Ruminant Nutrition: Dairy rumen metabolism

850 A novel inhibitor persistently decreased enteric methane emission and increased weight gain of high-producing Holstein cows without negatively affecting milk production. Alexander N. Hristov*[1], Joonpyo Oh[1], Fabio Giallongo[1], Michael T. Harper[1], Holley Weeks[1], Antonio F. Branco[2], Peter J. Moate[3], Matthew H. Deighton[3], S. Richard O. Williams[3], Maik Kindermann[4], and Stephane Duval[5], *[1]Department of Animal Science, The Pennsylvania State University, University Park, PA, [2]Departamento de Zootecnia, Universidade Estadual de Maringá, Maringá, Parana, Brazil, [3]Agriculture Research Division, Department of Economic Development Jobs Transport and Resources, Ellinbank, Victoria, Australia, [4]DSM Nutritional Products, Animal Nutrition and Health, Basel, Switzerland, [5]DSM Nutritional Products France, Research Centre for Animal Nutrition and Health, Saint Louis Cedex, France.*

This study investigated the effect of a CH_4 inhibitor, 3-nitrooxypropanol (3NOP), on enteric CH_4 emissions in lactating Holstein cows. The experiment was a randomized block design with 48 cows (DIM, 77 ± 3.9; lactations, 2.2 ± 0.15), with a 2-wk covariate and a 12-wk data collection periods. Treatments were: control (no additive) and 3NOP applied at 40, 60, and 80 mg/kg feed DM. 3NOP was mixed with the TMR and cows were fed once daily. Methane and H_2 emissions were measured using 2 methods, the GreenFeed system and the modified SF_6 tracer technique, during the covariate period and experimental wk 2, 6, 9, and 12. Compared with the control, 3NOP decreased the average CH_4 emission by 25, 31, and 32%, respectively, when measured using the GreenFeed system (481, 363, 333, and 329 g/cow/d; SEM = 15.9; $P < 0.001$). Similar inhibition of CH_4 emission by 3NOP was observed when determined using the SF_6 technique. Hydrogen emissions from the control cows were negligible throughout the experiment (on average 0.02 g/cow per day), but increased considerably for the 3NOP treatments (0.48, 0.96, and 1.27 g/cow per day, respectively; SEM = 0.116, $P < 0.001$). Methane emissions per kg of DMI or ECM were on average 29 and 31%, respectively, lower for the 3NOP treatments compared with the control. Treatment had no effect on DMI (27.8 ± 0.45 kg/d), milk production (45.5 ± 1.21 kg/d), and feed efficiency (1.65 kg/kg). Milk composition was not affected by 3NOP. Milk protein and lactose yields were increased ($P \leq 0.05$) by 3NOP. Body weight gain during the experiment was about 168 g/d greater ($P = 0.05$) for the 3NOP-treated cows. Apparent total-tract digestibility of DM, OM, CP, and ADF were quadratically increased ($P \leq 0.06$) by 3NOP compared with the control. This experiment demonstrated that enteric CH_4 emissions from ruminant animals can be successfully decreased by the use of a CH_4 inhibitor, without negatively affecting animal productivity. If adopted, this mitigation practice could substantially reduce greenhouse gas emissions from the ruminant livestock sector.

Key Words: methane, hydrogen, 3-nitrooxypropanol

851 Effect of frequency of total mixed ration delivery on digestibility and milk production in lactating dairy cows: A meta-analysis and meta-regression. Hamidreza Mirzaei-Alamouti*[1], Mehdi Kazemi-Joujili[1], Hamid Amanlou[1], and Mina Vazirigohar[2], *[1]Department of Animal Science, Faculty of Agriculture, University of Zanjan, Zanjan, Iran, [2]Department of Animal Science, Campus of Agriculture and Natural Resources, University of Tehran, Karaj, Alborz, Iran.*

The objectives of this study were to evaluate the effect of frequency of feeding dairy cows with total mixed ration (TMR) on digestibility, feeding behavior, and milk production and composition in lactating cows, using meta-analysis and meta-regression methods. A total of 14 studies with 25 comparisons between treatment (higher feeding frequency) and control (lower feeding frequency) groups, met the selection criteria and included in the analysis. Type and amount of feed ingredients did not differ between treatment and control diets. The mean (±SD) forage and grain amount in the experimental diets were 539 ± 89.9 and 274 ± 104.2 g/kg DM, respectively. Increasing frequency of feeding (in average; 1.0× vs. 3.3×) decreased dry matter intake [DMI; weighted mean differences (WMD) = −0.134 kg/d; 95% confidence interval (CI) = −0.505 to 0.236) but had no effect on milk production. The amount of forage in the basal diet and DIM were the sources of heterogeneity for DMI. Thrice-daily feeding compared with once a day increased milk fat yield (WMD = 15.02 g/d; 95% CI = 10.93 to 40.96), but milk fat content, and milk protein content, and yield remained unchanged. Increasing feeding frequency increased NDF digestion (WMD = 5.663%; 95% CI = 0.631 to 10.69). Results of meta-regression showed that more frequent feeding of diets containing high level of grains improved NDF digestibility in lactating cows, but lowered NDF digestion for high forage diets. Increasing the frequency of feeding did not change total feeding and ruminating times. In conclusion, feeding a TMR containing equal amounts of forage and concentrate 3 times a day vs. once a day decreased DMI without any changes on milk production.

Key Words: feeding frequency, lactating cow, meta-analysis

852 Relationship between rumen molar volatile fatty acid proportions and milk odd- and branched-chain fatty acid concentrations in cows fed diets containing sunflower oil. Mina Vazirigohar*, Mehdi Dehghan-Banadaky, Kamran Rezayazdi, and Ardeshir Nejati-Javaremi, *Department of Animal Science, Campus of Agriculture and Natural Resources, University of Tehran, Karaj, Alborz, Iran.*

Principal component analysis (PCA) was used to explore the relationship among molar proportions of individual rumen volatile fatty acid (VFA) and milk odd- and branched-chain fatty acid (OBCFA) concentrations. Data were obtained from an experiment with 24 lactating Holstein cows examining the effects of diets containing variable proportions of forage (39, 43.5 or 48% of forage in total diet DM) and concentrate containing sunflower oil (3% in diet DM) on milk fat content and composition. The data were analyzed using the loading plot of PCA which was performed using PASW (version 18.0). Molar proportions of butyrate were included in the initial evaluation, but these data were subsequently excluded because these did not meet the necessary PCA model fit criteria. Loading plot of PCA revealed that rumen molar acetate proportions clustered with milk *iso* fatty acids of <15 carbon atoms, whereas rumen molar propionate proportions clustered with milk straight odd-chain fatty acids (15:0 and 17:0) and their desaturation products in the opposite side of both PCs. Concentrations of 15:0, *cis*-9 15:1 and *cis*-9 17:1 had high loadings on PC1, whereas 17:0 had high loading on PC2 which was located close to molar propionate proportions. In conclusion, rumen molar acetate and propionate proportions were closely associated with milk fat *iso* and straight odd-chain fatty acids concentrations, respectively, in cows fed diets containing sunflower oil.

Key Words: milk odd- and branched-chain fatty acid, principal component analysis, rumen volatile fatty acid

853 The effect of increasing level of by-product inclusion on milk production, milk composition, nutrient digestibility and nitrogen excretion in early lactation grazing dairy cows. Billy Carey[1], Tommy M. Boland*[1], Stephen J. Whelan[2], Gaurav Rajauria[1], and Karina M. Pierce[1], *[1]School of Agriculture and Food Science, University College Dublin, Dublin, Ireland, [2]DairyCo, Agriculture & Horticulture Development Board, Stoneleigh Park, Kenilworth, United Kingdom.*

Irish dairy farming is characterized by a predominantly spring calving, pasture based production system with strategic use of concentrate supplementation when pasture availability is less than herd demand. Cereal grains are used extensively in concentrates as an energy source, but the use of these human edible energy sources is becoming somewhat controversial. By contrast, by-products, which cannot be consumed by humans, such as maize dried distillers' grains (DDG), palm kernel expeller meal (PKE) and soybean hulls (SH) can provide an economical source of nutrients to complement grazed grass. While these products have been extensively studied in US and New Zealand production systems, there is a paucity of information on their use in moderately yielding (30 kg/d) pasture fed cows. The objective of this research was to evaluate the effect of replacing barley with increasing dietary levels of by-products (DDG, PKE and SH) on milk production and composition, pasture and total dry matter intake (DMI), body condition score (BCS) and body weight (BW) and nitrogen (N) excretion in early lactation dairy cows grazing perennial ryegrass-based pasture. Forty-eight Holstein Friesian dairy cows (64 DIM ± 24) were blocked by pre-experimental milk yield and offered 1 of 4 supplementary concentrates (5.17 kg of DM/d) containing 35, 55, 75 and 95% by-products for T1, T2, T3 and T4 respectively. The concentrates offered contained DDG, PKE and SH in equal portions and the experiment continued for 70 d. Data were tested using Proc Mixed of SAS with trt, week, parity and their interactions included as fixed effects in the model. Treatment had no effect on milk yield (30.8 kg/d; $P = 0.78$) or fat and protein yield (2.1 kg/d; $P = 0.57$). Similarly, BCS (2.75; $P = 0.76$) and BCS change (−0.05; $P = 0.74$) were not affected by treatment. There was also no effect of treatment on pasture DMI (15.73 kg of DM/cow/d; $P = 0.99$), total DMI (21.05 kg of DM/cow/d; $P = 0.99$), digestibility of NDF (0.69; $P = 0.34$), ADF (0.59; $P = 0.36$) or N (0.33; $P = 0.70$) or the excretion of N in urine (0.26 kg/d; $P = 0.99$). The results from this research show that cereals can be replaced with by-products (DDG, PKE and SH) in the diet of grazing dairy cows without any adverse effects on production, feed intake, digestibility, BW, BCS or N excretion.

Key Words: dairy, byproduct, cereal

854 Effects of feeding Fermenten or urea on milk production, rumen nitrogen metabolism, and microbial nitrogen content in lactating dairy cattle. Samuel W. Fessenden*[1], Andreas Foskolos[1], Elliot Block[2], and Michael E. Van Amburgh[1], *[1]Department of Animal Science, Cornell University, Ithaca, NY, [2]Arm & Hammer Animal Nutrition, Princeton, NJ.*

The objective of this study was to evaluate effects of 2 different sources of rumen available nitrogen on cattle performance, rumen nitrogen dynamics, and rumen microbial metabolism in lactating dairy cattle. Eight ruminally cannulated multiparous Holstein cows averaging 60 ± 10 DIM and 637 ± 38 kg of BW were assigned to one of 2 treatment sequences in a switchback design. Diets contained (DM basis) 44% corn silage, 13% alfalfa haylage, 12% ground corn, and 31% protein premix containing either a control mix of urea and wheat middlings (CON) or Fermenten at 3% diet inclusion rate (EXP). Both diets provided similar level (DM basis) of aNDFom (31%), CP (16.5%), RDP (8.2%) and metabolizable energy (64 Mcal ME/d). Diets were formulated to provide approximately 115% of rumen NH_3-N requirement as predicted by the CNCPS. The trial consisted of 3 28 d experimental periods, where each period consisted of 21 d of diet adaptation and 7 d of data and sample collection. Digestion markers were infused continuously during the sampling period and composited omasal samples were used to calculate nutrient flows. All data were analyzed using the Proc Mixed procedure in SAS. Dry matter intake was 25.5 and 25.2 kg/d for CON and EXP, respectively ($P = 0.73$). Energy corrected milk yield was 42.2 and 43.2 kg/d for CON and EXP, respectively ($P = 0.43$), with no treatment differences ($P > 0.05$) in milk fat and protein yield or content. Compared with CON, EXP increased milk urea nitrogen (10.7 vs. 13.5 mg/dL; $P = 0.01$) and rumen NH_3-N (4.4 vs. 5.3 mg/dL; $P = 0.03$). Rumen bacteria and omasal protozoa N content tended to increase with EXP inclusion ($P < 0.1$), while rumen protozoa and omasal bacteria N content increased ($P < 0.05$) with EXP inclusion. Effects of Fermenten inclusion on rumen microbial metabolism, especially microbial N content, were consistent with previous observations of increased microbial growth and turnover associated with supplementation of rumen available non-NH_3-N in N efficient diets.

Key Words: microbial protein, omasum, Fermenten

855 Effect of passage rate and pH on microbial diversity and total methanogens in continuous culture. Benjamin A. Wenner*, Jill A. Stiverson, Zhongtang Yu, and Jeffrey L. Firkins, *Department of Animal Sciences, The Ohio State University, Columbus, OH.*

The present study was conducted as a 2 × 2 factorial treatment arrangement in a Latin square design using 4 continuous culture fermenters. Treatments were control pH (CpH; ranging 6.3 to 6.9) or low pH (LpH; 5.8 to 6.4) factorialized with solids passage rates (k_p) set to be either low (Lk_p; 2.5%/h) or high (Hk_p; 5.0%/h); total buffer k_p was constant at 7.0%/h. Fermenters were fed once daily (40 g DM; a 50:50 concentrate:forage diet). Periods lasted 10 d, with 3 d of sample collection. Effluent samples were collected once every 24 h for 3 d and pooled. Fermenter contents were sampled at 0, 4, 8 and 12 h post-feeding on d 6. We hypothesized that lowering pH would limit methanogen ability to grow in culture, and increasing k_p would challenge methanogens to increase growth rate for survival. Further, the combination of these treatments would decrease daily methane production per total archaeal 16s copy outflow and decrease methanogen concentration in culture. DNA was extracted using repeated bead beating protocols and amplified for total bacteria and total archaeal PCR-DGGE using respective universal 16S rRNA gene primers with GC clamps. Banding analysis clearly demonstrated clustering of effluent versus fermenter samples for bacteria and archaea. However, there were no clear banding patterns for treatment combinations or for times post-feeding. Total archaeal 16S rRNA gene copies were quantified using 787f and 1059r primers using qPCR. There was no significant ($P > 0.10$) interaction for treatment by time, and no difference in total archaeal 16S rRNA (copies/mL) between treatments: CpH, Lk_p: 1.13×10^5, CpH, Hk_p: 5.85×10^4, LpH, Lk_p: 6.84×10^4 and LpH, Hk_p: 4.67×10^4. Daily methane production per 16s copy was not significantly different ($P > 0.10$) between treatments: CpH, Lk_p: 1.12, CpH, Hk_p: 0.11 LpH, Lk_p: 0.67 and LpH, Hk_p: 0.43 nmol CH_4/archaeal 16s copy. Rumen microbes are resilient to small daily disturbances in pH or slight increases in k_p, but there is a lack of clear relationship between methanogen concentration and methane production. The poor methane/copy relationship of these treatments indicates a need to move methane mitigation research beyond inhibition toward potential influencers on methanogen metabolism and growth.

Key Words: fermenter, methanogen, methane

856 Lactational performance and ruminal morphometrics when mid-lactation dairy cows are fed *Sacchararomyces cerevisisae* fermentation products. Jon P. Pretz*[1], Subash Acharya[1], Ilky Yoon[2], Mark Scott[2], and David P. Casper[1], [1]*South Dakota State University, Brookings, SD,* [2]*Diamond V Mills Inc., Cedar Rapids, IA.*

This study evaluated *Saccharomyces cerevisiae* fermentation products (Diamond V original XPC and 2 prototypes) on lactational performance and ruminal fermentation. Eight ruminally cannulated (132 DIM and 34.4 kg milk) Holstein dairy cows (2 primiparous and 6 multiparous) were blocked by milk yield, DIM and parity and randomly assigned in a replicated 4 × 4 Latin square design. Treatments were (1) Control (C): corn silage and haylage based ration; (2) XPC: C ration with 14 g/hd/d Original XPC; (3) Prototype 1 (P1): C ration with 5 g/hd/d P1; and (4) Prototype 2 (P2): C ration with 19 g/hd/d P2. Treatments were mixed with dried distillers grains and then mixed in the TMR at 454 g/hd/d. Periods were 28 d with the first 21 d for adjustment followed by 7 d of data collection. Milk yield (3×/d) was recorded d and milk samples (2 d) during wk 4. On d 25 or 27, rumens were evacuated, weighed, markers added (Co and valeric acid), mixed, block the rumen-omasal orifice using a sponge, and rumen contents returned to the rumen. Ruminal samples were collected for 4 h at 20 min intervals to determine ruminal pH, ammonia, and volatile fatty acid concentrations. After 4 h of sample collection, rumen contents were re-evacuated, re-weighed, rumen-omasal sponge removed, and rumen contents returned. One cow died unrelated to study objectives and data were removed. Milk yield (30.7, 32.3, 32.0, 31.3 kg/d for C, XPC, P1, and P2, respectively) and intake of DM [(DMI); 24.5, 23.6, 23.6, and 25.3 kg/d] were similar ($P > 0.10$) between all cows, but feed efficiency (1.26, 1.36, 1.36, and 1.24 kg/kg milk/DMI) and energy-corrected milk/DMI (1.42, 1.54, 1.52, and 1.38 kg/kg was greater ($P < 0.01$) for cows fed XPC and P1 compared with cows fed C and P2. Milk composition was similar ($P > 0.10$) between cows fed all rations. Ruminal pH (6.06, 6.07, 6.02 and 6.13) was greater ($P < 0.05$) for cows fed P2 compared with cows fed other rations. The feeding of a dairy ration with a *Saccharomyces cerevisiae* fermentation product can improve ruminal pH and feed efficiency of mid-lactation cows.

Key Words: dairy cattle, volatile fatty acid, *Saccharomyces cerevisiae* fermentation product

857 Effects of nitrate and docosahexaenoic acid on methane production in lactating dairy cows. G. Klop*[1], B. Hatew[1], A. Bannink[2], and J. Dijkstra[1], [1]*Wageningen University, Animal Nutrition Group, Wageningen, the Netherlands,* [2]*Wageningen UR Livestock Research, Wageningen, the Netherlands.*

The objective of this experiment was to study the effects of dietary nitrate (NO_3) and docosahexaenoic acid (DHA; C22:6 n-3) on enteric methane (CH_4) production in lactating dairy cows. Twenty-eight lactating Holstein dairy cows were grouped into 7 blocks of 4 cows each. Within blocks, cows were randomly assigned to one of 4 treatments: CON (urea as alternative NPN source); NO_3 (21 g/kg DM); DHA (3 g/kg DM and urea as alternative NPN source); or NO_3 + DHA (21 g/kg DM and 3 g/kg DM, respectively). Cows were fed a total mixed ration consisting of 20% grass silage, 50% corn silage and 30% concentrate on a DM basis. Treatments were included in the concentrates. Methane production was measured during a 5-d period in climate respiration chambers after adaptation to the diet for 12 d. Previous to this 17-d period, cows assigned to a treatment including NO_3 were gradually pre-adapted to the treatment dose of NO_3 over a period of 21 d. Preliminary results show a significant ($P < 0.05$) NO_3 × DHA interaction for CH_4 expressed in g/d, and cows produced on average 368, 264, 369 and 298 g CH_4/d on treatments CON, NO_3, DHA and NO_3 + DHA, respectively. This interaction effect is explained by a lower DMI for the NO_3 treatment despite the restricted feeding regimen during the CH_4 measurement period. Per kg DMI, cows receiving NO_3 produced less CH_4 than cows receiving no NO_3 in their diets (17.5 vs. 22.4 g/kg DMI; $P < 0.01$). Feeding DHA did not affect CH_4 production per kg DMI, but did result in a higher ($P < 0.01$) CH_4 production per kg FPCM. Milk production was not affected by treatment, but FPCM was reduced ($P < 0.05$) by DHA because of a reduced milk fat concentration ($P < 0.01$), which averaged 29.6 and 41.1 g/kg for treatments with or without DHA, respectively. Milk protein concentration was reduced ($P < 0.05$) by NO_3 and averaged 30.0 and 31.0 g/kg for treatments with or without NO_3, respectively. In conclusion, NO_3 but not DHA reduced enteric CH_4 production and there were no interaction effects on CH_4 production expressed in g/kg DMI and g/kg FPCM.

Key Words: methane, nitrate, docosahexaenoic acid

858 Effects of clay (EcoMix) after a grain challenge on rumen health and metabolism of Holstein cows. Saige A. Sulzberger*[1], Carlie C. Kalebich[1], Sergey Melnichenko[2], and Felipe C. Cardoso[1], [1]*University of Illinois, Urbana, IL,* [2]*United Minerals Group, Kyviv, Ukraine.*

Oral supplementation of clay has been reported to function as buffer in dairy cows. However, its effects on rumen, blood, and fecal pH have been variable among studies. Our objective was to determine the effects of 3 levels of dietary clay (EcoMix) supplementation after a grain challenge. Ten multiparous rumen-cannulated Holstein cows (BW = 648 kg ± 12kg), 142 (60–502) DIM, were assigned to 1 of 5 treatments in a completely randomized replicated 5 X 5 Latin Square. Periods consisted of an 18-d adaptation period followed by a 3-d (d 19–21) measurement period. Cow average DMI from d 15–17 was used to restrict feed to 75% on d 18 and to give 20% wheat flour (grain challenge) on d 19, via cannula. Treatments were: CON, no EcoMix and no grain challenge; POS, no EcoMix with a grain challenge; 0.5%, 1%, and 2%, EcoMix as percentages of dietary DMI all with a grain challenge. Statistical analysis was performed using the MIXED procedure of SAS. Two contrasts CONT1 (POS vs. CON), CONT2 (POS vs. average of 0.5%, 1%, and 2%) were compared along with the linear and quadratic treatment effects. Rumen, fecal, and blood pH along with blood metabolites were measured at 0, 4, 8, 12, 16, 20, 24, 36, and 48 h relative to grain challenge. Rumen pH ($P = 0.003$) and fecal pH were lower (CONT1, $P < 0.001$) for POS (6.03 ± 0.06; 6.14 ± 0.04) than CON (6.20 ± 0.06; 6.38 ± 0.04), respectively. There was a linear treatment effect for rumen pH ($P = 0.001$) and fecal pH ($P = 0.05$). Fecal pH (6.22 ± 0.04, $P < 0.0001$) was higher for cows that received EcoMix then POS (6.14 ± 0.04, CONT2). There was a difference for negative incremental area under the curve (Rumen pH below 5.6/24h; 0.5% = 7.93 1% = 8.56, 2% = 7.79, SEM = 0.8, $P = 0.005$) when compared with POS (11.0, CONT2). Cows fed EcoMix had higher milk yield, (0.5% = 28.8 kg, 1% = 30.2 kg, 2% = 29.1 kg, SEM = 3.4), 3.5% FCM (0.5% = 29.9 kg, 1% = 34.1 kg, 2% = 33.1 kg, SEM = 3.4, $P = 0.02$) and ECM (0.5% = 29.1 kg, 1% = 32.8 kg, 2% = 31.6 kg, SEM = 3.3 $P = 0.01$) than cows in POS (CONT2, 27.72 kg, 28.0 kg, 27.71kg, respectively). In conclusion, cows that received EcoMix had higher rumen pH, milk yield, ECM and FCM than cows in POS.

Key Words: buffer, clay, rumen pH

859 Magnitude of difference in chemical and nutrient profiles, ruminal degradation kinetics, and intestinal digestion of three different types of co-products from bio-oil processing for dairy cattle. Xinxin Li*[1,2], Yonggen Zhang[1], and Peiqiang Yu[1,2], *[1]College of Animal Science and Technology, Northeast Agricultural University, Harbin, China, [2]Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.*

Co-products from bio-oil industry, rapeseed meal, canola meal and soybean meal, are good sources of feed protein for livestock. The objectives of this study were to determine the magnitude of differences among 3 types of co-products in terms of (1) protein nutrient profile, (2) protein subfractions associated rumen utilization, (3) protein rumen degradation kinetics and (4) intestinal absorbed true protein supply to dairy cattle. Rapeseed meal, canola meal and soybean meal were collected from 3 different sources in 2014. Crude protein was partitioned into 5 subfractions according to the Cornell net carbohydrate and protein system (CNCPS 6.5). Three lactating Holstein cows fitted with permanent rumen cannula were used for determining the protein rumen kinetics in the in situ trial. The estimation of intestinal rumen undegraded feed protein digestibility was determined using a modified 3-step in vitro procedure with 12 h pre-rumen incubation in lactating Holstein cows. In this study, statistical analyses were carried out using the PROC MIXED procedure of SAS 9.3. Significances were declared at $P < 0.05$. The results showed that CP content in soybean meal was higher than rapeseed meal and canola meal ($P < 0.05$). Rapeseed meal had the highest NPN content, followed by canola meal with NPN content lowest in soybean meal ($P < 0.05$). The contents of SCP, ADICP and NDICP in rapeseed meal and canola meal were higher than soybean meal ($P < 0.05$). Protein fractions of PA_2, PB_2 and PC were greater in rapeseed meal and canola meal than soybean meal ($P < 0.05$), but no significant difference was found between rapeseed meal and soybean meal. Both soybean meal and rapeseed meal had higher rumen degradable protein (RDP) than canola meal ($P < 0.05$). Soybean meal was greater than rapeseed meal and canola meal in intestinal digestible protein (IDP, $P < 0.05$). Total digestible protein (TDP) was highest in soybean meal, and lowest in canola meal ($P < 0.05$). Overall, the results indicated that soybean is a greater source of protein feed than canola meal and rapeseed meal.

Key Words: soybean meal, rapeseed meal, degradation profile

860 Amino acid profiles of ruminal microbes, ruminal undegradable protein, and gastrointestinal contents in lactating dairy cows when corn stover or rice straw replaces alfalfa hay. Bing Wang*[1,2] and J. X. Liu[1,2], *[1]Institute of Dairy Science, College of Animal Sciences, Hangzhou, P. R. China, [2]MoE Key Laboratory of Molecular Animal Nutrition, Zhejiang University, Hangzhou, P.R. China.*

The objective of this study was conducted to evaluate the effects of replacing alfalfa hay with rice straw or corn stover on amino acid (AA) profiles of ruminal microbes, rumen undegradable protein (RUP), and gastrointestinal contents in lactating cows. Eighteen Holstein dairy cows were individually fed, and randomly assigned into one of 3 treatments. Isonitrogenous diets contained similar concentrate and 15% corn silage, with 3 forage sources (DM basis): 23% alfalfa hay and 7% Chinese wild rye hay (AH); 30% corn stover (CS); and 30% rice straw (RS). After 14-wk feeding, all the cows were slaughtered to collect the samples of rumen fluid and gastrointestinal contents. The AA were analyzed with an AA analyzer (Model L-8800, Hitachi, Tokyo, Japan). The variance of the data was analyzed as a completely randomized design using PROC MIXED of SAS. The AA profiles of ruminal microbes were similar among 3 treatments except for the lower value of Asp in diet RS than in CS ($P < 0.01$) or AH ($P < 0.02$) and the greater value of Gly in AH than in RS ($P = 0.02$). Significant differences were found in the AA profiles among ruminal microbes, fluid, and digesta, with greater percentage of essential AA in digesta than in microbes or fluid ($P < 0.01$), and in microbes than in rumen fluid ($P < 0.01$). The free AA concentration in jejunum was the greatest, but the peptide-binding AA concentration was the greatest in duodenum, resulting in lower ratio of peptide-binding AA to free AA. In addition, the free essential AA profiles in jejunum fluids for all the 3 diets were similar with the recommended digestible AA and milk AA, with the ratio of Lys to Met at 3:1. Most of AA of RUP was independent on forage sources except for Phe ($P = 0.035$) and Gly ($P = 0.05$). There was linear correlation between dietary AA profile and AA composition in ruminal fluids ($P < 0.01$). The AA profiles of ruminal microbes and RUP were constant and independent on forage sources. It is indicated that the AA profile of metabolizable protein may be constant independent on dietary effects.

Key Words: amino acid profile, dairy cattle, gastrointestinal content

861 Effect of increasing concentration of dietary fiber in diets rich in plant oil on milk fat concentration, rumen parameters and feeding behavior of mid-lactating cows. H. R. Mirzaei Alamouti* and A. Aghaei, *Department of Animal Science, University of Zanjan, Zanjan, Iran.*

This experiment was conducted to investigate the effects of different levels of dietary NDF in diets rich in plant oil (sunflower and soybean) on feeding behavior, rumen parameters, milk yield and components of mid-lactating Holstein dairy cows. Four primiparous (BW: 525 ± 30 kg; days-in-milk: 103 ± 6) and 4 multiparous (BW: 587 ± 88 kg; DIM: 99 ± 12) cows were used in a 4 × 4 replicated Latin square design with 21-d experimental periods. Cows were received 1 of 4 dietary treatments: (1) 31% fiber and no supplement plant oil, LFNO; (2) 31% fiber with 3% supplement plant oil, LFHO; (3) 35% fiber with 3% plant oil, MFHO; (4) 39% fiber with 3% plant oil, HFHO. Daily dry matter intake (DMI), milk yield and composition, blood metabolites, dry matter digestibility, rumen fluid characteristics and BW variations were determined. There was no significant different in milk production among diets. Milk fat ($P < 0.01$) and protein ($P < 0.05$) concentrations were significantly affected by treatments. Dry matter intake and DM digestibility were higher ($P < 0.01$) in LFHO diet. The cows fed HFHO had higher NDF digestibility ($P < 0.01$). Total VFA and acetate concentration were greater for HFHO diet and propionate concentration was greater for LFHO diet ($P < 0.01$) than the others. Rumen fluid pH was increased by increasing dietary NDF concentration ($P < 0.01$). Plasma insulin ($P < 0.01$) and cholesterol ($P < 0.05$) concentration were affected by diets. Chewing activity was positively affected by increasing concentration of dietary NDF ($P < 0.01$). This study showed that diets rich in plant oil and low concentration of NDF induce the milk fat depression in mid-lactating cows, and with increasing dietary NDF concentration severity of milk fat depression can be alleviated.

Key Words: feeding behavior, oil supplementation, dietary fiber