T64 Effect of level and source of supplemental protein on rate of ruminal methane production and methanogen concentration in *Bos taurus* and *Bos indicus* steers fed low-quality forage. N. L. Bell*[1], R. C. Anderson[2], S. L. Murray[1], J. C. McCann[1], K. K. Weldon[1], A. D. G. Wright[3], J. E. Sawyer[1], and T. A. Wickersham[1], *[1]Texas A&M University, College Station, [2]USDA/ARS Southern Plains Agricultural Research Center, College Station, TX, [3]University of Vermont, Burlington.*

The adaptive response of ruminal methanogen populations to substrate availability is not well defined. In this study, 10 ruminally cannulated steers (5 each: *Bos taurus*, Bt, 303 ± 10 kg initial BW and *Bos indicus,* Bi, 323 ± 28 kg initial BW) were used to quantify differences in source and level of protein on rate of ruminal methane (CH_4) production and methanogen concentration. Breeds were assigned to separate 5 × 5 Latin squares and fed low-quality forage (4.5% CP). Treatments were arranged as a 2 × 2 factorial plus a control (no supplement): the first factor was level of protein, 60 or 120 mg N/kg BW daily; and the second was source, DIP (degradable intake protein; 72% DIP) or UIP (undegradable intake protein; 72% UIP). Rumen fluid collected immediately after feeding and 4 h later was processed according to standard laboratory protocols. There was a main effect of time after feeding ($P < 0.01$) for both Bt and Bi steers with CH_4 production being lower at 4 h after feeding versus 0 h (1.75 ± 0.45 and 2.32 ± 0.95 μmol CH_4/mL per h; respectively). There was a protein source by level interaction for Bt ($P = 0.03$) and Bi ($P = 0.07$) steers. In both cases, steers fed 60 or 120 mg N/kg BW UIP had lower levels of in vitro CH_4-producing activity (1.93 ± 0.74 and 1.90 ± 0.91 μmol CH_4/mL per h for Bt and Bi, respectively) than steers fed 60 or 120 mg N/kg BW DIP (2.25 ± 0.88 and 2.20 ± 0.74 μmol CH_4/mL per h for Bt and Bi, respectively). Contrary to our hypothesis, main effects of breed, treatment, or time, and the interactions were not observed ($P > 0.35$) for methanogen concentrations measured by most probable number (MPN) or quantitative PCR. Methanogen concentrations averaged 6.52 ± 1.13 and 7.08 ± 0.86 $\log_{10}$/mL rumen fluid when measured by MPN and PCR methods, respectively. These results suggest that while methanogen concentrations remained unchanged, the population may favor slow growing methanogens expressing high substrate affinity during periods of limiting reductant and favor more rapid growing species with lower substrate affinity when reductant is abundant.

Key Words: protein supplementation, methane

T65 Whole cottonseed can replace barley straw in TMR fed beef heifers at finishing period. S. P. Iraira[1], J. L. Ruíz de la Torre[1], M. Rodríguez-Prado[1], M. Pérez[2], X. Manteca[1], S. Calsamiglia*[1], and A. Ferret[1], *[1]SNiBA, Universitat Autònoma Barcelona, Bellaterra, Spain, [2]Unitat de Qualitat i Carn-IRTA, Girona, Spain.*

To study the effect of whole cottonseed (WCS) on performance and meat quality, and to compare the results with those provided by the use of barley straw (BS) offered either separately or mixed with the concentrate, 27 Simmental heifers (initial BW 265.1 ± 20.4 kg) were assigned to three treatments in a randomized complete block design. Treatments consisted of (1) concentrate and BS, both offered as free-choice in separate feedbunks (CH-BS), (2) concentrate and BS offered as total mixed ration (TMR) with a concentrate to BS ratio of 92 to 8 (TMR-BS), and (3) TMR in which 16% of WCS (DM basis) was used as an alternative fiber source (TMR-WCS). All diets were offered ad libitum and formulated according to NRC (2000) to be isoenergetic (3.0 Mcal ME/kg DM), and isonitrogenous (14% on DM). Animals were allotted to roofed pens with 3 animals per pen, and 3 pens per treatment. Intake, ADG and G:F ratio were registered. Dressing percentage was calculated from hot carcass weight and the BW recorded before transfer to the abbatoir. The Longissimus thoracis (LT) muscle was excised from the 6th rib, and was used for measurements of meat quality. Intake of DM, ADG, and G:F ratio were no different among diets, being on average 8.1 ± 0.34 kg/d, 1.4 ± 0.08 kg/d, and 0.18 ± 0.01, respectively. The concentrate to BS ratio in heifers fed CH-BS was 96 to 4. Intake of CP was greater ($P = 0.013$) in TMR-WCS than in CH-BS and TMR-BS, and NDF intake was greater ($P = 0.05$) in TMR-BS than in TMR-WCS. There were no differences in the carcass characteristics and meat quality among diets, but there were differences in the percentage of some fatty acids. The percentage of C17:0 ($P = 0.005$), and C18:1 *trans*-10, *trans*-11, *trans*-12 ($P = 0.012$) was greater in heifers fed TMR-WCS than heifers fed BS diets, but lesser in the case of C18:1 *cis*-9 ($P = 0.002$). The n-6:n-3 ratio was greater in TMR-WCS than in the other two diets ($P = 0.001$). In summary, these results suggest that WCS can replace BS in finishing beef heifers without affecting DM intake, ADG, G:F ratio, carcass characteristics, and meat quality, although it can cause some changes in the fatty acid profile of the LT muscle.

Key Words: beef cattle, whole cottonseed

T66 Effects of basal diet and degradable intake protein level on the growth response to slow release urea in beef steers. V. B. Holder*[1], J. S. Jennings[2], K. M. McLeod[1], J. M. Tricarico[3], and D. L. Harmon[1], *[1]University of Kentucky, Lexington, [2]Alltech Inc., Brookings, SD, [3]Innovation Center for the U.S. Dairy, Rosemont, IL.*

This experiment was conducted to determine the effects of basal diet, DIP level and urea source on the growth and efficiency of beef cattle. The experiment utilized 240 Angus crossbred steers (BW: 287 ± 1.4 kg) over a 70-d growth period. Steers were blocked by weight and, within block, randomly assigned to treatment. Each treatment combination had 6 replicate pens with 5 head per pen. Treatments were arranged as a 2 × 2 × 2 factorial structure with two concentrate levels (70% vs. 40%), two DIP levels (90% vs. 120% of requirements) and two sources of DIP (urea vs. slow release urea, OptigenII, Alltech Inc.). The basal diet was achieved by the addition of either wheat straw and corn stalks (40% concentrate) or high moisture shelled corn (70% concentrate) to a corn silage-based diet. Feed was offered once per day throughout the experiment and bunks were managed for ad libitum intake. The 70% concentrate diet increased DMI (9.38 vs. 7.76 kg/d, $P < 0.0001$), ADG (1.77 vs. 1.21 kg/d, $P < 0.0001$) and feed efficiency (189.1 vs. 156.4 g/kg, $P < 0.0001$). Similarly, the 120% DIP diets increased DMI (8.82 vs. 8.31 kg/d, $P < 0.0001$), ADG (1.61 vs. 1.38 kg/d, $P < 0.0001$) and feed efficiency (181.2 vs. 164.2 g/kg, $P < 0.0001$). There was an interaction between basal diet and DIP source where slow release urea increased ADG (1.80 vs. 1.75 kg/d, $P = 0.04$) and tended to improve feed efficiency (192.2 vs. 185.9 g/kg, $P = 0.07$) of 70% concentrate diets but tended to decrease these variables in 40% concentrate diets (ADG: 1.18 vs. 1.25 kg/d; efficiency: 154.6 vs. 158.2 g/kg). If provided when DIP is limiting, providing DIP as slow release urea instead of urea may increase performance and feed efficiency of animals on higher concentrate diets but not for the low quality high forage diets used in this experiment.

Key Words: N efficiency, N pollution

T67 In situ disappearance in lactating beef cows of dried distillers grains subjected to different levels of heat damage. K. P. Coffey*, A. N. Young, E. B. Kegley, D. Philipp, P. Hornsby, and J. Hollenback, *University of Arkansas Division of Agriculture, Fayetteville.*

Distillers dried grains (DDG) may be subjected to varied levels of heat damage during processing and transport. Our objective was to determine in situ DM disappearance of conventional (CDDG) or a lower-fat DDG (LFDDG) subjected to varied levels of heat damage. Both CDDG and LFDDG were mixed 80:20 with water, placed in Al pans, covered with foil, and heated for either 3 or 5.5 h at 150C. Contents from the center of each pan were retained separately from the exterior 2 cm of each pan. The exterior 2 cm from the 5.5-h heating was charred excessively and retained to represent excessive heat damage (5.5CHR). Ruminally cannulated beef cows (n=4; 533±14.0 kg BW) were offered bermudagrass hay with either no supplement or 0.45% of BW from either CDDG, LFDDG, or heated LFDDG (3 h at 150°C) in a 4 × 4 Latin square experiment. Nylon bags containing unheated CDDG and LFDDG, those heated for 3 or 5.5 h, and those from 5.5CHR were incubated in the rumen for multiple times up to 108 h. Dry matter remaining was fit to a non-linear model, resulting in estimations of immediately-soluble (A) and potentially degradable (B) fractions, along with disappearance rate (k_d). Cow diet did not affect ($P > 0.29$) in situ parameters. Fraction B was greater ($P < 0.05$), and k_d was less ($P < 0.05$) from CDDG vs. LFDDG. Fraction B was greater ($P < 0.05$) from 5.5CHR and DDG heated for 5.5 h, and k_d was slowest ($P < 0.05$) from 5.5CHR followed by DDG heated for 5.5 h. Neither measure differed ($P > 0.05$) between unheated DDG and DDG heated for 3 h. Linear relationships were strongest ($R^2 > 0.77$) between acid-detergent insoluble N (ADIN, % of total N) and fraction A within DDG type. Linear and quadratic relationships between ADIN and other kinetic parameters were observed ($P < 0.05$), but those relationships were lower ($R^2 \leq 0.41$) than for fraction A, and were even less ($R^2 = 0.06$ to 0.32) when analyzed across types of DDG. Therefore, moderate heat damage had little impact on ruminal DM kinetic measurements, and use of ADIN analyses to assess ruminal DM disappearance characteristics should be viewed with caution, even within DDG processing method.

Key Words: distillers dried grain, in situ disappearance, heat damage

T68 Raw soybeans in a whole corn diet for feedlot heifers. A. J. Pordomingo, N. A. Juan, G. Volpi Lagreca*, and R. Beierbach, *National Institute Agricultural Research (INTA), Anguil, La Pampa, Argentina.*

Small-scale beef producers often use raw soybeans as protein source. Ruminants have the ability to denature in the rumen the antitrypsin factors present in soybeans, but levels are not conclusive and require further elucidation. Ninety-six 285-kg Angus heifers were distributed in 24 feeding pens. Pens were allocated to 8 diets, a factorial combination of processing (raw or roasted) and 4 levels (0, 10, 16 and 22%) of soybeans. Diets were whole corn based and included 5% alfalfa hay, a mineral premix and monensin. Soybean were ground before feeding. Sunflower meal and urea were used to adjust the crude protein content to 14%. Animals were fed in excess to voluntary intake (DMI) over a 90 d period. Processing by level interactions were detected ($P < 0.05$) for final weight, ADG and intake. Increased roasted soybean concentration in the diet tended to improve ADG and final weight (linear trend; P = 0.06) No treatment effects were detected ($P > 0.05$) in DMI for roasted soybeans. A similar response was observed for raw soybeans up to the 16% level in the diet. Treatments with 10 or 16% raw or roasted soybean resulted in similar ($P > 0.627$) ADG, final live weight and intake. On the contrary, the diet with 22% raw soybean resulted in the lowest ADG and feed intake ($P < 0.001$) compared with the other treatments, which elicited the lowest final live weight. This treatment had also the poorest feed efficiency ($P < 0.034$). Increased performance with increasing soybean content could be attributed to the increased oil content of the diet and the quality of protein of soybeans versus sunflower meal. The lower ADG for the 22% raw soybeans vs. the other treatments could be at least in part explained by the presence of antitrypsin factors in the soybeans.

Key Words: antitrypsin factors, feedlot heifers, raw soybeans

T69 Effect of supplemental protein amount and degradability on intake and digestion in *Bos indicus* and *Bos taurus* steers fed rice straw. K. K. Weldon*, J. C. McCann, J. E. Sawyer, and T. A. Wickersham, *Texas A&M University, College Station.*

We evaluated effects of amount and degradability of supplemental protein on utilization of low-quality forage in 5 Angus steers (*Bos taurus*, Bt, BW = 303 ± 10 kg) and 5 Brahman steers (*Bos indicus*, Bi, BW = 323 ± 28 kg). Steers fitted with ruminal and duodenal cannulas were used in concurrent 5 × 5 Latin squares. Treatments were arranged as a 2 × 2 factorial plus a control (CON; no supplementation). Isonitrogenous (27% CP) supplements were formulated to provide different proportions of ruminally degradable protein (DIP; L = 28% DIP or H = 72% DIP). Each type of supplement was fed to deliver 60 or 120 mg of N/kg BW. Steers had ad libitum access to rice straw (4.4% CP, 72.8% NDF). Experimental periods were 15 d; 9 d adaptation and 6 d sample collection. Forage OM intake (FOMI) was greater for Bt than Bi ($P = 0.05$). Supplementation increased FOMI in both Bt and Bi ($P < 0.05$); Bi FOMI was increased from 13.5 g/(kg BW·d) to 14.8 g/(kg BW·d) and Bt from 16.5 g/(kg BW·d) (CON) to 17.6 g/(kg BW·d). Neither protein source, amount, nor their interaction affected FOMI within Bi or Bt ($P > 0.20$). OM digestibility (OMD) was greater in Bi than Bt ($P < 0.01$). Supplementation did not affect OMD in Bt ($P = 0.53$; 54.4% vs. 53.6% for CON vs. supplement), but increased OMD for Bi ($P = 0.02$) from 53.4% (CON) to 57.0% (supplemented). There were no source, amount, or source × amount effects ($P > 0.37$) within Bi or Bt for OMD. Total digestible OM intake (TDOMI) was similar between breeds ($P = 0.12$), and increased ($P < 0.01$) with supplementation. A 14% increase in TDOMI was observed from CON for Bt ($P = 0.04$); TDOMI increased 29% from CON for Bi ($P = 0.05$). There were no source, amount, or source × amount effects ($P > 0.22$) within either breed for TDOMI. While Bt had significantly higher FOMI, an increase in OMD for Bi with supplementation resulted in similar overall TDOMI between breeds.

Key Words: digestion, intake, straw

T70 Effect of degradability and level of protein supplementation on ruminal fermentation in *Bos indicus* and *Bos taurus* steers fed rice straw. K. K. Weldon*, J. C. McCann, J. E. Sawyer, and T. A. Wickersham, *Texas A&M University, College Station.*

We evaluated the effects of amount and degradability of supplemental protein on ruminal fermentation of different breeds of cattle fed low quality forage. Five Angus steers (*Bos taurus,* Bt) and 5 Brahman steers (*Bos indicus*, Bi) with ruminal cannulas were used in concurrent 5 × 5 Latin squares. Treatments were arranged as a 2 × 2 factorial plus a control (CON; no supplementation). Isonitrogenous (27% CP) supplements were formulated to provide different proportions of ruminally degradable protein (DIP; L = 28% DIP or H = 72% DIP). Each type of supplement was fed to deliver 60 or 120 mg of N/kg BW. Steers had ad libitum access to rice straw (4.4% CP, 72.8% NDF). Experimental

periods were 15 d; 9 d adaptation, and 6 d sample collection. Total digestible OM intake (TDOMI) was similar between breeds ($P = 0.12$), and increased ($P < 0.01$) with supplementation. Ruminal ammonia (NH_3-N) concentrations increased with supplementation ($P < 0.01$) versus CON in both breeds. *Bos indicus* steers had greater NH_3-N concentrations than Bt ($P < 0.01$). Supplement amount × source affected NH_3-N in Bt and Bi ($P < 0.01$). In Bt, increasing from 60-L to 120-L had minimal effect; increasing from 60-H to 120-H increased NH_3-N 58%. In Bi, increasing from 60 to 120 increased NH_3-N by 45% for L, but only 26% for H. Plasma urea nitrogen (PUN) was greater for Bi than Bt ($P < 0.01$) for all treatments and at both 0 and 4 h after feeding. Supplementation tended ($P = 0.06$) to increase PUN versus CON in Bt, but not Bi ($P = 0.82$). Increased amount of supplement tended to increase PUN in Bi ($P = 0.08$), while both increased supplement amount and proportion of DIP increased PUN in Bt ($P < 0.01$). *Bos taurus* steers had numerically ($P = 0.19$) greater total volatile fatty acids (VFA) across treatments than Bi steers. Increased amount of supplementation to Bt increased total VFA ($P < 0.01$) from 74.1 m*M* (60) to 76.3 m*M* (120), but did not change VFA in Bi ($P = 0.32$). Overall, Bi had higher ruminal and plasma nitrogen concentration than Bt; these concentrations increased as amount and DIP proportion of supplements increased in both breeds.

Key Words: forage, ruminal, fermentation

T71 Effect of amount and degradability of protein supplements on nitrogen metabolism in *Bos indicus* and *Bos taurus* steers fed rice straw. K. K. Weldon*, J. C. McCann, J. E. Sawyer, and T. A. Wickersham, *Texas A&M University, College Station.*

We evaluated effects of amount and degradability of supplemental protein on nitrogen metabolism in 5 Angus steers (*Bos taurus*, Bt, BW = 303 ± 10 kg) and 5 Brahman steers (*Bos indicus*, Bi, BW = 323 ± 28 kg). Steers fitted with ruminal and duodenal cannulas were used in concurrent 5 × 5 Latin squares. Treatments were arranged as a 2 × 2 factorial plus a control (CON; no supplementation). Isonitrogenous (27% CP) supplements were formulated to provide different proportions of ruminally degradable protein (DIP; L = 28% DIP or H = 72% DIP). Each type of supplement was fed to deliver 60 or 120 mg of N/kg BW. Steers had ad libitum access to rice straw (4.4% CP, 72.8% NDF). Experimental periods were 15 d; 9 d adaptation, and 6 d sample collection. Total nitrogen (N) intake was greater for Bt than for Bi steers ($P = 0.06$). As expected, supplementation increased total N intake vs. CON ($P < 0.01$), and higher amounts of supplemental N increased total N intake within both breeds ($P < 0.01$). Higher DIP supplements increased total N intake for Bt ($P < 0.01$); no effect of supplemental N source was observed in Bi ($P = 0.19$). Fecal N was higher in Bt than Bi ($P < 0.01$). Supplementation increased ($P < 0.01$) fecal N vs. CON for both breeds. Increased amount of N supplementation elevated fecal N in Bi ($P = 0.02$), but not Bt ($P = 0.13$). Urinary N tended to be higher for Bi than Bt ($P = 0.10$). Supplementation increased ($P < 0.05$) urinary N for both breeds. Increasing N amount increased urinary N excretion in Bi ($P = 0.02$), and Bt ($P = 0.06$). Retained N was greater for Bt over Bi ($P = 0.07$). In both breeds, N retention increased with supplementation vs. CON ($P < 0.01$). More N supplement increased N retained ($P < 0.01$). Increased supplementation raised N excreted and N retained for both breeds; fecal N was greater in Bt, while urinary N was greater in Bi. Total N intake tended to be greater in Bt, while total excretion was similar for Bt and Bi, resulting in greater amount of N retained by Bt.

Key Words: forage, nitrogen, balance

T72 Effect of different substitute levels of ground corn by coarsely ground wheat on ruminal fermentation, milk yield and composition in dairy cows. Y. Guo*, Y. Zou, X. Xu, Z. Yang, S. Li, and Z. Cao, *State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University, Beijing, China.*

Eight multiparous Holstein cows (569 ± 47 kg of BW; 84 ± 17 DIM) were used to evaluate the effects of different levels of coarsely ground wheat (CGW, 3-mm screen, geometric mean particle sizes: 1,139 μm) as replacements for ground corn (GC, 3.5-mm screen, geometric mean particle sizes: 666 μm) in diets on ruminal fermentation, milk yield and composition in dairy cows. The cows were settled in a replicated 4 × 4 Latin square design with 3-wk treatment periods; four cows in one of the replicates were fitted with rumen cannulas. The four diets contained 0, 9.6, 19.2, and 28.8% CGW and 27.9, 19.2, 9.6, and 0% GC (DM basis), respectively. The cows were fed a TMR, with a 47:53 forage to concentrate ratio, where forage was 27% corn silage, 14% alfalfa hay, and 6% Chinese wild rye. The cows were fed and milked twice daily. Substituting CGW for GC had no effect on daily mean ruminal pH, but tended to reduce minimum ruminal pH and increase pH range when the cows were fed the 28.8% CGW diets. Increasing the dietary concentration of CGW resulted in a linear increase in ruminal propionate and ruminal NH_3-N concentration, while ruminal acetate: propionate tended to decrease in cows fed the 28.8% CGW diets. Daily DM intake averaged 19.7kg and tended to increase quadratically. Milk production was not affected by diets; however, percentage and yield of milk fat, 3.5%FCM, and ECM decreased linearly, and milk urea nitrogen increased linearly, when the level of CGW was increased. Dietary treatments had no effect on feed efficiency (milk/DMI), while 3.5%FCM/DMI decreased linearly with increasing levels of CGW. The data indicate that CGW is a suitable substitute for GC in diets of dairy cows and that it may be included up to a level of 19.2% of dry matter without adverse effects on ruminal fermentation, feed intake, milk yield and composition, if the cows are fed fiber-sufficient diets and the levels are adjusted gradually. However, high inclusion levels of CGW, such as in the case of 28.8% CGW diets, could increase the risk of subacute ruminal acidosis, and milk-fat depression.

Key Words: wheat, dairy cow, rumen fermentation

T73 Effects of feeding a corn straw or mixed forage diet to lactating cows on rumen fermentation parameters using a wireless data logger. C. F. Qin[1,2], D. P. Bu[1], J. Q. Wang*[1], P. Sun[1], P. H. Zhang[2], X. W. Zhao[1], J. N. Li[1], and P. Zhang[1], *[1]State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China, [2]Hunan Provincial Key Laboratory for Genetic Improvement of Domestic Animal, College of Animal Science and Technology, Hunan Agricultural University, Changsha, Hunan, China.*

The objectives of this study were to evaluate the effects of feeding two different diets on ruminal pH, temperature and oxidation reduction potential (ORP) and their rhythms for 24 h through real-time monitoring. Eight primiparous lactating Holstein cows fitted with rumen cannula were blocked by milk yield and body weight and then randomly assigned to high forage diet (HF; forage:concentrate = 60:40) with Chinese wildrye, alfalfa hay and corn silage as the forage source or low forage diet (LF, forage:concentrate = 40:60) with corn straw as the forage source. Ruminal pH, temperature and ORP were real-time monitored by a wireless data logger during a trial period of 14 d. Data were analyzed using the PROC MIXED procedure of SAS. Cows fed LF diet had higher ruminal pH compared to those fed HF diet (6.32 and 6.12; $P < 0.01$),

whereas temperature (38.57 and 38.86 °C; $P < 0.01$) and ORP (−384.25 and −361.88 mV; $P < 0.01$) were lower in LF group. The pH values were higher in LF group compared to those fed HF diet at the minutes when morning (6.33 and 6.17; $P < 0.05$) and evening (6.57 and 6.42; $P < 0.05$) ingestion began and at the minutes when night rumination (6.22 and 6.02; $P < 0.01$) proceeded and when morning (6.30 and 5.99; $P < 0.01$) and evening (6.29 and 6.02; $P < 0.01$) ingestion finished. Cows fed LF diet had less minutes for ruminal pH < 6.0 (161.55 and 449.74 min/d; $P < 0.05$) and pH < 5.8 (79.45 and 230.50 min/d; $P < 0.05$) compared to those fed HF diet, and ruminal pH < 5.6 (31.86 and 79.53 min/d; $P = 0.07$) tended to be less in LF group. However, minutes for pH < 5.2 were not affected by diets. Ruminal pH and ORP rose to their peaks when feeding began but reduced to the minimums when feeding finished. Ruminal temperature reduced to minimum after feeding at noon. The results indicated that rumen fermentation parameters were affected by forage-to-concentrate ratio in the diets, and the wireless data logger system can accurately and precisely measure rumen fermentation parameters.

Key Words: forage pattern, wireless data logger, rumen fermentation parameter

T74 Effect of feeding a corn straw or mixed forage diet on mixed-rumen bacterial fatty acid profiles in lactating cows. C. F. Qin[1,2], J. Q. Wang[1], D. P. Bu*[1], P. Sun[1], P. H. Zhang[2], M. Yi[1], S. K. Jiang[1], and J. N. Li[1], *[1]State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China, [2]Hunan Provincial Key Laboratory for Genetic Improvement of Domestic Animal, College of Animal Science and Technology, Hunan Agricultural University, Changsha, Hunan, China.*

Rumen microbial matter is a vital source of nutrients for the host animal and it may be affected by diet systems. Our objective was to determine the effect of different forage sources on fatty acid (FA) composition of mixed-rumen bacteria. Twelve primiparous, lactating and ruminally fistulated Holstein cows were used in this study. Cows were randomly assigned to high forage diet (MF, forage:concentrate = 60:40) with Chinese wildrye, alfalfa hay and corn silage as the forage source or low forage diet (CS, forage : concentrate = 40 : 60) with corn straw as the forage source. This study lasted for 9 weeks with 2-week of preliminary period and 7-week of trial period. Rumen samples were collected 4 times daily in the last 3 excessive days to insure each sample was obtained with 2-hour intervals inter. All samples were composited for each cow and kept at -20°C for further analysis. Data were analyzed using the PROC MIXED procedure of SAS 9.1. Compositions of C14:1 (5.53 and 6.09%), C15:0 (3.01 and 3.38%), *trans*-9 C18:1 (0.23 and 0.26%), *trans*-11 C18:1 (1.42 and 1.50%), *cis*-9, *cis*-12 C18:2 (2.66 and 2.85%), *cis*-9, *tran*-11 CLA (1.33 and 1.18%), *trans*-10, *cis*-12 C18:2 (0.33 and 0.37%), C20:0 (0.32 and 0.31%), mono unsaturated FA (11.93 and 11.80%), poly unsaturated FA (4.75 and 4.75%), saturated FA (83.32 and 83.44%) and unsaturated FA (16.68 and16.57%) were not affected by forage sources ($P > 0.05$). Proportions of C18:0 (49.17 and 42.92%; $P < 0.05$), *cis*-9 C18:1 (4.50 and 3.66%; $P < 0.01$), > C16:0 (61.61 and 55.02%; $P < 0.01$) and long chain FA (16.68 and16.57%; $P < 0.01$) were increased in cows fed with CS. Percentages of C16:0 (25.23 and 30.28%; $P < 0.01$), C18:3 (0.20 and 0.36%; $P < 0.01$) and medium chain FA (33.22 and 44.84%; $P < 0.01$) were lower in CS group. The CS diet tended to have a negative effect on proportion of C12:0 (0.80 and 0.99%; $P = 0.09$), C14:0 (3.33 and 3.97%; $P = 0.08$) and C22:0 (0.26 and 0.39%; $P = 0.09$). In conclusion, different forage patterns influenced mixed-rumen bacterial FA synthesis and caused the alteration of rumen microbial FA profiles in cows.

Key Words: forage source, lactating cow, mixed-rumen bacterial fatty acid

T75 Effect of fed a corn straw or mixed forage diet on fatty acid extraction in mammary gland of lactation dairy cows. H. Y. Chen[1,2], D. P. Bu*[1], F. D. Li[2], X. M. Nan[1], X. W. Zhao[2], and H. Hu[1], *[1]Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China, [2]Gansu Agricultural University, Lanzhou, Gansu, China.*

Changing the fatty acids (FA) profile of plasma might affect FA metabolism in the mammary gland of dairy cows. This study was conducted to evaluate the effect of feed type on the FA profile of plasma, blood parameters and fatty acids extraction in mammary gland of dairy cows in lactation. Twenty lactating Holstein cows (BW = 558 ± 40 kg, DIM at the beginning of the experiment = 83 ± 10 d, n = 10) were randomly assigned to high forage diet (MF, forage : concentrate = 60 : 40) with Chinese wildrye, alfalfa hay and corn silage as the forage source or low forage diet (CS, forage : concentrate = 40 : 60) with corn straw as the forage source. The experiment lasted for 49 d with a 14 d adaptation period for cows to adjust to the treatment diets. On the 48 d and 49 d of the experiment, blood samples were taken from the coccygeal artery (representing mammary arterial supply) and milk vein at 3 hr after morning feeding. Extraction (%) of each FA was assessed via arterial-rectificative venous concentration (AC-RVC) differences. Data were analyzed using the MIXED models of SAS, with treatment as fixed effect. The results showed that MF increased the contents of C14 (0.71 and 0.69, $P < 0.05$), C16:1 (0.72 and 0.55, $P < 0.05$) and PUFA (68.88 and 67.81, $P < 0.05$) in the blood, while the content of c9c12C18:2 in MF was lower than the CS (59.29 and 60.85, $P < 0.01$), A nonsignificant increase of other FA was observed in our trial. Compared to the CS, MF did not affect most of the fatty acids extraction in mammary gland ($P > 0.05$), except C18:3 (24.26 and 42.10, $P < 0.05$). The MF increased content of NEFA in plasma (0.92 and 0.85, $P < 0.05$) and tended to increase the content of TC and LDL. These results indicated that different diet can changed the plasma fatty acid profile, which can cause the fatty acid extraction rate to change. Moreover, the results suggest that when FA taken up from arterial plasma by mammary gland tissues, there is a relationship between them. Changing the type of diet affects FA metabolism in the mammary gland of dairy cows.

Key Words: blood parameter, fatty acid extraction rate, feed type

T76 Effect of replacing timothy silage with alfalfa silage in dairy cow diets on enteric methane production. F. Hassanat*[1], R. Gervais[2], P. Y. Chouinard[2], H. Petit[1], D. Massé[1], and C. Benchaar[1], *[1]Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Sherbrooke, QC, Canada, [2]Département des Sciences Animales, Université Laval, Québec, QC, Canada.*

The objective of this study was to determine the impact of replacing timothy silage with alfalfa silage (AS) in dairy cow diets on enteric CH_4 emissions. Nine lactating, multiparous Holstein cows (DIM = 92 ± 19; BW = 696 ± 71 kg; milk yield 46.2 ± 4.3 kg) used in a replicated 3×3 Latin square (32-d periods, 14-d adaptation) were fed (ad libitum) a TMR (60:40, forage:concentrate ratio) with the forage portion being either timothy silage (0% AS), alfalfa silage (100% AS) or a 50:50 mixture (50% AS). Diets were formulated to contain 16.5% CP and 1.64 Mcal/kg NE_L. Production of CH_4 was determined (3 consecutive days) using respiration chambers. Digestibility and milk performance were determined over 6 consecutive days. Linear and quadratic contrasts (MIXED Procedure; SAS) were used to determine the effects of increasing AS proportions on response variables. Significance was declared at $P \leq 0.05$ and tendencies at $0.05 \leq P \leq 0.10$. Dry matter (DM) intake (22.5, 23.7, and 24.6 kg/d for 0, 50 and 100% AS, respectively) increased linearly while DM digestibility did

not change as the proportion of AS increased in the diet. Yields of milk, fat-corrected milk (FCM) and energy-corrected milk (ECM) were not affected by increasing dietary AS proportions. Daily CH_4 emission tended ($P = 0.10$) to increase with increasing proportions of AS in the diet (476, 483 and 491 g/d for 0, 50 and 100% AS, respectively). Methane production adjusted for DM (average 19.8 g/kg) or gross energy intake (average 5.83%) was not affected by increasing AS inclusion in the diet. When expressed on FCM or ECM yield bases, CH_4 production increased linearly ($P = 0.03$) with increasing AS proportions in the diet. In conclusion, under the experimental conditions of this study, CH_4 energy losses (% gross energy intake) were not affected by replacing timothy silage with alfalfa silage in dairy cow diets.

Key Words: alfalfa silage, timothy silage, methane

T77 The optimal ratio of canola meal and dried distillers grain proteins in high producing Holstein cow diets. N. Swanepoel*[1,2], P. H. Robinson[1], and L. J. Erasmus[2], [1]*Department of Animal Science, University of California, Davis,* [2]*Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria, South Africa.*

Limited data is available on dairy cow performance when feeding canola meal (CM) and distillers dried grains with solubles (DDGS) as main supplemental crude protein (CP) sources. Our objective was to determine the optimal ratio of CM to DDGS CP in a contemporary California dairy ration by feeding combinations of CM and high protein (low oil) DDG (HPDDG) to high producing dairy cows. The design used 4 pens of 320 high-producing cows/pen in a 4 × 4 Latin square crossover with 28-d periods. Treatments varied in the amount of CM and HPDDG added on a dry matter (DM) basis: (1) 0 CM, 200 g/kg HPDDG, (2) 65 CM, 135 g/kg HPDDG, (3) 135 CM, 65 g/kg HPDDG, (4) 200 CM, 0 g/kg HPDDG. DM intake was not affected (avg: 24.4 kg/d) by the CM/HPDDG ratio. Milk (44.9, 47.4, 47.9, 47.4 kg/d for 0, 65, 135, 200 g/kg CM respectively; $P < 0.01$) and true protein yield (avg: 1.37 kg/d) increased quadratically with the higher CM/HPDDG ratio, peaking at 135 g/kg CM. Milk fat yield (avg: 1.61 kg/d) and true protein (TP) % (avg: 2.93) responded quadratically ($P < 0.01$), peaking at ~120 g/kg CM. Milk fat % (avg: 3.44) had a linear decrease ($P < 0.01$) with lowest values at 200 g/kg CM. Body condition score (BCS) change responded quadratically (0.001, 0.034, 0.08, 0.029 units/28 d for 0, 65, 135, 200 g/kg CM respectively; $P < 0.01$), with highest BCS gain at ~120 g/kg CM. Results suggest the optimum level was 120 to 135 g/kg of supplemental protein from CM. The urine purine derivative to creatinine index increased linearly ($P < 0.01$) with higher CM level, suggesting microbial protein production (MCP) was limited at 0 g/kg CM and progressively stimulated by higher feeding levels of CM. Plasma amino acid (AA) levels suggest a reduction in lysine from dietary protein, with the decreased MCP production, resulted in substantial reduction in lysine available to support milk production, limiting performance in higher HPDDG rations. The only essential plasma AA to linearly decrease ($P < 0.01$) with higher CM were Phe, Leu and Met. The additional quadratic response ($P < 0.01$) of Met and Phe at the 200 g/kg CM treatment suggests that Phe and/or Met limited production in the highest CM ration.

Key Words: urine purines, amino acids

T78 Intake, milk yield, and blood acid-base balance of cows in response to marine algae meal. N. M. Lopes[1], R. A. N. Pereira[2], and M. N. Pereira*[1], [1]*Universidade Federal de Lavras, Lavras, MG, Brazil,* [2]*Empresa de Pesquisa Agropecuaria de Minas Gerais, Lavras, MG, Brazil.*

The skeleton of the marine algae *Lithothamnium calcareum*, a source of calcium carbonate, has been fed to dairy cows as an alkalizer, despite the lack of strong evidence for its effectiveness and for the mode of action. This experiment evaluated the performance, diet digestibility, and venous acid-base balance of cows supplemented with algae meal (Algarea, Brazil) or sodium bicarbonate. Twenty Holsteins (248 DIM) received treatments in 4 × 4, 21-d period, Latin squares. Treatments were: Control (C), 1% of DM of algae meal (A), 0.5% algae meal+0.5% sodium bicarbonate (AB), or 1% sodium bicarbonate (B). Diets had (% of DM): 52.7 corn silage, 2.2 Tifton hay, 21.7 soybean meal, and 20 high moisture corn. On days 19 to 21, acidosis was induced by abrupt replacement of 12.4% DM units of corn silage by high moisture corn. Jugular vein gasometry was performed 9.5h post-feeding on day 19. Pre-planned contrasts were: C vs. A, A vs. B, and AB vs. (A+B). Total tract digestibility, determined by total collection of feces, was not affected by treatments ($P > 0.64$). Milk yield was (kg/d): 21.5 for C, 20.6 for A, 21.5 for AB, and 22.3 for B, and DMI was 18.1, 17.5, 18.0, and 18.8, respectively. There was a trend for decreased DMI when algae meal was added to the control diet ($P = 0.06$), and a linear decrease in DMI ($P < 0.01$) and milk yield ($P = 0.10$) when it replaced bicarbonate. During acidosis induction, the response across treatments in DMI and milk yield followed that same pattern. Satiety, measured as the duration of the first meal, was shortest in C, while the proportion of daily DMI between 7AM and 12AM was smallest in A. Across treatments, the response in satiety paralleled the response in blood gasometry. Treatment A had the strongest measures of blood hypoxia, although a similar, but weaker response, was also elicited by bicarbonate. The net Ca^{++} and Na^{++} absorption apparently induced hypoventilation for the maintenance of blood pH at 7.41. Algae meal was a potent manipulator of acid-base balance, but at 1% of diet DM it did not improve performance or digestibility of cows in late lactation.

Key Words: blood acid-base balance, algae meal, *Lithothamnium calcareum*

T80 Starch digestion variation between in vitro and in situ digestion techniques. C. R. Heuer*[1,2], J. P. Goeser[1], and R. D. Shaver[2], [1]*Rock River Laboratory Inc., Watertown, WI,* [2]*University of Wisconsin, Madison, Madison.*

Starch digestion (starchd) of grains and forages is important to dairy cattle nutritionists. By being able to accurately predict the starchd they are able to maximize milk production and milk fat. Our objective was to determine if different starchd techniques, rumen in vitro (IV) and in situ (IS), generate comparable results and are repeatable across weeks. Corn silage (n = 2), snaplage (n = 2), TMR (n = 2), high moisture corn (n = 2), and dry corn (n = 2) were dried and ground (4 mm). For the IV technique samples were weighed (0.5 g) into 125-mL flask, rumen fluid was collected from 2 lactating dairy cows and went through a standardization procedure. Samples were analyzed in triplicate for 3 and 7 h time points. IS samples were weighed (6 g per bag) in triplicate to be placed in 3 lactating dairy cows consuming a commercial diet for 3 and 7h. Residue bags were rinsed until effluent was clear. Bags were dried and weighed to determine the dry matter digestion. Residue samples were composited and ground to 1mm. Starch content was then determined by the use of an YSI 2700 to determine glucose (g/L). Starch was calculated as 100 × [(volume/weight) × (glucose) × (0.9)/1000]. Starchd was calculated as 100 × [($Starch_{0h}$ − $Starch_{residue}$) / ($Starch_{0h}$)]. Each of these techniques was evaluated 2 weeks to assess repeatability. We analyzed the data set using SAS 9.3 and linear models. Both starchd and technique modeled as response variables, with fixed effects of week and hour in both

and technique in the starchd model and ID as a random effect in both. When comparing techniques, IS was used as the response variable. Means were compared by Tukey's test. IV results yielded greater estimates than IS results (69.2% vs. 56.4%, $P < 0.04$). When comparing the variation IV samples averaged a numerically higher standard deviation than IS samples (7.80 vs. 2.01). The IV results tended to be related to IS results ($P < 0.07$). Results suggest that the IV technique of determining starchd causes elevated digestion levels compared to IS starchd. The tendency in relationship between techniques suggest IV may be an acceptable predictor of IS starchd.

Key Words: starch digestion

T81 Geometric mean diameter fails to reflect diversity in size of particles in processed maize grain. L. J. Nuzback, W. J. Seglar, M. Laubach, T. Hageman, and F. N. Owens*, *DuPont Pioneer, Johnston, IA.*

For feeding livestock, most maize grain is processed to reduce particle size and increase the surface area exposed for digestion. This in turn increases rate of ruminal digestion and total tract digestion of maize starch by lactating cows. Geometric mean diameter (GMD) of feed particles is appraised through measuring the mass retained on stacked sieves of different pore sizes. For forages, 5 sieves are used but for cereal grains a stack of 14 screens commonly are used and samples typically are dried prior to screening. We tested whether fewer screens might be used and the impacts of drying and processing method on GMD. Using dry processed and high moisture maize grain (12 and 7 samples) gathered from various Midwest dairies, GMD by the 14 screen system was determined at a commercial lab. These same samples were appraised through a simpler 4 screen system (Tyler 4, 8, 16 and 30 sieves). With the 4 screen system, GMD was determined with samples that differed in moisture content. For dry (rolled or hammer milled) maize grain samples, GMD was determined as received (85 to 88% DM). For high moisture rolled maize (HMC; 70 to 77% DM), GMD was determined either as received or after being air dried at least 48 hours or being oven dried at 50 C for 24 hours. Correlations of GMD determined at a commercial lab with GMD determined with 4 screens for the 5 sets of samples were high, being 0.99 (dry maize), 0.91 (as received HMC), 0.97 (air dried HMC), and 0.99 (oven dried HMC) with RMSE being 95, 137, 220, and 102 microns, respectively. For field use, GMD determined with the shorter stack system appears suitable. Although the GMD for the rolled and hammer milled dry grain samples did not differ, the standard error of the GMD was greater for hammer milled samples reflecting a wider distribution in particle sizes. GMD values alone fail to reflect this particle size diversity, a factor of interest nutritionally because very small particles may induce acidosis while larger particles likely are digested less extensively.

Key Words: grain, particle size, processing

T82 Performance and digestion of dairy cows in response to exogenous amylase. A. S. R. Andreazzi[2], N. N. Morais Junior[1], R. F. Lima[1], A. C. S. Melo[1], R. B. Reis[2], R. A. N. Pereira[3], and M. N. Pereira*[1], *[1]Universidade Federal de Lavras, Lavras, MG, Brazil, [2]Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil, [3]Empresa de Pesquisa Agropecuária de Minas Gerais, Lavras, MG, Brazil.*

Exogenous amylase supplementation of dairy diets may increase the nutritive value of corn, especially when floury endosperm hybrids are not available. Twenty-eight Holsteins (171 ± 80 DIM at day 1) were paired blocked and assigned to a treatment for 70 days, after a two-week standardization period. Treatments were: Control or Amylase (Ronozyme RumiStar, DSM Nutritional Products). The enzyme was mixed to ground corn and added to a mixer to achieve 0.5g of enzyme per kg of TMR DM (300 KNU/kg of DM). Cows were individually fed in tie stalls. The diet contained (% of DM): 32.1% starch, 39.4% corn silage, 11.2% re-hydrated and ensiled mature corn, and 11.7% finely ground mature corn. Corn hybrids were semi-dent or flint type. Milk yield and DMI were recorded daily, milk solids weekly, and BW and BCS at 14-day intervals. On week 10, total tract digestibility and allantoin excretion were determined by total collection of feces and urine, PUN was measured at 0, 1, 2, 3, 6, 9, 12, and 18h post-feeding, and rumen pH and plasma glucose at 12h post-feeding. Eating and rumination pattern was visually evaluated for a 24h period. Data was analyzed with Mixed of SAS as a covariate adjusted randomized block design with repeated measures over time, except when data was obtained once along the experiment. Amylase increased milk yield (33.0 vs. 32.3kg/d, $P = 0.02$) and reduced DMI (19.7 vs. 20.7kg/d, $P < 0.01$), increasing feed efficiency ($P < 0.01$). Body weight and condition score did not differ ($P > 0.44$). Milk lactose production was increased by Amylase ($P = 0.01$) and there was a trend for increased plasma glucose content ($P = 0.07$). Amylase decreased PUN (13.6 vs. 14.7, $P = 0.05$), and induced numerical increase in the relative rumen microbial yield and reduced the duration of the first daily meal and rumen pH, all suggestive of increased ruminal OM fermentation. Total tract digestibility of DM, OM, NDF, and starch were not responsive to the enzyme ($P > 0.41$). Exogenous amylase supplementation increased feed efficiency of dairy cows. The decrease in PUN suggests that the enzyme increased ruminal starch degradation, without affecting total tract nutrient digestibility.

Key Words: amylase, starch, corn

T83 Effects of single or pulse dose of sugar on in vitro DMd and NDFd digestibility of corn silage. D. N. Lobão da Silva*[1], R. S. Younker[2], and N. B. Litherland[1], *[1]University of Minnesota, Saint Paul, [2]Milk Specialties, Eden Prairie, MN.*

DaisyII incubator, (Ankom Technology, Fairport, NY) rotating jar-in vitro system is an inexpensive technique to measure feedstuff digestibility and has potential to serve as a screening tool to evaluate ruminant feeds and feed additives; however, in vitro systems may better mimic natural feeding conditions through pulse dosing of test compounds. The objectives of this study were to evaluate the usage of rotating jar system using one or three pulse doses, and determine the effects of supplementing in vitro rumen culture with commercially available sugar supplement, on 30 h %IVDMd and %IVNDFd of corn silage (CS) with 38.0% NDF, 8.1%CP and 31.6% starch. In the first experiment, 1.3 g of RUMIN8 (R) per 400ml of rumen fluid using a single dose (R1) or three pulses doses (R3) and no sugar supplementation (C1) were evaluated. In the second experiment, 2.1g of 6 types of sugars (R), lactose (L), sucrose (S), molasses (M), whey permeate (W) and corn syrup solids (CSS) were evaluated. Amounts of 1.3g and 2.1g of sugar were calculated to represent in vivo diet inclusions of 0.7% and 1.0% of diet DM /cow/day. In both experiments, replicate samples were placed in Dacron bags and incubated in two Daisy II incubators. Data was analyzed using the MIXED procedure of SAS as completely randomized design. In the first experiment, IVDMD was similar ($P = 0.37$) among treatments and averaged 78.6, 79.5 and 77.76 ± 0.8% and IVNFDd was similar ($P = 0.45$) 39.4, 42.3, and 37.6 ± 2.7% for C1, R1, and R3, respectively. In the first experiment, results suggest that increased dosing frequency of Rumin8 did not increase %IVDMd or %IVNFDd of CS compared to C1. In the second experiment, L and S improved IVDMd ($P < 0.01$) by 4

and 3.5%, respectively compared with C, R, M, W and CSS (75.1, 75.0, 74.8, 76.8, 75.0 ± 0.7%). Also, L and S increased ($P < 0.01$) IVNDFd by 12.7 and 10.8% respectively compared with C, R, M, W and CSS (32.5, 32.1, 31.4, 34.3, 31.4 ± 2.0%). In vitro incubations of CS with sugar supplementation suggested that L and S greatly improve digestibility of DM and NFD compared with C, R, M, W and CSS.

Key Words: fiber digestibility, sugar, corn silage

T84 Feeding of a sugar alcohol during summer months to Holstein cows during transition phase to support subsequent lactation performance. J. A. Davidson*, C. M. Klein, and B. L. Miller, *Purina Animal Nutrition Center, Gray Summit, MO.*

The objective was to determine if a sugar alcohol (Rally) improves milk and component yield of transition cows during the summer months. Holstein cows (44 multiparous and 18 primiparous) were blocked by calving date (June 22 to Sept 4, 2010 and June 20 to Aug 28, 2011) and randomly assigned to dietary treatments of control (C) or sugar alcohol (R) from d -28 to 30 relative to parturition. Individual cows were fed with Calan doors once a day, ad libitum, and diets were formulated to be iso-nitrogenous and iso-caloric. On d 30 postpartum, all cows were fed the same diet. Within the free-stall housing, cows were provided with thermostat-controlled fan cooling only. During the treatment period of d -28 to 30 d, cows experienced environmental temperature humidity index readings greater than 68 for 91.1% of the time. During the prepartum, dry matter intake (DMI) and body weight (BW) were not different. From 0 to 30 DIM, milk yield was greater for R fed cows compared with C (32.5 vs 30.2 kg/d, SE = 0.78, $P < 0.05$). Cows fed R had greater DMI of 1.26 kg relative to C fed (SE = 0.39, $P < 0.05$). Cows fed R had lower milk fat (%) during the first 30 d postpartum than C fed cows with the greatest difference occurring during the first week postpartum ($P < 0.01$). However, component yields were not significantly different. Multiparous cows had greater improvement in milk yield compared with primiparous cows. For 0 to 21 DIM, multiparous cows fed R had lower plasma non-esterified fatty acid concentrations than C fed cows (0.79 vs. 0.93 meq/L, SE = 0.05, $P = 0.07$). Additionally, plasma β-hydroxybutyrate concentrations were also lower (7.6 vs 10.5 mg/dL, SE = 0.61, $P < 0.01$). From d 0 to 60 postpartum, multiparous cows fed R during transition phase produced an additional 2.9 kg/d of milk and consumed an additional 1.6 kg/d of DMI compared with C. When feeding R, cows had lower circulating metabolites and milk fat (%) immediately postpartum may be indicative of changes of metabolism by peripheral tissues. Feeding R during warm seasons improved transition cow milk yield and DMI which may lead to better performance for the entire lactation during the cooler seasons.

Key Words: Rally, cows, lactation

T85 Relationships between circulating plasma amino acid concentrations and milk protein production in lactating dairy cows. R. A. Patton*[1], H. Lapierre[2], and C. Parys[3], *[1]Nittany Dairy Nutrition Inc., Mifflinburg, PA, [2]Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada, Sherbrooke, Quebec, Canada, [3]Evonik Industries AG, Hanau, Germany.*

Better understanding of the relation between amino acid (AA) supply and milk protein output may increase protein efficiency. Direct measurements of the digestive AA flow require invasive, expensive experiments. Plasma AA concentrations ([AA]) might be used as surrogates to investigate relationships between AA supply, requirement and milk protein output. A database was developed after a literature search to identify studies in lactating dairy cows reporting circulating plasma [AA], production data, and adequately described rations. A total of 105 studies representing 420 diets were used. Using the AminoCow ration program, duodenal AA flow and metabolizable protein (MP) were estimated. Relationships were evaluated using multi-factorial regression (JMP 10 version of SAS) including study as a random factor. Plasma [Arg] was greater for first parity compared with greater parities. Plasma [AA] was most significantly related to predicted duodenal AA flow: Arg, Ile, Lys, Thr, and Val were related quadratically whereas His, Met and Phe were related linearly to their respective duodenal flow. Highest correlation between duodenal and plasma [AA] was for Arg ($R^2 = 0.90$) and the lowest was for Met ($R^2 = 0.69$). Associations of [AA] with milk protein % (MlkP%) or milk protein yield (MlkPY) were similar whether AA were expressed as plasma [AA], AA duodenal flow (duo: g/d or % of MP).

MlkP% (mean: 3.15%)

= 2.77 + (0.083 × Metduo, %MP) + (0.032 × Lysduo, %MP); RMSE = 0.136; $R^2 = 0.81$

= 3.3437 + (0.0036 × Metduo, g/d) – (0.0028 × Thrduo, g/d); RMSE = 0.139; $R^2 = 0.81$

= 3.17 + (0.0016 × [Lys], μ*M*) – (0.0028 × [Phe], μ*M*); RMSE = 0.140; $R^2 = 0.81$

MlkPY (mean = 0.908 kg/d)

= 0.942 – (0.071 × Thrduo, %MP) + (0.050 × Hisduo, %MP) + (0.029 × Argduo, %MP) + (0.015 × Lysduo, %MP); RMSE = 0.050; $R^2 = 0.94$

= 0.5270 + (0.0018 × Thrduo, g/d) + (0.0007 × Lysduo, g/d); RMSE = 0.050; $R^2 = 0.95$

= 0.8072 + (0.00081 × [Lys], μ*M*) + (0.00016 × [Val], μ*M*); RMSE = 0.050; $R^2 = 0.94$.

Relationships were stronger for MlkPY than for MlkP%. These preliminary results suggest that circulating [AA] could be useful in adequately modeling AA requirements.

Key Words: amino acid, concentration, milk protein yield

T86 Hepatic gene expression and post-ruminal protein supply in lactating dairy cattle. H. Tucker*[1], M. Hanigan[2], and S. Donkin[1], *[1]Purdue University, West Lafayette, IN, [2]Virginia Polytechnic Institute and State University, Blacksburg.*

Metabolizable protein supply limits milk production in dairy cows. Amino acid (AA) availability to extrahepatic tissues, including mammary tissue, is a combined function of the quantity of metabolizable protein supplied and hepatic AA catabolism. The latter is determined by nutrient supply and physiological status. This experiment evaluated the effect of post-ruminal protein infusion on key genes for ureagenesis and amino acid catabolism. Six multiparous early-lactation Holstein cows were utilized in a replicated cross-over design. Cows were fed a TMR (14.5% CP) and given postruminal infusion of either 0 or 600 g/d of milk protein isolate. Periods were 21 d in length consisting of a 14-d washout phase followed by 7 d of protein infusion. On the last day of each infusion, liver samples were collected for mRNA analysis and explant culture, milk samples were collected for mRNA analysis and blood samples were collected for plasma metabolite analysis. Postruminal infusion of protein increased ($P < 0.05$) milk yield by 10.5%, milk fat yield by 12.5%, milk protein yield by 20%, milk lactose yield by 11%, and total solids by 15.5%. Postruminal infusion of protein increased ($P < 0.05$) milk urea N by 23.5%, blood urea N by 18.6%, and abundance

of ornithine transcarbamoylase mRNA by 52.8%. Postruminal infusion of protein did not alter ($P > 0.1$) abundance of argininosuccinate synthase, aminoadipate semialdehyde synthase, cysteine sulfinic acid decarboxylase, cystathionase, and associated milk protein synthesis mRNA. Postruminal protein infusion increased ($P < 0.05$) metabolism of L-[U ^{14}C] Lys to CO_2 by 127% (0.14 vs. 0.063 ± 0.05 nmol substrate converted to CO_2 · mg tissue^{-1} · h^{-1}) while metabolism of L-[U ^{14}C] Ala to CO_2 tended ($P < 0.1$) to be greater (0.52 vs. 0.37 ± 0.06 nmol product · mg tissue^{-1} · h^{-1}) compared with control. These data indicate increased ureagenesis matched by up-regulation of non-essential AA catabolism and a disproportional increase in Lys oxidation in response to increased postruminal protein infusion in lactating dairy cows.

Key Words: protein, gene expression, postruminal protein infusion

T87 Kelp meal (*Ascophyllum nodosum*) did not improve milk yield but increased milk iodine in early lactation organic Jersey cows during the winter season. N. T. Antaya*, A. F. Brito, N. L. Whitehouse, N. E. Guindon, and S. Werner, *University of New Hampshire, Durham.*

Kelp meal (KM) made from dry and ground *Ascophyllum nodosum*, a brown algae, is often fed as a mineral supplement on northeastern organic dairy farms. Sixteen (4 primiparous and 12 multiparous) organic Jersey cows with initial BW of 444 kg (SD ± 46) and DIM of 49 (SD ± 30), were blocked by DIM and parity and randomly assigned to 4 replicated 4 × 4 Latin squares to investigate the effects of incremental dietary levels of KM (0, 57, 113 or 170 g, as fed) on milk yield and composition. Periods lasted 21 d with 14 d for diet adaptation and 7 d for data and samples collection. Data were analyzed using the MIXED procedure of SAS with linear and quadratic contrasts. Cows were fed a TMR containing: (DM basis) 64% alfalfa/grass baleage and 36% of a cornmeal/barley/soybean meal-based concentrate. TMR averaged: 16% CP, 49% NDF, and 34% ADF. To ensure complete consumption, KM was mixed with 227 g concentrate and fed after the a.m. milking, cows on the control treatment (0 g KM) received concentrate only. Feeding incremental levels of KM to early-lactation cows did not affect milk yield, DMI, or concentrations and yields of milk components. However, concentration of milk iodine increased lineally in response to incremental levels of KM, possibly explained by high content of iodine (820 mg/kg DM basis) in this brown algae supplement. Kelp meal did not improve animal performance or milk composition but increased milk iodine to levels that may be of concern to human health, particularly children. Results also suggest that KM may not be a cost effective supplement for organic dairy farms.

Table 1. Effects of kelp meal on milk yield and composition.

	Kelp meal					*P*-value	
	0 g	57 g	113 g	170 g	SED	Linear	Quadratic
Milk yield, kg/d	16.3	16.2	16.4	15.8	0.37	0.27	0.24
DMI, kg/d	17.5	17.6	17.7	17.1	0.36	0.27	0.16
Milk fat, %	5.10	5.10	5.24	5.09	0.10	0.74	0.28
Milk fat, kg/d	0.84	0.85	0.88	0.86	0.04	0.35	0.55
Milk protein, %	3.68	3.70	3.64	3.63	0.06	0.27	0.79
Milk protein, kg/d	0.61	0.62	0.61	0.62	0.02	0.86	0.95
MUN, mg/dL	12.1	11.4	11.6	11.6	0.31	0.18	0.12
Milk iodine, µg/L	178	602	1,015	1,370	81.7	<0.0001	0.55

Key Words: iodine, kelp meal, milk yield

T88 Influence of maize kernel maturity on chemical characteristics, prolamin content, and in vitro starch digestion. . W. J. Seglar*, M. Pauli, A. Patterson, L. Nuzback, and F. N. Owens, *DuPont Pioneer, Johnston, IA.*

As an indicator of starch digestion, commercial laboratories measure in vitro starch disappearance of ground grain incubated for 7 hours (7HSD). As kernels mature, this index has been reported to decrease while prolamin content has been suggested to increase. Both presumably are correlated with kernel density. In trials in 2011 and 2012, we examined the relationships between kernel maturity (half-milk line, near black layer, and at full maturity) and density by gas pycnometer, chemical composition, and 7HSD using grain from 5 (2011) or 6 (2012) commercial Pioneer hybrids grown at 79K/hectare at each of two locations (central and southern Wisconsin). 7HSD and chemical composition were determined at a commercial laboratory. Differences among hybrids and years were detected ($P < 0.01$) for all chemical measurements except for NDF and ash; year by hybrid interactions were detected for 7HSD, prolamin, and starch. With kernel maturation, kernel weight increased stepwise (by 32 and 10% in 2011; 19 and 1% in 2012) while 7HSD percentages decreased slightly in 2011 (73% vs. 75%; $P < 0.05$) but increased slightly in 2012 (70% vs. 65%; $P < 0.05$). At the growing location with higher N fertility, protein and prolamin content of kernels were greater ($P < 0.05$). Within individual years, specific gravity was correlated with prolamin in 2011 (r = 0.63; $P < 0.01$) but not in 2012 (r = −0.15); 7HSD was poorly correlated with prolamin (r = −0.11 in 2011; r = −0.03 in 2012) across all samples but these two factors were correlated more strongly within kernel maturity groups (r = −0.3 to −0.51). The factor related most closely related ($P < 0.01$) to prolamin content was crude protein content of grain (r = 0.91 in 2011; r = 0.55 in 2012). For the hybrids, locations, and kernel maturities tested, kernel maturation failed to increase prolamin content or the prolamin:starch ratio. Neither reliably predicted 7HSD indicating that factors beyond hybrid and maturity were altering these measurements.

Key Words: prolamin, starch digestion, maize

T89 Range in starch content and digestibility of common starch sources in US and Japan and their effect on in vitro microbial biomass production when incorporated into total mixed rations. K. W. Cotanch*[1], H. M. Dann[1], J. W. Darrah[1], R. J. Grant[1], Y. Koba[2], and K. Hirano[2], *[1]William H. Miner Agricultural Research Institute, Chazy, NY, [2]ZEN-NOH National Federation of Agricultural Cooperatives, Tokyo, Japan.*

New methods have been developed to assess fermentability of starch sources including enzymatic digestion at 7 h (Cumberland Valley Analytical Services, Hagerstown, MD) and in vitro measurement of ruminal microbial biomass production (MBP; Fermentrics, Dairyland Labs, Arcadia, WI). The objective of this project was to evaluate the range in starch content, starch digestibility (starch-D), and MBP when common starch sources fed in the US and Japan are incorporated into total mixed rations (TMR). Descriptive statistics were applied to the database to evaluate mean values and ranges. Samples of grains were obtained from across the US, Canada, and Japan (rice only) that included: fine/medium corn (n = 20), flaked corn (n = 12), barley (n = 13), wheat (n = 12), and rice (n = 9). The mean and range of starch content (% of DM) plus 7-h enzymatic starch-D (% of starch) were determined (table). Rations based on corn silage (24.6% corn silage and 30.3% haycrop silage, DM basis), haycrop silage (49.7% haycrop silage), and dry hay (19% alfalfa hay, 16% timothy hay, and 7.6% oat hay) were formulated to contain similar starch content using

each starch source. For corn silage and hay-based TMR, ground rice grain resulted in highest MBP (182 and 188 mg/g, respectively, with range across diets of 137-182 and 130-188 mg/g) whereas for haycrop silage-based TMR fine ground corn resulted in the greatest MBP (141 mg/g with range across diets of 121-141 mg/g). These in vitro measures indicate that starch sources influence fermentation differently depending on the forage base. Existing feed databases used in ration formulation models may be updated with these starch digestibility and in vitro MBP values.

Table 1.

	Starch, % of DM		Starch-D, % of starch		MBP,
Grain	Mean	Range	Mean	Range	mg/g
Fine/medium corn	73.2	71.4 – 75.8	51.3	44.9 – 56.4	186
Flaked corn	74.5	72.2 – 77.3	52.7	40.3 – 63.0	266
Ground barley	59.7	55.3 – 63.9	57.4	46.2 – 62.4	248
Whole rice	79.7	77.3 – 82.2	16.8	13.5 – 18.0	332
Ground wheat	67.7	66.4 – 69.8	59.7	55.4 – 62.5	238

Key Words: digestibility, forage, starch source

T90 Kelp meal (*Ascophyllum nodosum*) did not improve milk yield or mitigate heat stress but increased milk iodine in mid lactation organic Jersey cows during the grazing season. N. T. Antaya*[1], A. F. Brito[1], K. J. Soder[2], N. L. Whitehouse[1], N. E. Guindon[1], A. D. B. Pereira[1], and C. C. Muir[1], *[1]University of New Hampshire, Durham, [2]USDA-ARS, Pasture Systems and Watershed Management Research Unit, University Park, PA.*

Kelp meal (KM) made from dry and ground *Ascophyllum nodosum*, a brown algae, is often used as a mineral supplement on northeastern organic dairy farms. Twenty (12 primiparous and 8 multiparous) organic Jersey cows with an initial BW of 410 kg (SD ± 39) and DIM of 135 (SD ± 52) were blocked by milk yield and parity. Cows were randomly assigned to treatments (0 or 113 g KM as fed) to examine the effects of KM supplementation on milk yield, milk components, plasma metabolites, and indicators of heat stress. The study lasted from June to October 2012 with 4, 28- d periods with the last 7 d used for data and sample collection. Data were analyzed using the MIXED procedure of SAS with repeated measures over time. Cows had access to mixed mostly cool-season grass pasture for 16 h daily, which was managed using rotational strip grazing. Cows were supplemented a TMR made (DM basis) of 51% grass-legume baleage, 47% concentrate, and 2% liquid molasses fed via Calan doors. Kelp meal had no impact on milk yield, components or heat stress indicators. However, concentration of milk iodine was 77% higher in KM fed cows than those fed no KM, which is explained by the high concentration of iodine (i.e., 820 mg/kg DM basis) found in brown algae. No KM effects were seen for plasma cortisol, NEFA, and thyroxine (T_4); a trend for lower plasma triiodothyronine (T_3) was found in KM cows, likely as a result of higher iodine intake. Kelp meal did not improve milk yield or mitigate heat stress but increased milk iodine, which may be of concern to human health, particularly children.

Table 1. Effects of kelp meal on milk yield, plasma metabolites, and heat stress indicators

	Kelp meal			
	0 g	113 g	SED	*P*-value
Milk yield, kg/d	12.4	13.0	0.90	0.56
Milk fat, kg/d	0.54	0.57	0.04	0.47
Milk protein, kg/d	0.44	0.45	0.03	0.59
MUN, mg/dL	11.6	12.1	0.58	0.40
Milk iodine, µg/L	138	592	66.1	<0.001
Plasma cortisol, ng/mL	95.7	111	16.6	0.36
Plasma NEFA, µg/dL	129	111	12.7	0.18
Plasma T_3, ng/mL	0.89	0.81	0.03	0.09
Plasma T_4, ng/mL	41.9	39.7	1.86	0.25
Rectal temperature, °C	38.2	38.3	0.07	0.24
Respiration rate, /min	44.5	44.3	1.79	0.92

Key Words: iodine, kelp meal, pasture

T91 Effects of partial replacement of corn grain with alkaline pretreated corn stover on production of lactating dairy cows. D. E. Cook*[1], M. J. Cecava[2], P. H. Doane[2], M. B. Hall[3], and D. K. Combs[1], *[1]University of Wisconsin-Madison, Madison, [2]ADM Research, Decatur, IL, [3]USDA-ARS, US Dairy Forage Research Center, Madison, WI.*

The fiber digestibility of corn crop residues can be improved by pretreatment with calcium oxide (CaO). The objective of this study was to evaluate how intake and milk production was affected when corn grain was replaced with CaO-treated corn stover. Corn stover was pretreated with CaO (50 g CaO kg^{-1} stover DM in 500 g H_2O kg^{-1} stover DM) at ambient conditions. Sixty-three Holstein dairy cows (101 ± 29 DIM, 39.2 ± 2.4 kg milk d^{-1}) were fed diets containing treated corn stover at 0, 40, 80, 120 g stover DM kg^{-1} TMR. The design of the study was a randomized complete block utilizing a 14-d covariate period, followed by a 6 wk experimental period. Cows were blocked by DIM and parity. Body weight change was not affected by treatment. DMI decreased linearly ($P < 0.01$) with each level of stover inclusion, (Table 1). Milk production as well as fat and protein production ($P < 0.01$ for all) also declined linearly with increasing levels of stover inclusion. Energy-corrected milk (ECM) decreased linearly ($P < 0.01$) from 47.6 kg d^{-1} to 40.7 kg d^{-1}. Stover inclusion had no effect ($P > 0.6$) on feed conversion rate as measured by ECM divided by DMI (1.766 ± 0.14). Overall, in high producing dairy cows, replacement of corn grain with treated stover caused a decline in DMI and milk yield.

Table 1.

	Stover inclusion (g stover DM kg^{-1} TMR DM)				
	0 (n = 16)	40 (n = 16)	80 (n = 16)	120 (n = 15)	SEM
DMI (kg d^{-1})	26.7	25.8	24.3	23.5	0.2
Milk (kg d^{-1})	42.2	40.8	39.4	36.9	0.4
Fat (kg d^{-1})	1.79	1.71	1.60	1.51	0.04
Protein (kg d^{-1})	1.32	1.24	1.17	1.11	0.02

Key Words: calcium oxide, stover, treated stover

T92 Effects of dietary starch content and NDF source on intake and milk production by dairy cows. S. M. Fredin*, L. F. Ferraretto, M. S. Akins, and R. D. Shaver, *University of Wisconsin, Madison, WI.*

An experiment was conducted to evaluate the effects of dietary starch concentration and source of NDF on intake, ruminal fermentation, and milk yield, composition and component yields. Eight ruminally-cannulated multiparous Holstein cows (193 ± 11 d in milk at trial initiation) were randomly assigned to treatments in a replicated 4 × 4 Latin square design with 21-d periods. Treatment TMR were high corn grain (HCG; 38% corn silage, 19% dry ground corn and 4% soy hulls), high soy hulls (HSH; 38% corn silage, 11% dry ground corn, 13% soy hulls), high corn silage (HCS; 50% corn silage, 6% dry ground corn, and 4% soy hulls) and low corn silage (LCS; 29% corn silage, 15% corn, and 19% soy hulls). The HCG, HSH, HCS, and LCS diets contained 29, 23, 24, and 22% starch, 27, 32, 30, and 32% NDF, and 21, 21, 25, and 17% forage NDF, respectively. During each period milk samples were obtained from a.m. and p.m. milkings on d 16 and 17 and rumen fluid four times daily at 2-h intervals on d 18-20 such that the samples represented a 24-h feeding cycle. Data were analyzed using the MIXED procedure of SAS. Mean DMI (24.9 kg/d) and milk yield (36.0 kg/d) were unaffected by treatment. Cows fed LCS had reduced milk fat percentage (3.54%; $P = 0.02$) compared with HSH and HCS (3.85 and 4.00%, respectively). Mean milk fat yield (1.33 kg/d), milk protein percentage (3.29%), and protein yield (1.16 kg/d) were unaffected by treatment. Milk urea nitrogen concentration was greater for HCS (19.8 mg/dL; $P = 0.0001$) compared with the other treatments (mean = 16.1 mg/dL). Rumen ammonia concentration was lower for HCG and LCS (9.6 and 8.0 mg/dL; $P = 0.001$) compared with HCS (12.1 mg/dL). Rumen pH was greater for cows fed HCS (6.25; $P = 0.007$) compared with cows fed LCS (6.04). Feeding a diet with corn silage NDF partially replaced by soy hulls NDF reduced milk fat percentage and rumen pH.

Key Words: dairy cow, NDF, starch

T93 Metabolic profile and onset of puberty of growing dairy heifers fed increased dietary fat from dried distillers grains. J. L. Anderson*[1], K. F. Kalscheur[1], J. A. Clapper[1], G. A. Perry[1], D. H. Keisler[2], A. D. Garcia[1], and D.J. Schingoethe[1], *[1]South Dakota State University, Brookings, [2]University of Missouri, Columbia.*

The objective of this trial was to determine if feeding increased dietary fat from dried distillers grains with solubles (DDGS) to growing dairy heifers affects metabolic profiles and onset of puberty. Thirty-three Holstein heifers (133 ± 18 d old) were fed one of three diets in a 24-wk randomized complete block design. Diets were: 1) control (C) that contained 15.9% (DM basis) ground corn and 17.9% soybean products, 2) low-fat (LFDG) that contained 21.9% reduced-fat DDGS and 11.9% ground corn, and 3) high-fat (HFDG) with 33.8% traditional DDGS. All diets contained 39.8% grass hay, 24.8% corn silage, and 1.5% vitamins and minerals. Although, diets were isonitrogenous and isocaloric, HFDG was formulated to contain 4.8% fat versus 2.8% in C and LFDG. Every 4 wk, jugular blood samples were collected for metabolites and metabolic hormones analysis. When heifers weighed between 200 and 300 kg of body weight (BW), coccygeal vein blood samples were taken two times per wk for progesterone analysis to estimate puberty. Plasma NEFA was similar among treatments ($P = 0.63$) and over time ($P = 0.67$). Plasma BHBA, insulin, IGF-1 and leptin were similar ($P > 0.10$) among treatments, but increased ($P < 0.05$) over time. Serum glucose tended ($P = 0.06$) to be less in heifers fed HFDG compared to C. Plasma urea nitrogen (PUN) was less ($P = 0.03$) in LFDG-fed heifers compared to other treatments and increased ($P < 0.01$) over time in all. Plasma total cholesterol was greater ($P < 0.01$) in heifers fed HFDG compared to other diets. Because cholesterol increased markedly in heifers fed HFDG, but remained more stable in the LFDG and C fed heifers, there were effects of time ($P < 0.01$) and treatment × time ($P = 0.02$). Based on progesterone analysis, 81.8% of heifers fed HFDG were pubertal at < 300 kg of BW compared to 36.4 and 27.3% in C and LFDG, respectively ($P = 0.03$). These findings provide evidence that dietary fat from DDGS can be used in replacement of starch from corn in diet of growing dairy heifers and maintain energy status. Feeding increased fat from DDGS may decrease the body weight at puberty.

Key Words: dairy heifer, distillers grains, metabolic profile

T94 Lactation performance of cows fed soybean meal or canola meal supplements. F. E. Contreras-Govea*[1], S. Bertics[1], G. A. Broderick[2], A. Faciola[3], and L. E. Armentano[1], *[1]University of Wisconsin-Madison, Department of Dairy Science, Madison, [2]US Dairy Forage Research Center, Madison, WI, [3]University of Nevada, Department of Agriculture, Nutrition, and Veterinary Sciences, Reno.*

Performance of mid lactation-Holstein cows fed diets with 17.3% CP based on soybean meal (SBM) or canola meal (CM) was determined. Sixty four cows were housed in a free stall barn equipped with 32 Insentec electronic feeding gates (RIC systems; Insentec BV, Marknesse, the Netherlands). Each gate allows access by one or more selected cows and record individual daily DMI. The SBM diet was assigned randomly to 16 gates, and 32 cows (16 multiparous and 16 primiparous) were assigned randomly to these 16 gates. The additional 32 cows were assigned to the other 16 gates and fed CM. Cows within a diet had access to all 16 gates with that diet, and cow was considered the experimental unit. For 21 d, all cows received a common diet and covariate measurements were obtained. Cows were then fed their treatment diet for the next 63 d. Treatment diets (dry matter basis) were 25.7% alfalfa haylage, 31.6% corn silage, corn grain (24.0% for CM diet, 27.2% for SBM diet), and either 16.5% CM or 13.3% SBM. Cows were milked twice daily and yields were recorded for 84 d. Cow were weighed weekly. Milk composition was determined for two consecutive milkings weekly. Covariately adjusted data were analyzed as a complete randomized block design with cow within treatment and parity as the subject for weekly repeated measurements. Cows fed CM had greater intake (28.4 vs. 23.6 kg DM/d), and yield of milk (39.0 vs. 36.2 kg/d), milk fat (1.44 vs. 1.36 kg/d), milk protein (1.24 vs. 1.15 kg/d), and milk lactose (1.93 vs. 1.78 kg/d), but observed feed efficiency was lower for cows fed CM (1.38 vs. 1.55 kg milk yield/kg intake; all $P < 0.05$). Body weight increased across weeks ($P < 0.05$), but diet by week interaction was not significant ($P = 0.678$) and condition score observations did not reveal an obvious energy balance difference due to diet. The predicted undiscounted TDN for the CM and SBM diets were 71% and 73%, and energy allowable 3.5% fat corrected milk was 47.2 and 39.4 kg/d for CM and SBM. The measured intake differences are larger than expected even considering the greater milk yield and lower predicted energy density of the CM diet.

Key Words: canola, protein, soybean

T95 Utilization of byproducts from human food production as feedstuffs for dairy cattle and relationship to greenhouse gas emissions and environmental efficiency. K. L. Russomanno, T. F. Christoph, R. J. Higgs, and M. E. Van Amburgh*, *Cornell University, Ithaca, NY.*

The objective of this study was to use survey data collected from nutritionists representing significant regions of dairy production to evaluate the methane (CH_4) and carbon dioxide (CO_2) production per unit of dietary byproducts fed. The data included a complete set of diet ingredients, including chemical analysis of individual ingredients and a complete diet summary. In addition, values for group average body weight (BW), dry matter intake (DMI), milk yield (kg), and milk fat and protein concentrations were provided. Ninety-one diets from seventy different farms representing ten different states were compiled, and included a range of different byproducts (e.g., soy hulls, distillers grains, almond hulls), forages, protein feeds, and minerals. The average byproduct concentration in the diets was 31.3% DM with a range of 12.7% and 56.7%, DM. Data were evaluated in the Cornell Net Carbohydrate and Protein System v6.1 (CNCPS; Tylutki et al., 2008, Van Amburgh et al., 2010). Equations for enteric CH_4 and CO_2 emissions were incorporated into the CNCPS from Mills et al., (2003) and Casper and Mertens, (2010), respectively. Total emission of CO_2 per cow was positively related to total milk yield ($R^2 = 0.69$). However, CO_2 emissions per kg of milk yield (kg CO_2/kg milk) resulted in a negative relationship, ($R^2 = 0.81$). The average CO_2 emission per unit of milk yield was 0.353 kg CO_2/kg milk, with minimum and maximum values of 0.283 kg and 0.423 kg, respectively. The mean prediction of CO_2 (kg) per kg of byproducts was 0.05 and the correlation between CO_2 emission and inclusion of byproduct as a proportion of the total DMI was high ($R^2 = 0.81$). CH_4 emissions per kg DMI ranged from 0.021 kg to 0.027 kg with a mean of 0.024 kg CH_4/kg milk. Total CH_4 emissions were positively correlated with milk yield (slope = 0.004; $R^2 = 0.68$) but CH_4 kg/kg milk was negatively correlated (slope = −0.26; $R^2 = 0.88$) similarly to CO_2. Use of byproducts in diets for dairy cattle reduces the environmental impact of human food production and enhances the efficiency of the dairy industry.

Key Words: byproduct, dairy, greenhouse gas

T96 The effects of different ratio of metabolizable protein to metabolizable energy on dry matter intake, average daily gain, and nutrient digestibility in Holstein heifers. H. R. Motalebei, M. Dehghan-Banadaky*, K. Rezayazdi, and H. Kohram, *Department of Animal Science, University of Tehran, Karaj, Tehran, Iran.*

The purpose of this study was to investigate the effects of different ratio of metabolizable protein (MP) to metabolizable energy (ME) on dry matter intake (DMI), average daily gain (ADG), feed efficiency and nutrient digestibility in Holstein heifers. In present experiment 24 Holstein heifers with a mean age of 7 months and the average weight of 217 kg were used. Heifers were randomly assigned to 3 rations: 1) ration which includes 10% metabolizable protein less than NRC (2001) (−10% NRC) 2) control ration which metabolizable protein based on NRC (2001) (NRC). 3) Ration with includes 10% metabolizable protein more than NRC (2001) (+10% NRC). Rice hull and soybean meal used for adjusting diets. Metabolizable energy in all rations was based on NRC requirements. DMI, ADG and feed efficiency were measured once every 14 days and digestibility once every 28 days. The nutrients digestibility was affected by rations ($P < 0.05$) and the nutrients digestibility were higher in ration 1 than rations 2 and 3, but no significant differences were observed in DMI, ADG and feed efficiency between rations. The results showed that by increasing the ratio of protein to energy metabolizable, nutrients digestibility decreased.

Table 1. Effects of different ratio of metabolizable protein to metabolizable energy on DMI, ADG, feed efficiency, and nutrient digestibility

	MP/ME (g/Mcal)				
Item	−10% NRC (31.14)	NRC (34.57)	+10%NRC (38)	*P*-value	SEM
DMI (kg)	6.18	6.20	6.19	NS	0.017
ADG (g)	827	842	817	NS	0.027
Feed efficiency	7.98	8.31	8.22	NS	0.31
Digestibility %					
Dry matter	67.79[a]	64.41[b]	60.31[c]	0.01	1.761
Crude protein	67.74[a]	63.25[b]	60.60[c]	0.007	1.592
Organic matter	69.39[a]	66.10[b]	61.41[c]	0.01	1.865

Key Words: heifer, digestibility, metabolizable protein