaw, GA)). Cows were individually fed the total mixed ration with similar net energy for lactation (1.58 Mcal/kg dry matter), crude protein (13.3%) and dietary cation-anion difference (-32 meq/kg dry matter) from 21.9 ± 2.47 d relative to expected calving until calving. After calving, all cows received the same lactation diet until 21 d in milk. Colostrum production and composition were determined until 12 h after calving. Milk production and composition were determined 3 times per day until 21 d in milk. Data were analyzed using MIXED Procedure from SAS and cows nested in the diets were as random effects. Different variance-covariance error structures were tested for data measured over time as repeated measures. Diet with 0.41% sulfur from magnesium sulfate (diet 2) compared with diets 1 and 3 significantly decreased dry matter intake at periparturient period (8.7 vs. 7.4 and 9.7 ± 0.36 at prepartum and 10.7 vs. 8.1 and 10.9 ± 0.65 kg/d at postpartum, for the diets 1, 2, and 3, respectively). Colostrum production was lower ($P < 0.01$) for the diet 2 compared with the others (11 vs. 18 and 16.3 ± 2.45 kg, for the diets 1 and 3, respectively). The Diet 3 significantly increased protein and ash content in colostrum but fat content was not affected. Cows fed the diet 2 had lower ($P < 0.01$) milk yield (19.7 vs. 24.5 and 24.9 ± 1.15 kg/d) and milk components yield compared those fed diets 1 and 3, but milk components concentration were not affected. Cows fed the diet 2 significantly lost BW and body condition score. In summary, increasing sulfur concentration (0.41% of DM) using magnesium sulfate in close-up diets compared with other diets used in this study depressed performance of periparturient cows.

Key Words: sulfur, prepartum diet, periparturient Holstein cows