M313 Effect of sugar and sodium propionate for barley grain in dairy calves starter on weaning and performance. H. Beiranvand, M. Khorvash, G. R. Ghorbani*, A. Homayouni, M. Mirzaei, and S. Kargar, *Isfahan University of Technology, Isfahan, Iran.*

Replacing dietary starch with sugar and sodium-propionate has been reported to improve performance in ruminant animals. This experiment was conducted to determine the effects of replacing different sources of energy with barley grain in dairy calves′ starter on weaning, dry matter intake, average daily gain (ADG), feed efficiency, skeletal growth, and fecal score. A total of 21 male calves (42 ± 4 kg; mean ± SD) were assigned randomly to one of 3 following treatments: 1) no replacing (Control); 2) replacing sugar at 5% of dietary DM with barley (Sugar); and 3) replacing sodium-propionate at 5% of dietary DM with barley (Propionate). These parameters were measured and reported during 3 time periods (d 1 to 42, 43 to 70 and 1 to 70). All data were analyzed as completely randomized design using the MIXED procedure of SAS (SAS, 2003). Each calf was housed in an individual box with unlimited access to water. All dietary treatments were provided ad-libitum in addition to milk (4 kg/head/day). The base of weaning was consumption of 1 kg solid feed during 3 consecutive days. Feeding Sugar significantly decreased age of weaning compared with Propionate (50 vs. 60 d), however, Propionate negatively affected this variable compared with Control ($P < 0.02$). Dry matter intake, ADG, feed efficiency, skeletal growth indices and fecal score were not affected by treatments. Results of current experiment showed that using sugar but not sodium-propionate as an alternative for barley grain in dairy calves starter can be an option based on its cost and availability.

Key words: dairy calves, propionate, sugar

M314 Evaluation of content and epithelial attached bacterial community in the rumen of steers differing in susceptibility to rumen acidosis. Y. Chen*, M. Oba, and L. L. Guan, *Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Alberta, Canada.*

Rumen acidosis is a common digestive disorder problem in ruminant livestock industry. The objective of this study was to determine if ruminal bacteria diversity and density are different between acidosis-susceptible (AS) and acidosis-resistant (AR) beef cattle. Six steers were selected from a pool of 17 steers fed a feedlot diet containing grain at 85% of dietary DM. Based on continuous rumen pH measurements for a 3-d period, steers that were highest (n = 3) and lowest (n = 3) in severity of rumen acidosis, indicated by the area under pH 5.8 (pH units × min/d), were classified as AS and AR animals, respectively. Rumen papillae and digesta were collected at 0, 2, 4 and 6h after feeding and bacterial diversity was characterized using PCR-denaturing gradient gel electrophoresis (PCR-DGGE) and quantitative real time PCR (qRT-PCR) analysis. Bacterial profiles of rumen digesta samples from AR group was 69.7% similar to those from AS group while the epimural bacterial (bacteria attached to the ruminal papillae) profiles from AR group was 73.5% similar to those from AS group. The copy number of total 16S rRNA genes in the rumen digesta of AS steers was 10-fold higher than that of AR steers, while it was not different between AR and AS epimural communities. However, the copy number of 16S rRNA gene of *Selenomonas ruminantium* was higher for AS compared with AR steers ($P = 0.05$) for both digesta and epimural samples. In addition, the copy number of total 16S rRNA genes of epimural bacteria was positively correlated with ruminal pH (r = 0.59, $P = 0.04$) and negatively correlated with total VFA concentration (r = −0.59, $P = 0.05$) for AR steers, but no such relationship was found for AS animals. Furthermore, the copy number of total 16S rRNA genes of content bacteria was positively correlated with molar proportion of butyrate (r = 0.74, $P = 0.006$) for AR animals, while it was negatively correlated with molar proportion of butyrate (r = −0.73, $P = 0.007$) for AS animals. These results suggest that the diversity and population of some bacterial species can be different between AS and AR animals.

M315 Supplementing rumen-protected Met and Lys in alfalfa and red clover silage diets fed to lactating dairy cows. G. A. Broderick*[1], R. P. Walgenbach[1], M. J. de Veth[2], and N. D. Luchini[3], *[1]U.S. Dairy Forage Research Center, Madison, WI, [2]Balchem Corporation, New Hampton, NY, [3]Adisseo, Alpharetta, GA.*

Action of polyphenol oxidase reduces NPN formation in red clover silage (RCS). In 7 previous trials, RCS averaged (% of total N) 36% NPN vs. 54% NPN in alfalfa silage (AS). Feeding RCS increased intestinal protein absorption but with no improvement in N utilization, suggesting depressed utilization of one or more essential AA. This trial tested effects of adding rumen-protected Met (RPM) and Lys (RPL) to AS and RCS diets. Forty-eight lactating Holstein cows were blocked by DIM and parity into 6 squares in an incomplete 8x8 Latin square with a 2x2x2 arrangement of diets: AS or RCS, with or without RPM (15 g/d of Smartamine-Mproviding 10.5 g/d of total Met), with or without RPL (69 g/d of AminoShure-L providing 26 g/d of total Lys). Diets were formulated to contain (DM basis): 50% AS and 20% corn silage or 63% RCS and 7% corn silage; plus 24% corn, 3% solvent soybean meal; and 16% CP and 31% NDF. Periods were 4-wk (total 16 wk); data from the last 2 wk were analyzed using Proc Mixed in SAS. LS-means are reported in the table. Feeding AS increased DMI, yield of ECM, milk fat content and yield, and protein content. However, RCS improved ECM/DMI and MUN. RPM increased DMI and milk fat and protein content. No responses to RPL were detected but RPM × RPL interactions suggested differential responses to RPL versus RPL plus RPM. Lack of silage × RPAA interactions suggested there was no specific impairment of Met or Lys utilization on RCS.

Table 1.

	Forage			RPM, g/d			RPL, g/d		
Variable	AS	RCS	P > F	0	15	P > F	0	69	P > F
DM intake, kg/d	23.9	22.7	<0.01	23.1	23.6	0.01	23.3	23.3	0.98
Milk, kg/d	35.0	34.8	0.47	34.9	34.9	0.92	35.1	34.7	0.23
ECM, kg/d	34.0	33.2	0.03	33.5	33.7	0.47	33.7	33.5	0.64
ECM/DMI	1.43	1.47	0.02	1.46	1.43	0.07	1.45	1.44	0.65
Fat, %	4.06	3.93	<0.01	3.95	4.04	0.05	3.98	4.01	0.43
Fat, kg/d	1.40	1.34	<0.01	1.37	1.38	0.46	1.38	1.38	0.81
Protein, %	3.04	3.01	0.03	2.99	3.06	<0.01	3.01	3.04	0.12
Protein, kg/d	1.04	1.03	0.09	1.03	1.04	0.11	1.04	1.03	0.66
MUN, mg/dl	15.1	12.9	<0.01	14.0	14.0	0.63	13.9	14.1	0.12

Key words: alfalfa silage, red clover silage, rumen-protected AA

M316 Steam-flaked soybeans in lactating dairy cow diets. H. R. Bruns*[1], K. F. Kalscheur[1], D. J. Schingoethe[1], R. Rosenboom[2],

G. Doppenberg[2], and A. R. Hippen[1], *[1]South Dakota State University, Brookings, [2]Deluxe Feeds, Sheldon, IA.*

While most soybean feedstuffs have been extensively investigated for use in ruminant diets, there is a lack of information regarding steam-flaked soybeans (Deluxe Feeds – EnRG Flakes; Sheldon, IA). This research evaluated various inclusion rates of steam-flaked soybeans (SFSB) in lactating dairy cattle diets. Twelve multiparous Holstein cows (103 ± 39 DIM) were used in a 4 × 4 Latin-square experiment with 28-d periods, 14-d for diet transitioning followed by a 14-d sampling period. Treatments were inclusion of SFSB at 0, 5, 10 and 15% of dietary DM, replacing a mixture of soybean meal, soyhulls, calcium salts of fatty acids, and choice white grease. Animals were fed typical lactating dairy cow diets formulated to be isonitrogenous and isoenergetic containing 60% of DM as forage and 40% of DM as concentrate. Dry matter intake (30 kg/d) was similar for all treatments and milk production was also not different with 42.1, 43.1, 41.9, and 41.9 kg/d for 0, 5, 10, and 15% SFSB, respectively. Milk fat percentage (3.6%) and yield (1.5 kg/d) was similar across treatments. Milk protein percentages (3.6%) and yields (1.15 kg/d) and lactose concentrations (4.9%) were also unaffected by the amount of SFSB in the diet. Feed efficiency (1.4 kg milk / kg DMI) was consistent throughout all dietary treatments. Milk urea nitrogen concentration and yield decreased linearly (14.6, 14.2, 13.9 and 13.3 mg/dL and 6.2, 6.2, 5.8 and 5.6 g/d; $P < 0.01$) as the amount of SFSB in the diet increased. Body weight changes (−3.69, 3.43, 7.97 and 14.8 kg; $P < 0.10$) tended to increase linearly, and body condition score changes (0.07, 0.06, 0.03 and −0.03; $P < 0.05$) decreased linearly as the amount of SFSB in the diet increased. This research demonstrates that steam-flaked soybeans can be substituted for soybean meal and commercial fat sources while maintaining milk and milk fat production and significantly decreasing milk urea nitrogen production.

Key words: steam-flaked soybeans, full-fat soybeans, lactating cows

M317 Effects of different amounts of dietary protected and unprotected niacin on intake and milk production. F. C. Cardoso*[1], J. Garrett[2], and J. K. Drackley[1], *[1]University of Illinois, Urbana, [2]QualiTech, Chaska, MN.*

Oral supplementation of niacin has been reported to increase milk yield in dairy cows. However, its effects on milk yield and components have been variable among studies. Protection of niacin against degradation by rumen microbiota might help achieve consistent response to niacin. Our objective was to determine the effects of 3 levels of protected niacin (PN) in comparison with unprotected niacin (UN) either in the diet or infused into the abomasum. Six multiparous rumen–cannulated Holstein cows (BW = 656 kg) after peak lactation (128 ± 23 d in milk) were assigned to 1 of 6 treatments in a completely randomized 6 × 6 Latin Square with an extra period to measure carryover effects. Periods consisted of a 7-d adaptation period followed by a 7-d measurement period. Cows were fed according to NRC (2001) recommendations. Treatments were: CON, no niacin; INF, abomasal infusion of 12 g unprotected niacin (UN); N12, 12 g UN; BN3, 3 g PN; BN6, 6 g PN; and BN12, 12 g PN. Treatments N12, BN3, BN6, and BN12 were top-dressed on the TMR twice daily. The daily dose of treatment INF was divided in 5 equal portions and infused during the day every 4 h. Cows receiving treatments other than INF were infused with the same volume of water at the same time. Statistical analysis was performed using the MIXED procedure of SAS. Least squares means were separated using the Tukey adjustment. Milk yield tended ($P = 0.06$) to be greater for N12 (37.1 ± 2.3 kg) than for BN12 (33.4 ± 2.3 kg). The DMI was lower ($P = 0.02$) for BN12 (21.5 ± 1 kg) than for N12 (24.3 ± 1 kg). The linear effect among BN3, BN6, and BN12 was significant ($P = 0.04$) for DMI. Feed efficiency (FE = energy-corrected milk/DMI) was greater ($P = 0.04$) for BN12 (1.7 ± 0.1) than for N12 (1.5 ± 0.1).Furthermore, the positive linear effect among BN3, BN6, and BN12 was significant ($P = 0.03$) for FE. The milk fat/protein ratio (F/P) was higher ($P = 0.03$) for BN12 (1.28 ± 0.09) than for N12 (1.15 ± 0.09). The positive linear effect among BN3, BN6, and BN12 was significant ($P < 0.01$) for F/P. In conclusion, cows receiving BN12 had higher F/P and FE but lower milk yield than cows receiving the same amount of UN.

Key words: niacin, milk yield, feed efficiency

M318 Effect of malate supplementation to dairy cows on milk production: A meta-analysis. J. Alcañiz*[1], J. J. Mallo[1], M. Puyalto[1], M. I. Gracia[2], and J. Sánchez[2], *[1]Norel, S.A., Madrid, Spain, [2]Imasde Agroalimentaria, S.L., Madrid, Spain.*

We evaluated the effect of malate supplementation on milk production in lactating dairy cows. Four trials involving 516 dairy cows assessed the efficacy of malate. A blocked design was applied in each study with 2 treatments: 1) Control, and 2) Malate (48–84 g/cow/day). The studies were similar in basic design and each treatment group (T1 Control and T2 Malate) equivalence in terms of parity, pretrial milk yield and days in milk. Three trials supplemented the additive at 48 g/cow/day in the TMR and one study at 84 g/cow/day in the concentrate. Milk production was recorded daily during 71–90 d of lactation and averages calculated in a weekly basis. Data were tested for homogeneity, pooled and combined in a meta-analysis. Data were analyzed using mixed models ANOVA with terms included for the fixed effect of treatment and the random effect of study. Animal (cow) within treatment and study were considered as a random effects. Pretrial milk yield and DIM were included as a covariate. A repeated measures ANOVA was conducted with time. Malate supplementation significantly increased milk production by 2.3% across the lactation weeks studied (41.81 vs. 42.85 kg/d; $P = 0.0107$, SE = 0.33). An interaction between lactation week and treatment was detected ($P = 0.0015$). Malate supplementation increased milk production from the beginning of the trial until the fourth week of trial (41.8 vs. 41.1 kg/d, SE = 0.46; 42.2 vs. 42.3 kg/d, SE = 0.45; 41.6 vs. 42.1 kg/d, SE = 0.44; 41.5 vs. 42.7 kg/d, SE = 0.42; for wk 1 to wk 4, respectively), maintaining the improvement afterward. It can be concluded that the supplementation of dairy cow rations with malate increases milk production under farm conditions.

Key words: dairy cows, malate, milk yield

M319 Independent effects of diet chemical fiber and physical measurements on dairy cows. D. Sauvant*[1], W. Z. Yang[2], D. R. Mertens[3], and K. A. Beauchemin[2], *[1]AgroParisTech-INRA, Paris, France, [2]Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, [3]Innovation & Research, Belleville, WI.*

Fiber effectiveness has been defined by peNDF, which is the product of NDF and the fraction retained on a 1.18-mm sieve. To evaluate the concept of using an index (product of fiber and particle size) for predicting cow responses, a meta-analysis was performed to assess the independent and interaction effects of chemical fiber (NDF) and alternative physical measurements (PM). A database was compiled from 24 published experiments using lactating dairy cows and 104 (n) treatments where dietary NDF and PM were reported. Forages were long, chopped or grounded. Dietary NDF averaged 35.3 ± 7.1% of DM.

Three PM were considered: mean particle size (MPS; 3.72 ± 2.02 mm, n = 44), particles retained on a 2-mm sieve (P2; 42.4 ± 15.5% DM, n = 40) or on 19-mm and 8-mm sieves of the Penn State Particle Separator (P8; 49.5 ± 12.7% DM, n = 36). As the PM was not measured with the same criteria across the experiments, a dummy variable (0 or 1) was created to systematically code the short or long PM, respectively. The effects of NDF and PM were tested on chewing index (CI; 37.5 ± 11.9 min/kg DMI, n = 78), rumen pH (6.08 ± 0.26, n = 60), acetate to propionate ratio (A:P; 2.70 ± 0.73, n = 52), milk yield (MY; 29.0 ± 10.6 kg/d, n = 96) and milk fat percentage (MF; 3.75 ± 0.62%, n = 82). Meta analyses were carried out using GLM procedure including the effects of experiment, NDF, PM and the interaction. NDF was a continuous covariable. The mean differences between treatments were: NDF = 4.3%DM; MPS = 1.31mm; P2 = 7.5%DM; and P8 = 8.6%DM. Experiment was systematically significant ($P < 0.01$). For CI, pH and A:P, influences of NDF and PM were significant ($P < 0.01$), but there was no interaction between them. For MY and MF, only the effect of NDF was significant ($P < 0.01$). As expected, MF was negatively affected ($P < 0.01$) by pH (MF = −1.05 + 0.76 pH, n = 48, RMSE = 0.05%). In conclusion, the effects of NDF and PM appeared to be additive in published trials, which questions the principle and the validity of their product (peNDF) for predicting lactating cow responses.

Key words: effective fiber, meta-analysis, dairy cattle

M320 Effect of feeding *Camelina sativa* seeds or meal on lactation performance and milk fatty acid composition in lactating dairy cows. J. P. Sarramone*[1,2], C. Benchaar[3], Y. Lebeuf[1,2], R. Gervais[1], and P. Y. Chouinard[1,2], *[1]Département des sciences animales, Université Laval, Québec, QC, Canada, [2]Institute of Nutraceuticals and Functional Foods (INAF), Québec, QC, Canada, [3]Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre, Sherbrooke, QC, Canada.*

Camelina sativa and flaxseed are both sources of *c*9,*c*12,*c*15–18:3. The objective of the current study was to evaluate the effects of feeding camelina seeds, camelina meal, flaxseed, or dried distillers grains with solubles (source of *c*9,*c*12–18:2) on milk yield and composition in lactating dairy cows. Four Holstein cows were used in a 4 × 4 Latin square design with 21-d periods, including 14 d of adaptation followed by 7 d of sampling. Four isolipidic dietary treatments (4.5% fat) were formulated: DDGS) 18% corn dried distillers grains with solubles; CM) 9.5% camelina meal; CS) 4.2% camelina seeds; FS) 4.7% flaxseed (DM basis). Differences between treatments were declared significant at $P \leq 0.05$ using the Tukey correction for multiple comparisons. Body weight, DM intake, milk protein content and yield, milk lactose content, MUN, and SCC were similar among treatments. Milk yield was higher for DDGS (37.4 kg/d;*b*), intermediate for CM (37.0 kg/d;*ab*), and CS (36.5 kg/d;*ab*), and lower for FS (35.6 kg/d;*a*). Milk fat content and yield were lower for CM (2.71%, 1000 g/d;*a*) compared with DDGS (3.63%, 1355 g/d;*b*), FS (3.73%, 1328 g/d;*b*), and CS (3.48%, 1258 g/d;*b*). Concentrations (mg/g FA) of *c*11–20:1 and *c*13–22:1 were lower for DDGS (0.9*c* and 0.2*c*), and FS (0.5*c* and 0.1*c*), intermediate for CS (3.4*b* and 1.0*b*), and higher for CM (8.1*a* and 1.8*a*). Cows fed FS had a higher content of *c*9,*c*12,*c*15–18:3 (6.4*a*) in milk fat compared with DDGS (3.5*c*), CM (4.5*bc*), and CS (5.0*b*). Feeding CM and FS increased milk fat content of *c*9,*t*11,*c*15–18:3 compared with DDGS and CS (0.4*a*, 0.4*a*, 0.2*b*, and 0.3*b*, respectively). Milk fat contents of *t*11,*c*15–18:2, *c*9,*t*13–18:2, and *t*13/*t*14–18:1 were higher for CM (7.2*a*, 2.9*a*, and 17.6*a*) intermediate for CS (2.3*b*, 1.9*ab*, 13.4*b*) and lower for FS (1.2*bc*, 1.5*b*, and 8.0*c*) and DDGS (0.8*c*, 1.6*b*, and 8.2*c*). Milk fat contents of *t*10–18:1 and *t*11–18:1 were higher for CM (22.0*a* and 29.2*a*) compared with DDGS (5.4*b* and 17.9*b*), CS (6.4*b* and 17.2*bc*), and FS (3.2*b* and 8.6*c*). In conclusion, FS was more efficient to increase *c*9,*c*12,*c*15–18:3 in milk fat compared with camelina fed as meal or seeds.

Key words: *Camelina sativa*, linseed, milk fatty acids

M321 Milk fatty acid profile of dairy goats fed increasing levels of an unprotected conjugated linoleic acid (UCLA) supplement. D. Fernandes[1], J. Souza[2], M. M. Almeida[3], M. Baldin[1], R. Dresch[1], F. Batistel[2], E. Ticiani[2], M. A. S. Gama[4], and D. E. Oliveira*[2,1], *[1]Centro de Ciências Agroveterinárias, UDESC, Lages, SC, Brasil, [2]Centro de Educação Superior do Oeste, UDESC, Chapecó, SC, Brasil, [3]Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brasil, [4]Embrapa, CNPGL, Juiz de Fora, MG, Brasil.*

The aim of this study was to evaluate the dose-response changes in milk fatty acid profile associated with the reduction observed in milk fat content and yield of dairy goats fed increasing levels of UCLA (Fernandes et al., 2010, JDS, 93:456). Eight Toggenburg goats (4 primiparous and 4 multiparous; 120–150 DIM) received 4 levels of UCLA in a 4 × 4 Latin square (LS) design. The treatments were: 1) Control: 45 g/d of calcium salts of soybean oil (CSSO); 2) CLA15: 30 g/d of CSSO plus 15 g/d of UCLA; 3) CLA30: 15 g/d of CSSO plus 30 g/d of UCLA and 4) CLA45: 45 g/d of UCLA. Each experimental period lasted 12 d, with 6 d of washout intervals. The UCLA contained 29% of t-10, c-12 CLA and 29% of c-9, t-11 CLA. Lipid supplements were mixed into the concentrate (1.0 kg/d) fed twice a day. Milk samples were collected on the last day of each experimental period for fatty acid analysis. Data were analyzed using GLM procedures, including animal, period, LS, and treatment as sources of variation. The UCLA reduced linearly the desaturase indexes (Table 1). Concentration of fatty acids < 16C in milk fat was linearly reduced as the CLA dose increased, suggesting that inhibition of de novo synthesis was more pronounced with the highest CLA dose. The secretion of t-10, c-12 CLA in milk increased with the CLA dose (Control = 0.02g/d; CLA15 = 0.08g/d; CLA30 = 0.13g/d; CLA45 = 0.17g/d; $r^2 = 0.77$; $P < 0.001$). The transfer efficiency of t-10, c-12 CLA into milk fat decreased with the CLA dose (CLA15 = 1.82%; CLA30 = 1.48%; CLA45 = 1.33%; $r^2 = 0.71$; $P < 0.001$). The milk fatty acid profile was changed in a dose-response way.

Table 1. Fatty acid profile of dairy goats fed increasing levels of UCLA

	Control	CLA15	CLA30	CLA45	SEM	*P*-value
g/100g of total FA						
CLA isomers						
cis-9,trans-11	0.5	0.6	0.7	0.8	0.03	0.001
trans-10,cis-12	0.03	0.1	0.3	0.5	0.02	0.001
Desaturase indexes						
14:1/14:0+14:1	0.01	0.008	0.006	0.005	0.0005	0.001
16:1/16:0+16:1	0.02	0.018	0.017	0.01	0.001	0.003
18:1/18:0+18:1	0.59	0.53	0.49	0.46	0.01	0.001
CLA/18:1t11+CLA	0.30	0.27	0.26	0.27	0.01	0.05
Ratios						
<C16	28.7	26.7	24.3	23.3	0.7	0.004
C16+C16:1	25.1	24.7	23.6	21.9	0.3	0.001
>C16	42.2	44.8	47.5	49.4	0.8	0.001

Key words: dairy products, fatty acid profile, desaturase index

M322 Performance and milk fatty acid profile of dairy goats fed a total mixed ration (TMR) containing an unprotected conjugated linoleic acid (UCLA) supplement. M. Baldin[1], J. Souza[2], M. M. Almeida[3], R. Dresch[1], D. Fernandes[1], F. Batistel[2], E. Ticiani[2], F. C. F. Lopes[4], M. A. S. Gama[4], and D. E. Oliveira*[2,1], *[1]Centro de Ciências Agroveterinárias, UDESC, Lages, SC, Brasil, [2]Centro de Educação Superior do Oeste, UDESC, Chapecó, SC, Brasil, [3]Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brasil, [4]Embrapa, CNPGL, Juiz de Fora, MG, Brasil.*

Lactating goats have been shown to be less prone to trans-10 cis-12 CLA-induced milk fat depression (MFD) than cows and ewes on a metabolic live-weight basis. This study aimed to evaluate the effects of UCLA, fed as a TMR ingredient, on performance and milk fatty acid (FA) profile of dairy goats. Eighteen Toggenburg goats (83 ± 17 DIM) were used in a crossover design with 14 d experimental periods and 6 d washout interval. The treatments were: 1) Control (C): 30 g/d of calcium salts of soybean oil or 2) CLA: 30 g/d of UCLA (29% of trans-10 cis-12 CLA). Lipid supplements were mixed into 1.0 kg of concentrate and then with corn silage (50:50, DM basis) and fed 3 times a day. After complete consumption, corn silage was fed ad libitum and orts recorded. Milk samples were taken every 2 d to determine its solid contents and on the last day of each experimental period for milk FA analysis. Data were analyzed as a repeated measurement design using PROC MIXED of SAS, assuming period and treatment sequence as random effects. Milk yield (1.91 vs. 1.90 kg/d, SEM = 0.28), body weight (45.6 vs. 45.2 kg, SEM = 10.5), dry matter intake per metabolic weight (7.66 vs. 7.53%, SEM = 0.87), milk protein content (2.80 vs. 2.81%, SEM = 0.18) and milk protein yield (51.3 vs. 51.4 g/d, SEM = 7.06) were unchanged ($P > 0.05$) by CLA. CLA reduced ($P < 0.001$) milk fat content (4.10 vs. 3.29%, SEM = 0.39) and yield (75.0 vs. 61.1 g/d, SEM = 9.5). CLA reduced the concentrations of C4:0 to C14:0 chain FA (24.8 vs. 29.0%, SEM = 1.58) and C16:0 (22.9 vs. 26.6, SEM = 1.27), but increased long chain FA in milk fat (45.9 vs. 38.7%, SEM = 2.41, $P < 0.001$). Milk fat trans-10 cis-12 CLA was strongly increased by CLA (0.42 vs. 0.02%, SEM = 0.03, $P < 0.001$), whereas all desaturase indexes were reduced ($P < 0.05$). Results showed that milk fat synthesis was partially reduced despite the large increase in milk fat trans-10 cis-12 CLA content, corroborating previous data indicating that goats are less responsive to CLA-induced MFD than cows and ewes (Acknowledgment: FAPEMIG).

Key words: milk fatty acids, milk fat depression, goats

M323 Effects of feeding levels of a milk replacer on growth performance, digestion and metabolism of nutrients, and serum biochemical markers in calves. X. Xu, J. Wang, Y. Tu*, N. Zhang, C.-G. Jiang, and Q. Diao, *Key Laboratory of Feed Biotechnology of Ministry of Agriculture/Feed Research Institute, Chinese Academy of Agricultural Sciences, Beijing, P. R. China.*

This study investigated the effect of feeding levels of a milk replacer on growth, digestion and absorption of nutrients and serum biochemical markers in calves. Twenty-four newborn Holstein calves were allotted to 3 groups with 8 calves each and each group was fed a milk replacer at 9.5%(group L), 11.0% (group M) or 12.5% (group H) of body weight (BW), respectively, for 8 weeks. Feed intake(FI), BW and body measurement of the calves were measured and blood samples were collected at 0, 2, 4, 6 and 8 weeks of age. A digestion trial was conducted by total collection of feces and urine during 3–4 and 5–6 weeks of age, respectively. Data were analyzed by GLM progress of SAS software. FI differed among 3 groups (519.8, 625.5 and 711.1 g/d, $P < 0.05$). The average daily gain of calves from group M or H was greater than that from group L (357.6 or 349.3 vs. 250.0 g/d, $P < 0.05$) during 3–4 weeks of age. Body length, wither height and heart girth did not differ among 3 groups. During 3 to 4 weeks of age, the apparent digestibility of dry matter (DMD) or organic matter (DOM) were greater in group L than in group H (84.16% vs. 80.69% or 86.55% vs. 82.02%, $P < 0.05$), and the apparent digestibility of crude protein was greater in group M than in group H (68.65% vs. 61.51%, $P < 0.05$). During 5 to 6 weeks of age, DMD, DOM and the apparent digestibility of calcium were greater in group M than in group H (87.11% vs. 85.40%, 88.07% vs. 86.70%, and 67.75 vs. 58.04%, $P < 0.05$). At 2 weeks of age, the serum albumin concentration was greater in group L or M than that in group H (31.49 or 31.38 vs. 29.40 g/L, $P < 0.05$), the serum triglyceride concentration was greater in group H than in group L ($P < 0.05$), and serum urea nitrogen was greater in group M than in group L (3.43 vs. 2.59 mmol/L, $P < 0.05$). At the other ages, serum biochemical markers were not influenced by the treatments. The milk replacer fed at 11.0%BW was better than those fed at 9.5 or 12.5%BW in growth of the calves, especially at 2–4 weeks of age. But the digestion and absorption of nutrients decreased as feeding level increased.

Key words: calves milk replacer, feeding level, growth and digestion

M324 Effect of dietary starch content on response to an intravenous glucose tolerance test in early lactation dairy cows. B. H. Nelson*, K. W. Cotanch, R. J. Grant, and H. M. Dann, *William H. Miner Agricultural Research Institute, Chazy, NY.*

Multiparous Holstein cows (n = 24) were used to evaluate the effect of dietary starch content in corn silage-based diets fed from 1 to 21 d in milk (DIM) on blood metabolites following an intravenous glucose tolerance test (GTT). Cows were fed either 1) a low-starch diet (L; 21.0% starch; 76.5% in vitro 7-h starch digestibility (IVSD); 1.65 Mcal NE_L/kg), 2) a medium-starch diet (M; 23.2%; 76.7% IVSD; 1.67 Mcal NE_L/kg), or 3) a high-starch diet (H; 25.5%; 74.5% IVSD; 1.68 Mcal NE_L/kg). Corn meal was replaced partially with soyhulls and wheat middlings in the L and M diets. The GTT was done on d 15 ± 2. Cows were fasted 1 h before and during the GTT. Glucose (dextrose 50% w/v) was infused via a jugular catheter at 0.25g/kg of body weight. Blood samples were collected at −15, −10, 0, 10, 15, 20, 25, 30, 45, 60, 90, 120, 150, and 180 min relative to glucose administration and analyzed for plasma glucose, serum insulin, and serum nonesterified fatty acids (NEFA). The NLIN procedure of SAS was used to fit exponential curves for [glucose] during the first 60 min of the GTT to calculate clearance rate (CR), time to reach half maximal concentration ($T_{1/2}$), and time to reach basal level (T_{basal}). Area under the curve (AUC) was calculated using the trapezoidal method and actual concentration values discounted for the mean basal concentration (mean of −15, −10, and 0 min). Data were analyzed as a completely randomized design by ANOVA with the MIXED procedure of SAS using treatment as a fixed factor and cow within treatment as a random factor. Treatment did not affect ($P > 0.10$) peak [glucose] (218 ± 13 mg/dL), nadir [glucose] (46 ± 3 mg/dL), CR_{60} (3.46 ± 0.38%/min), $T_{1/2}$ (21.4 ± 2.0 min), Tbasal (42.1 ± 1.7 min), AUC_{60} (3018 ± 203 mg/dL × min) or AUC_{180} (2782 ± 366 mg/dL × min). The insulin response (peak: 119 ± 21 μIU/mL; AUC_{60}: 2905 ± 534 μIU/mL × min; AUC_{180}: 2657 ± 518 μIU/mL × min) was unaffected ($P > 0.10$) by treatment. The peak (1151 ± 211 μEq/L) and nadir (212 ± 1 μEq/L) [NEFA] were not different ($P > 0.10$) among treatments. Dietary starch content did not affect glucose metabolism in early lactation cows.

Key words: starch, transition cow, glucose tolerance test

M325 Effect of milk feeding level on pre- and post-weaning performance of dairy calves. E. K. Miller-Cushon[1], R. Bergeron[2], K. E. Leslie[3], and T. J. DeVries*[1], *[1]Dept. Animal and Poultry Science, University of Guelph, Kemptville Campus, Kemptville, ON, Canada, [2]Dept. Animal and Poultry Science, University of Guelph, Campus d'Alfred, Alfred, ON, Canada, [3]Dept. Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada.*

There is evidence that milk feeding level influences growth and solid feed intake of calves early in life. The objective of this study was to determine the effects of milk feeding level on intake and growth of calves, particularly once transitioned to a novel diet post milk-weaning. Twenty individually housed Holstein bull calves were randomly assigned at birth to a daily milk allotment, fed via a teat for 6 wk: 1) ad libitum (ADL), or 2) a rate of 5 L/d, in 2 feedings (LIM). Concentrate was provided ad libitum during the milk-feeding stage. Calves were weaned during wk 7 by reducing milk allotment by 15%/d. After milk weaning, all calves were fed a complete pelleted diet ad libitum for 7 wks. Intake was recorded daily and calves were weighed 2x/wk. Data was analyzed using a repeated measures mixed model. During milk-feeding, ADL calves consumed more milk (12.2 L/d vs. 4.9 L/d, SE = 0.8, $P < 0.001$), but LIM calves had greater DMI (0.48 vs. 0.09 kg/d, SE = 0.08, $P < 0.001$). ADL calves had greater ADG than LIM during milk-feeding (1.2 vs. 0.6 kg/d, SE = 0.07, $P < 0.001$); before weaning, ADL calves had greater weights (94.2 vs. 68.2 kg, SE = 4.8, $P < 0.001$). During the 7 d of weaning, LIM calves experienced no growth check, while ADL calves plateaued in weight gain (0.7 vs. −0.03 kg/d, SE = 0.15, $P < 0.001$). Upon transition to solid feed, DMI was similar between all calves (in wk 8, 1.9 kg/d, $P = 0.2$), indicating that differences in early feed intake did not influence later willingness to consume a novel ration. Calves had similar ADG immediately after weaning (in wk 8, 0.7 kg/d, $P = 0.9$) and there was no long-term treatment effect on ADG (post-weaning mean of 1.2 kg/d, $P = 0.9$). Thus, greater body weights for calves previously fed ADL were maintained in the post-weaning period (in wk 14, 143.5 vs. 123.5 kg, SE = 5.5, $P = 0.002$); daily DMI as a % of body weight was less for ADL calves (2.7 vs. 3.3%, SE = 0.2, $P = 0.01$), indicating greater efficiency of growth during that time period. The results indicate that calves fed different milk levels had similar long-term intakes and ADG; however, ADL calves maintained their advantage in body weight during the post-weaning period.

Key words: dairy calf, milk feeding level, growth

M326 Effects of methionine hydroxy copper supplementation on lactation performance, fertility, nutrients digestibility and some metabolic indices in dairy cows. F. Wang[1], S. L. Li*[1], Y. J. Wang[1], X. Jin[1], H. Cao[2], F. C. Guo[2], and Y. M. Wan[2], *[1]State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University, Beijing, China, [2]Novus International Research Center, Beijing, China.*

The objective of the study was to investigate the effects of chelated copper ((HMTBA)2-Cu; MINTREX Cu Novus International Inc., St. Charles, MO) on lactation and reproductive performance of dairy cow. Thirty lactating Holstein cows were assigned into 3 groups using randomized block design: 1) S: 12 ppm Cu in concentrate provided by CuSO4; 2) SM: 6 ppm Cu provided by CuSO4 plus 6 ppm by (HMTBA)2 Cu; 3) M: 12 ppm Cu provided by (HMTBA)2 Cu, and the level of diet Cu was determined according to NRC (2001) requirement. The trial was completed in 120 d, including 20 d for adaptation. The results showed that the average milk yield and 4% FCM yield of cows in SM were increased significantly compared with those in the S and M($P = 0.08$; $P = 0.06$). Cows fed SM had lower milk lactose compared with S or M fed cows. Reproductive performance showed that the number of follicles and ovarian score of SM and M increased numerically ($P > 0.05$) . ADF apparent digestibility of SM increased compared with S ($P < 0.1$), while the digestibility of NDF increased compared with M ($P < 0.1$). According to the comprehensive analysis of serum at fasting and hours 1, 2, and 4 after first feeding, Significantly decrease was observed for serum Cu concentration of SM ($P < 0.01$) while significantly increase was observed for serum K concentration in SM and M compared with S ($P < 0.05$). It is concluded that feeding 6 ppm chelated Cu plus 6 ppm CuSO4 optimized performance of dairy cows.

Key words: fertility, methionine hydroxy copper, nutrient digestibility

M327 Effects of methionine hydroxy zinc supplementation on lactation performance, fertility, nutrients digestibility and some metabolic indices in dairy cows. F. Wang[1], S. L. Li*[1], H. Cao[2], F. C. Cao[2], and Y. M. Wang[2], *[1]State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University, Beijing, China, [2]Novus International Research Center, Beijing, China.*

The objective of the study was to investigate the effects of chelated zinc ((HMTBA)2-Zn; MINTREX Zn Novus International, Inc., St. Charles, MO) on lactation and reproductive performance of dairy cow. Thirty lactating Holstein cows were assigned into 3 groups using randomized block design: 1) S: 42 ppm Zn in concentrate provided by ZnSO4; 2) SM: 21 ppm Zn provided by ZnSO4 plus 21 ppm by HMTBA)2 Zn; 3) M: 42 ppm Zn provided by HMTBA)2 Zn, and the level of diet Zn was determined according to NRC (2001) requirement. The trial was completed in 120 d, including 20 d for adaptation. The results showed that milk yields of the 3 groups showed slight downward trends overall and the average milk yield of all cows during the trail was 29.89kg/d. The average milk yield and 4%FCM of S (28.79kg; 29.28kg) were lower than the SM (30.40kg; 32.49kg) and the M (30.49kg; 31.04kg), but no significant difference were found between groups ($P = 0.42$; $P = 0.53$). Cows fed SM had lower milk lactose compared with S or M fed cows ($P = 0.08$). Numerically, the apparent digestibility of organic matter, crude protein, crude fat and acid detergent fiber of S were the lowest The serum alkaline phosphatase and Lactate dehydrogenase contents in M cows were significantly higher than the S and the SM ($P < 0.05$). According to the comprehensive analysis of serum at fasting and hours1, 2, and 4 after first feeding, the serum zinc concentration of S was significantly lower than SM and M group ($P = 0.01$), while K ion content was significantly higher than the SM and M ($P = 0.04$). It is concluded that feeding 42 ppm of chelated zinc optimized the performance and Zn status of dairy cows.

Key words: fertility, methionine hydroxy zinc, nutrient digestibility

M328 Effect of metabolizable protein level on milk production and composition of early lactating Holstein cows. A. Laki, K. Rezayazdi, and M. Dehghan-Banadaky*, *Animal Science Department, Campus of Agricultural and Natural Resources, University of Tehran, Karaj, Tehran, Iran.*

The objective of present study was to investigate the effects of metabolizable protein (MP) levels on milk production and milk composition in early lactating cows. Twenty 4 Holstein cows in early lactation (days

in milk = 30.67) were assigned to 4 diets with different MP levels included: 1) 10.60%, 2) 11.07%, 3) 11.54%, and 4) 12.00% basis of dry matter (DM). MP values for diets were determined by CNCPS software (V 5.2). Experiment lasted in 8 weeks. Cows were milked 3 times a day and milk yield was recorded at each milking times. Milk samples were taken every week. Milk compositions were analyzed by infrared test method. The results of this study showed that fat corrected milk (FCM) yield and protein yield increased as MP level increased until 11.54% (DM) and then decreased ($P < 0.05$). Milk fat percentage and yield not affected by MP level ($P > 0.05$). Milk lactose, solids not fat, total solids percentage and yield were the highest at 11.54% (DM) level (diet 3). Increasing MP level more than 11.54% (DM) did not improve milk composition. Milk urea nitrogen increased linearly as MP level increased. We conclude that nitrogen efficiency decrease linearly as MP level increased and relationship between FCM yield and milk protein yield with MP level is nonlinear.

Table 1. Effects of MP offered to dairy cows in early lactation on milk yield and milk composition

Item	1	2	3	4	SEM
Milk yield (kg/d)	34.78^{b}	35.0^{b}	36.01^{a}	36.44^{a}	0.60
FCM 4% (kg/d)	29.81^{b}	30.28^{ab}	32.2^{a}	31.68^{ab}	0.64
fat%	3.06	3.0	3.29	3.13	0.11
protein%	2.56^{b}	2.79^{a}	2.77^{ab}	2.6^{ab}	0.07
lactose%	4.72^{b}	4.74^{ab}	4.94^{a}	4.71^{b}	0.04
MUN (mg/dl)	15.0^{c}	16.89^{b}	18.54^{a}	19.16^{a}	0.90
fat (kg/d)	1.06	1.08	1.18	1.14	0.04
protein (kg/d)	0.89^{c}	0.97^{ab}	1.0^{a}	0.95^{b}	0.02
lactose (kg/d)	1.64^{c}	1.66^{bc}	1.78^{a}	1.72^{b}	0.02

$^{a–c}$Means within same row with different superscripts differ ($P < 0.05$).

Key words: Holstein cows, metabolizable protein, milk composition

M329 The effect of reducing dietary phosphorus on bone metabolism in lactating dairy cows. L. Puggaard[1], A. Liesegang[2], J. Sehested*[1], and P. Lund[1], *[1]Department of Animal Health and Bioscience, Aarhus University, Tjele, Denmark, [2]Vetsuisse Faculty, University of Zurich, Zurich, Switzerland.*

The effect of dietary phosphorus (P) on P balance and concentration of bone resorption marker carboxyterminal cross-linking telopeptide of Type 1 bone collagen (CTX) and bone formation marker osteocalcin (OC) were investigated in 18 Danish Holstein cows (676 ± 73 kg BW) in the period −6 to 36 weeks relative to calving. However, only data from wk 2, 6 and 12 will be presented here. Cows were blocked by calving date and randomly assigned to one of 3 dietary treatments: Low P (LP), Medium P (MP) or High P (HP) providing 2.2, 2.8 and 3.5 g P/kg DM. A pre-mix LP concentrate was composed of sugar beet pulp, soybean meal, molasses, rapeseed oil, feed salt and urea. The LP ration was composed of (g/kg DM): 461 (premix), 287 (corn silage), 163 (grass silage) and 88 (molasses). MP and HP diets were obtained by adding NaH2PO4 to the LP pre-mix. All diets were fed ad libitum. Individual P balances (difference between P intake and P in milk, feces and urine) were recorded at wk 2, 6 and 12 relative to calving. Milk yield and DMI were recorded over 2 d and corresponding fecal outputs were estimated by grab sampling and feed INDF as marker. Urinary output was estimated from 6 h quantitatively sampling. Blood samples were collected from the tail vein. Concentrations of CTX and OC were determined in serum using commercial available immunoassays. Intake of DM (kg/d) was significantly ($P = 0.0003$; SEM = 1.2) lower in LP (15.4) compared with HP (21.4) and MP (20.3). Milk production was similar among treatments (33.8 kg/d, $P = 0.51$; SEM = 3.0). Concentration of CTX (ng/mL) was significantly ($P = 0.005$; SEM = 1.3) higher in LP (5.4) compared with HP (2.7) and MP (2.9), whereas OC was similar among treatments (58.6 ng/mL, $P = 0.41$; SEM = 12.1). Balance of P (g/d) was significantly ($P = 0.01$; SEM = 5.8) lower in LP (−24.4) compared with HP (−10.2) and tended ($P = 0.06$) to be lower in MP (−19.5) compared with HP. The results suggest that cows were not able to maintain DMI at LP. The results also indicate that plasma CTX reflects P balance, which is influenced by dietary P level in early lactation.

Key words: bone markers, CTX and OC, phosphorus balance

M330 Evaluation of rumen microbial diversity population under influence of a polyclonal antibody preparation against lactate-producing and proteolytic bacteria in cows fed different energy sources. C. Marino*[2], W. Otero[1], C. Barreto[3], V. Pellizari[3], F. Ferreira[1], M. Arrigoni[2], and P. Rodrigues[1], *[1]University of Sao Paulo, FMVZ-USP, Pirassununga, Sao Paulo, Brazil, [2]University of Sao Paulo State, FMVZ-UNESP, Botucatu, Sao Paulo, Brazil, [3]University of Sao Paulo, ICB II-USP, Sao Paulo, Sao Paulo, Brazil.*

Nine ruminally cannulated cows fed different energy sources were used to evaluate an avian-derived polyclonal antibody preparation (PAP) against specific ruminal bacteria *Streptococcus bovis*, *Fusobacterium necrophorum*, *Clostridium aminophilum*, *Peptostreptococcus anaerobius* and *Clostridium sticklandii* and monensin (MON) on rumen protozoa counting. The experimental design was 3 Latin squares 3 × 3 distinguished by the main energy source in the diet [dry-ground corn grain (CG), high moisture corn silage (HMCS) or citrus pulp (CiPu)]. Inside each Latin square, animals received one of the feed additives per period (21 d) [none (CON), MON or PAP]. The ruminal content was collected in the d 21 of each trial at 4 h after feeding for the analysis of microbial ruminal diversity by the denaturing gradient gel electrophoresis (DGGE). Data were analyzed by MIXED procedure, which separated the effects of interaction between feed additive and energy source, effect of feed additive, effect of energy source as well as effects of period and animal inside the square. Mean effects were separated by PDIFF. Differences were declared at $P < 0.05$. An interaction between feed additive and energy source ($P = 0.0423$) was observed for the count of bands that were amplified in DGGE for *Archaea* community. In animals fed HMCS, the number of bands amplified in DGGE for *Archaea* community was greater in CON group (5.67) compared with MON (2.33) and PAP (2.67). In general lines, in the present experiment, it was not possible to assign that there was a pattern in the structures of amplification by *Bacteria* and *Archaea* communities of the ruminal content of animals treated with 2 different rumen modifiers or 3 distinct energetic sources.

Key words: denaturing gradient gel by electrophoresis, ionophore, microorganism

M331 Effect of poly-unsaturated fatty acid on plasma and milk fatty acid composition in early lactating dairy cows. B. Vlaeminck*[1], M. Hostens[2], E. Colman[1], S. De Campeneere[3], G. Opsomer[2], and V. Fievez[1], *[1]Laboratory for Animal Nutrition and Animal Product Quality, Ghent University, Melle, Belgium, [2]Department of Reproduction, Obstetrics and Herd Health, Ghent University, Merelbeke, Bel-*

gium, [3]Department of Animal Sciences, Institute for Agricultural and Fisheries Research, Melle, Belgium.

Twenty 4 Holstein cows were randomly assigned to 3 groups to evaluate the effect of feeding n-6 (18:2n-6 or 20:4n-6, from 2 weeks before expected calving date to 2 weeks after parturition, period 1 (P1)) followed by n-3 poly-unsaturated fatty acids (FA) (18:3n-3 or 22:6n-3, P2) on plasma and milk FA. FA (140 g/d 18:2n-6 or 18:3n-3 and 22 g/d 20:4n-6 or 22:6n-3) were supplied as plant (soybean oil and extruded linseed; treatment 1) or as marine oils (Vevodar and DHA-gold, treatment 2). In the control treatment, palm prills were used to obtain iso-energetic, isoproteinic and isolipidic diets. Milk parameters were monitored weekly during the first 7 weeks of lactation in milk samples obtained during 4 consecutive milkings per week. Plasma was sampled on day −14, −7, 0, 8, 14, 20, 26, 33, 40 and 46 relative to parturition. Supplementation with 18:2n-6 (P1) did not increase plasma FA proportions (g/100g FA) of 18:2n-6 whereas trans-10–18:1 (0.07 vs. 0.12, $P < 0.01$) and trans-11–18:1 (0.44 vs. 0.73, $P < 0.05$) increased compared with the control. Supplementation with 20:4n-6 (P1) increased its proportion in plasma (3.13 vs. 3.78, $P < 0.05$). In P2, 18:3n-3 supplementation increased 18:3n-3 (5.4 vs. 8.6, $P < 0.001$). Feeding 22:6n-3 increased trans-10–18:1 (0.07 vs. 0.63, $P < 0.001$), trans-11–18:1 (0.40 vs. 1.55, $P < 0.001$) and 22:6n-3 (0.16 vs. 0.87, $P < 0.001$), whereas 18:0 decreased (12.4 vs. 10.1, $P < 0.001$). Changes in plasma FA were largely reflected in milk with an increase in 18:3n-3 (0.36 vs. 0.68, $P < 0.001$) when 18:3n-3 was supplemented. Feeding 22:6n-3 increased trans-10–18:1 (0.57 vs. 2.03, $P < 0.001$), trans-11–18:1 (1.18 vs. 3.24, $P < 0.001$) and 22:6n-3 (0.02 vs. 0.05, $P < 0.001$), whereas 18:0 decreased (12.0 vs. 8.5, $P < 0.001$). The increase in plasma 20:4n-6 in P1 was not reflected in milk whereas 18:2n-6 in milk fat increased (1.52 vs. 1.74, $P < 0.05$) through 18:2n-6 supplementation despite similar proportions in plasma FA. In the current experiment, supplementation of n-3 FA from 2 to 7 weeks in lactation increased their plasma concentration in a form which allows extraction by other tissue as shown by changes in milk FA.

Key words: dairy, fatty acids

M332 Effect of extruded flaxseed or alfalfa protein concentrate in interaction with two levels of concentrate on milk protein and Ca synthesis. C. Hurtaud*[1], G. Chesneau[2], D. Coumier[3], and J. L. Peyraud[1], *[1]INRA-Agrocampus Ouest UMR1080 Production du Lait, Saint-Gilles, France, [2]Valorex, Combourtillé, France, [3]Desialis, Paris, France.*

Feeding extruded flaxseed (FLAX) and alfalfa protein concentrate (APC) to dairy cows increased milk omega-3 content but their effect on other milk components is not known yet. The objective of this study was to compare the effect of FLAX and APC in interaction with the level of concentrate on milk protein composition and Ca content. The corn silage based diets were composed with 30% (C0) or 65% concentrate (C+) and supplemented with FLAX (1 kg.d^{-1}) or APC (2 kg.d^{-1}). The diets supplied the same level of energy, protein and Ca. The trial was carried out according a nested reversed design using 24 dairy cows averaging 117 ± 14 DIM with 2 periods of 14 d. Data were analyzed according a split plot design using proc mixed procedure. The significance threshold was set at $P \leq 0.05$. There was no significant interaction between the sources of omega 3 and the level of concentrate. C+ significantly increased milk yield (+ 3.7 kg), milk protein content (0.16%) and yield (141 g.d^{-1}). C+ largely decreased casein/protein ratio (−2.6% units) and increased total and colloidal Ca (respectively +172 and +148 mg.kg^{-1}). Increase in milk soluble protein might reflect a loss of integrity of mammary epithelium and/or a production of inflammatory proteins (such as haptoglobulin) associated with subacute ruminal acidosis. High level of concentrate could have induced bone mobilization to produce bicarbonate thus making more available Ca for mammary gland. Compared with FLAX, APC tended to decrease milk yield (0.9 kg.d^{-1}, $P = 0.061$), despite no effect on DMI. APC increased both total protein and casein contents without impact on casein/protein ratio and protein yield. It decreased milk urea content. These results suggest that APC might have not changed the total supply of metabolic protein while reducing the supply of ruminal soluble nitrogen. APC decreased soluble Ca content. This result suggests that biodisponibility of Ca is lower for APC than for CaCO3 and minerals. This experiment shows that the source of omega-3 affects milk casein content whereas large increase of concentrate level does not increase milk casein content even though protein content increased.

Key words: concentrate, lipids, milk Ca

M333 Effect of cow variation on the efficiency of nitrogen recycling to the rumen in dairy cattle. M. Aguilar*[1], M. E. Van Amburgh[2], W. A. D. Nayananjalie[1], and M. D. Hanigan[1], *[1]Virginia Polytechnic Institute and State University, Blacksburg, [2]Cornell University, Ithaca, NY.*

Milk urea nitrogen (MUN) and blood urea nitrogen (BUN) are correlated with nitrogen balance and nitrogen excretion. Wood et al. (2003) found that cows in lactations 1, 2, and 3 had a heritability for MUN of 0.44, 0.59, and 0.48, respectively. The genetic components of MUN concentrations may be associated with differences among urea transporters in the kidney and the rumen wall. We hypothesized that on a common diet, MUN concentrations would be inversely correlated with gastrointestinal entry rates (GER) of urea. Eight lactating cows with similar milk production but varying MUN levels were selected for the study. Cows remained on a common diet, and nitrogen balance and urea kinetics (using [^{15}N^{15}N] urea) were assessed during a 4 d period. Urea synthesis (UER), GER, and urinary urea excretion (UUE) were calculated from ^{15}N enrichments (Lobley, 2000). MUN levels ranged from 10.3 – 16.7 mg/dl and averaged 14.91 ± 2.06 mg/dl. Milk yield and body weight averaged 26.34 ± 4.39 and 505.64 ± 61.87 kg, respectively. N intake and fecal N output averaged 0.51 ± 0.06 and 0.49 ± 0.09 kg of DM, respectively. Despite the common diet and similar milk production, UER was variable averaging 21.26 ± 2.61g/h. GER, UUE, and UUE/UER were also variable averaging 13.57 ± 1.98 g/h, 7.69 ± 2.01 g/h, and 0.36 ± 0.08, respectively. UER was positively correlated with GER, but not with N intake due to minimal dietary N variation, indicating GER is a significant determinant of UER. Further, UER was also positively correlated with MUN ($P = 0.03$) indicating MUN variation is driven by UER. MUN was also positively correlated with UUE ($P = 0.1$), but contrary to our hypothesis, MUN was not correlated with GER ($P = 0.42$). GER variation may be driven more by fermentable carbohydrate supply, than by urea concentrations in blood. Thus MUN was driven by UER, and UUE was driven by blood urea concentrations as reflected by MUN. MUN was not an indicator of GER.

Key words: gut entry rate, recycling, urea

M334 Effect of enhanced feeding rates of conventional milk replacer on pre- and post-weaning performance and health of dairy calves. D. Carlson*[1], B. Ziegler[2], D. Schimek[2], M. Raeth-Knight[3], G. Golombeski[3], J. Linn[3], N. Litherland[3], D. Ziegler[4], and H. Chester-Jones[4], *[1]Milk Products, Chilton, WI, [2]Hubbard Feeds Inc.,*

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Holstein heifer calves [n = 100, 2–4 d old, average bodyweight (BW) = 39.9 kg] were used in an experiment to evaluate the effects of enhanced (ENH) feeding rates of conventional milk replacer (MR) on calf growth, starter intake, and health during pre- (d 1–42) and post-weaning (d 43–56) periods. Calves were housed in individual calf pens within a naturally ventilated barn with curtain sidewalls. All calves were fed a 20% CP, 20% fat all-milk MR reconstituted to 15% solids, an 18% CP (as-fed basis) texturized calf starter and free-choice water. Calves were assigned randomly to 1 of 4 treatments: 1) 0.57 kg/d (as-fed MR powder weight) d 1–35 and 0.28 kg/d d 36–42 (CON), 2) 0.68 kg/d d 1–21, 0.45 kg/d d 21–35 and 0.23 kg/d d 36–42 (ENH21), 3) 0.68 kg/d d 1–28, 0.45 kg/d d 28–35 and 0.23 kg/d d 36–42 (ENH28), and 4) 0.68 kg/d d 1–35 and 0.34 kg/d d 36–42 (ENH35). Calf BW on d 56 was greater ($P < 0.05$) for ENH35 (79.2 kg) and ENH28 (78.5 kg) calves compared with CON (75.1 kg), whereas BW of ENH21 (76.6 kg) calves did not differ from CON. Average daily gain from d 1–56 tended to be greater ($P = 0.10$) for ENH35 (0.70 kg/d) than for CON (0.63 kg/d) calves, with ENH21 (0.65 kg/d) and ENH28 (0.69 kg/d) calves having intermediate growth rates. Frame growth from d 1–56 also differed due to treatment; ENH35 (10.5 cm) and ENH28 (9.91 cm) calves had greater ($P < 0.05$) hip height gain than CON (8.81 cm), while ENH21 (9.47 cm) calves had similar changes in frame growth compared with CON. Coinciding with decreased MR intake, calves on the ENH21 treatment had greater ($P < 0.05$) starter intake from d 22–35 compared with ENH35, whereas ENH28 calves consumed more ($P < 0.05$) starter than ENH35 calves from d 29–35. Overall, starter intake from d 1–42 and 1–56 did not differ ($P > 0.10$) among treatment. Total MR intake (as-fed) was 22.6, 22.9, 24.5, and 26.6 kg/calf for CON, ENH21, ENH28, and ENH35, respectively. Health parameters did not differ among treatments. Compared with CON, feeding ENH rates of a conventional MR (0.68 kg/d) for at least 28 d increased d 56 BW and d 1–56 hip height gain without affecting starter intake.

Key words: calves, milk replacer, feeding rate

M335 Form of trace mineral supplementation on complete lactation performance, reproduction, and locomotion in Holstein cows. G. I. Zanton*[1], D. E. Diaz[1], M. Vazquez-Anon[1], and J. E. Nocek[2], *[1]Novus International Inc., St. Charles, MO, [2]Spruce Haven Farm and Research Center, Auburn, NY.*

When formulating to meet the absorbable trace mineral requirements of the cow, the level of trace mineral required in the diet can vary depending on source and form due to differences in bioavailability. The objective of this experiment was to evaluate the effects of feeding the chelated trace mineral, Mintrex (Zn, Cu, and Mn) at a reduced level compared with inorganic trace minerals (ITM) supplied as sulfates on a commercial level, on complete lactation (305 d) performance, reproductive performance, and locomotion in Holstein cows. To accomplish this objective, 216 Holstein cows were housed in 4 pens (2/treatment) for a complete lactation and fed diets containing ITM formulated to supplement Zn, Cu, and Mn at commercial levels or all ITM replaced by Mintrex and formulated to supplement at approximately half commercial levels. Group DMI and individual milk production was monitored daily, milk composition was evaluated monthly, locomotion scores were evaluated at 150 and 300 DIM, and reproduction performance was monitored. Data were analyzed with pen as the experimental unit and treatment differences are considered significant when $P < 0.05$ and trending toward significance when $P < 0.15$. Twenty-six percent of cows were removed from the trial for various reasons, but the number removed ($P > 0.67$), time of removal ($P > 0.95$) and reason for removal ($P > 0.35$) did not differ between treatments. Complete lactation performance did not differ between treatments ($P > 0.60$) with milk yield, fat, and protein percent averaging 36.75 kg, 3.53%, and 3.04%, respectively. Somatic cell count linear score tended to be reduced in cows fed Mintrex (ITM: 3.11, Mintrex: 2.70; $P < 0.11$). Conception at each individual service did not differ between treatment ($P > 0.16$) and days open also did not differ ($P > 0.25$), however ordinal logistic analysis indicated the cows fed Mintrex tended to have greater odds to conceive at earlier services ($P < 0.08$). Locomotion scores did not differ between treatment ($P > 0.24$). In conclusion, cows fed Mintrex at reduced levels with no dietary ITM had similar performance as cows fed higher levels of ITM.

Key words: trace minerals, lactation performance, reproduction

M336 Effect of replacing corn grain and soybean meal with a treated wheat grain on the performance of dairy cows. J. Benninghoff*[1], G. Hamann[2], H. Steingaß[3], F.-J. Romberg[2], K. Landfried[2], and K.-H. Südekum[1], *[1]University of Bonn, Bonn, Germany, [2]DLR Westpfalz, Münchweiler/Alsenz, Germany, [3]University of Hohenheim, Stuttgart, Germany.*

This study evaluated a wheat grain which was treated to reduce ruminal degradation of starch and crude protein. The wheat grain (WeiPass) was treated with xylose in aqueous Ca-Mg lignosulphonate solution at elevated temperatures. Two isocaloric and isonitrogenous diets were formulated with, on dry matter (DM) basis, either 16% corn grain and 6.4% soybean meal (control group, CON) or 17.8% WeiPass and 4.6% soybean meal (wheat group, WHEAT). The DM of both diets contained 30.6% grass silage, 16.4% corn silage, 6.8% grass hay, 16% barley-wheat grain mixture, 6.4% rapeseed meal, and 1.4% mineral and vitamin mixture. Diets were offered as total mixed rations. Thirty-six German Holstein dairy cows were assigned to one of the 2 groups according to parity, body weight after calving, and milk yield during the previous lactation. The DMI and milk production were recorded from 20 d in milk (DIM) to 120 DIM. Blood samples were obtained from each cow 21 d before the expected calving date to 14 DIM at weekly intervals and then every second week until 120 DIM. Response variables were DM intake (DMI), milk production and composition, and blood metabolites. All data were analyzed using a mixed model procedure with treatment, lactation number, calving month, and week of lactation as fixed factors, and cow as random factor. The average of DMI, energy-corrected milk (ECM) yield, and milk fat and protein yields (all given as kg/day) were 18.9, 28.7, 1.25, and 1.02 for CON cows and 19.3, 32.5, 1.36, and 1.11 for WHEAT cows, respectively. Only ECM and milk protein yields were greater ($P < 0.05$) for WHEAT cows, all other variables were similar ($P > 0.10$) for both groups. Blood metabolites indicated that cows in both groups were healthy throughout the trial and no differences were observed between groups. In conclusion, a treated wheat grain could replace corn grain and part of the soybean meal in a diet for lactating dairy cows and overall performance might be slightly improved. Thus, treated wheat grain may be an alternative to corn grain in diets of lactating dairy cows depending on availability and costs of grain sources.

Key words: dairy cow, grain, starch

M337 Comparison of models to predict ruminal methane from milk fatty acids. J. M. Castro-Montoya, V. Fievez, and B. Vlae-

minck*, *Laboratory of Animal Nutrition and Animal Product Quality, Gent University, Gent, Belgium.*

Increased awareness of livestock's contribution to the greenhouse effect enhanced interest in monitoring methane emissions from dairy cattle through models based on milk fatty acids (FA). A first aim of this study was to assess the correlation between these models using a data set from 12 experiments (n = 180), covering a wide range of diets. These FA data allowed to compare 3 models described by Castro-Montoya et al. (2011) with CH_4 proportions (mmol/mol total VFA) predicted from the odd- and branched-chain FA (OBCFA) *iso* C14:0, *iso* C15:0, C15:0, *iso* C16:0 and the sum of C17:0 and *cis*–9 C17:1; Weill et al. (2009) with CH_4 (g/L milk) = Sum FA ≤ C16 × 11.37 × (milk production (kg/year) $^{-0.427}$) (model 1); and Dijkstra et al. (2011) with CH_4 (g/kg DMI) = 25.5 + (0.302 × C18:0) – (10.2 × *cis*–11 C18:1) – (2.5 × *trans*–10+11 C18:1) (model 2). Pearson correlations between CH_4 output from the OBCFA–model and model 1 (r = 0.2) and 2 (r = 0.54) were poor to modest which could be related to differences in units to express methane, inclusion of additional variables (e.g., milk production) and dietary conditions from which models were developed. To overcome the differences in units, multiple linear regression with forward variable selection and 7–fold cross validation was performed to predict CH_4 (mmol/mol total VFA) based on the milk fatty acids retained in each of the models. A random experiment effect was included. The models developed from Dijkstra et al. [CH_4 = 323.3 – (18.8 × *cis*-11 C18:1) – (72.2 × *trans*-10+11 C18:1)] and from OBCFA [CH_4 = 329.9 + (221 × *iso* C14:0) + (116.5 × *iso* C15:0) – (38.9 × C15:0) – (61.9 × *iso* C16:0) – (33 × C17:0 + *cis*-9 C17:1)] performed similarly (Adj R^2 = 0.67; RMSPE = 4%). A third model from regression of the sum of FA ≤ C16 correlated modestly with CH_4 proportions (Adj R^2 = 0.52; RMSPE = 5.0%). Finally, by individually introducing 17 FA ≤ C16, the model CH_4 = 283 + (12.6 × C8:0) + (147.7 × *iso* C14:0) + (104.6 × *iso* C15:0) – (7.6 × C14:1) – (49.9 × C15:0) – (20 × *iso* C16:0) + (0.9 × C16:0) performed similarly to the former two models (Adj R^2 = 0.73; RMSPE = 3.7%). In this last model the predominance of OBCFA worth notice.

Key words: methane, milk fatty acids

M338 Effects of methionine analog supplementation on milk yield and composition of primiparous dairy cows in a Brazilian dairy herd. L. Alegransi[1], V. L. Souza[1], M. C. Doska[1], G. F. Zanetti[1], E. M. Ribas[2], A. Ostrensky[3], and R. Almeida*[1], *[1]Universidade Federal do Paraná, Curitiba, PR, Brazil, [2]Nutron Alimentos, Brazil, [3]Pontifícia Universidade Católica do Paraná, Curitiba, PR, Brazil.*

The objective of this trial was to evaluate the effects of methionine analog supplementation on milk yield and composition in a commercial dairy herd at Paraná State, south of Brazil. Eighty-eight Holsteins and 12 Brown Swiss primiparous cows were paired blocked based on breed, milk yield, and days in milk. The treatment consisted on the daily supplementation of 25 g of methionine hydroxyl analog (MFP, Novus International, Inc., USA). Both groups, with 50 first-lactation cows each, were fed simultaneously twice daily the same basal diet in a TMR, had received bST injections every 10 d and were milked thrice daily. Each group of cows was housed in a side of a free stall and no cow entrance was allowed during the trial. Cows (220 DIM and 31.5 mo) were allocated to a sequence of 2 treatments in a crossover design with 42-d periods, and the response variables were measured on d 40 to 42 of treatment allocation. Twenty-six cows were lost due to dry off, death, and mastitis treatment. Data was analyzed with the GLM of SAS with a model containing the effects of block, cow within block, period, and treatment. The DM, CP and NDF contents of the offered diets were similar between treatments, as well as cow′s body condition score. The estimated nutritional levels of this diet using CPM-Dairy were 45.2%DM, 1.73 Mcal/kg NE_{lac}, 17.6% CP, 34.9% NDF, 19.7% ADF, 21.7% $_{pe}$NDF, 37.8% NFC, 5.2% EE, 0.80% Ca, and 0.43% P. With the MFP® supplementation, the estimated lysine:methionine relationship was 3,10:1 (6,40% Lys and 2,07% Met). Milk yield was 33.3 kg for Control and 34.2 kg for methionine-treated cows (P = 0.19). MFP treated cows produced 53 g more fat yield per day (P = 0.03) than non-treated cows. It was observed a tendency (P < 0.10) of methionine-treated cows produced more 3.5%fat-corrected milk, more energy-corrected yield, 30 g more protein yield, and a higher total solids content. Supplementation with methionine analog did not increase milk yield, but it was shown a tendency of higher milk components on methionine-treated cows.

Key words: amino acids, metabolizable protein, nitrogen balance

M339 Dry matter digestibility of dairy goats diets during pregnancy. A. R. Rivera*, I. A. M. A. Teixeira, C. J. Härter, L. D. Lima, D. S. Castagnino, T. R. Delphino, H. G. O. Silva, T. T. Berchielli, and K. T. Resende, *Universidade Estadual Paulista, Jaboticabal, SP, Brasil.*

Physiological stage influences feed intake and digestibility of nutrients and has been observed that during pregnancy females change their feeding pattern and intake. Many studies have focused on late pregnancy and/or early lactation of cows and ewes, with scarce results evaluating the diet digestibility during the entire pregnancy. Thus the objective of this study was to evaluate the effect of number of fetuses on the diet digestibility of 2 dairy goat breeds during the pregnancy. A total of 12 multiparous goats with average body weight of 52.3 ± 9.56kg were used. At the beginning of pregnancy (d 35 post mating) the goats were distributed into 4 groups, as such: 1-fetus-Saanen (n = 3), 2-fetuses-Saanen (n = 3), 1-fetus-Oberhasli (n = 3) and 2-fetuses-Oberhasli. Four digestibility assays were performed (initiating at 45, 75, 105 and 135 d of pregnancy) with the goats allocated into digestibility cages that allowed total feces collection in a 5-d period. Statistical analyses were performed considering a repeated measure design. A significant interaction between breed and fetuses number (P < 0.05) was observed for apparent dry matter (DM) digestibility. In Saanen goats, DM digestibility with 2-fetuses was significantly lower (70.9 ± 3.21%). than 1-fetus (77.2 ± 1.88%). The significant interaction between days of pregnancy and fetus number (P < 0.05) indicated that the number of fetuses influenced DM digestibility with a linear increase as pregnancy advanced in single pregnant goats. On the other hand, in twin pregnancies the DM digestibility showed a quadratic pattern as pregnancy progressed. These previous results indicates that stage and type of pregnancy have major effects on digestibility which probably is modified to allow better nutrient absorption to meet the extra nutrient demand due to pregnancy. This research is in progress (Fapesp project number 2008/57302–0).

Key words: days of pregnancy, goats, nutrient absorption

M340 Effect of different levels of a mycotoxin deactivating feed additive on Holstein crossbred dairy cows in Southeast Asia fed rations naturally contaminated with mycotoxins. U. Hofstetter*[1], I. Rodrigues[1], and K. Kiyothong[2], *[1]Biomin Holding GmbH, Herzogenburg, Austria, [2]School of Agriculture, Food and Rural Development, University of Newcastle, Newcastle, UK.*

The objectives of this study, carried out in Thailand, were to determine the impact of mycotoxins on lactating dairy cows and to evaluate the effects of different levels of a mycotoxin deactivating product. Twenty-four early lactating multiparous Holstein-Friesian x local dairy cows with an average body weight of 420kg and an average daily milk yield of 13.7kg were allocated according a randomized complete block design (RCBD) with 4 dietary treatments and 6 animals per treatment. The trial consisted of a 2-week adaptation period followed by a 10-week experimental period. Diets were fed as a total mixed ration (TMR). Mycotoxin analyses showed a contamination of 38µg/kg aflatoxin B1, 541µg/kg zearalenone, 720µg/kg deoxynivalenol, 701µg/kg fumonisin B1, 270µg/kg T-2 toxin and 74µg/kg ochratoxin A. The trial groups consisted of the contaminated TMR and contained different levels of the feed additive (groups 1–4 with 0, 15, 30 or 45g/cow/day). Data were subjected to ANOVA procedure for a randomized complete block design experiment using the general linear model (GLM) of the SAS System. Treatment means were compared using Duncan's New Multiple Range test. Total milk yield and milk protein yield were significantly higher ($P < 0.05$) in cows fed rations containing the mycotoxin deactivator. Cows in treatments 2, 3 and 4 produced approximately 2kg more milk than cows fed the unsupplemented ration (see table). Milk from cows in treatment 1, the negative control, contained 0.7µg/kg of AFM1. Milk from cows fed any of the 3 rations containing the feed additive had non-detectable levels of AFM1 . Additionally somatic cell count was significantly lower ($P < 0.05$) in these groups, which is a strong indicator that the immune system of the cows was improved by eliminating the immune suppressing effects of mycotoxins. The results confirm that mycotoxin contaminated rations impair health and performance of lactating dairy cows by affecting somatic cell count and milk production. The trial results also demonstrate that a feed additive can ameliorate these detrimental effects.

Table 1. Milk production and quality

Parameter	Treatment 1 (neg. control)	Treatment 2	Treatment 3	Treatment 4
Milk yield [kg/cow/day]	12.6[a]	14.7[b]	14.7[b]	14.9[b]
Protein [g/kg]	31.0[a]	34.2[b]	34.3[b]	36.1[b]
AFM1 [µg/kg] (detection limit = 0.06 µg/kg)	0.7	nd	nd	nd
Somatic cell count [x 10^3 cell/ml]	547[a]	385[b]	346[c]	346[c]

[a-c]Values within a row with different superscripts differ significantly ($P < 0.05$).

Key words: aflatoxin M1, mycotoxins

M341 Voluntary selection of starter ingredients offered separately to nursing calves. C. Montoro*[1] and A. Bach[1,2], *[1]Ruminant Production, IRTA, Caldes de Montbui, Barcelona, Spain, [2]ICREA, Barcelona, Spain.*

An experiment was conducted to determine whether calves exposed to different ingredients would consume the similar amounts of nutrients to calves offered all ingredients in a single starter. Forty Holstein male calves (initial BW = 41.5 ± 0.9 kg, age = 7 ± 0.5 d) individually housed on wood shavings were randomly assigned to either Control (CTR): a common starter ad libitum composed of ground corn (47.2%), soybean meal (20%), oats (11%), barley (10.1%), soybean hulls (8%) and soybean full fat (1.2%), or Choice (CH): the same 6 ingredients offered in separate buckets to each animal ad libitum. All calves were offered 2 L of milk replacer (MR) at 12.5% DM twice daily in a bucket during the 5 wk of study. Differences between treatments in total daily feed consumption, nutrient consumption (CP, EE, NFC, and NDF), and individual consumption of each ingredient were analyzed using a mixed-effects model with repeated measures that included initial BW as a covariate, dietary treatment, time (day or week of study) and their 2-way interaction as fixed effects, and animal as a random effect. Time entered the model as a repeated measure. No differences were observed between treatments on total DM, NDF, and NFC consumption (Table 1). Contrary, consumptions of CP and EE were greater ($P < 0.01$) in CH animals than in CTR calves. These differences in nutrient intakes were a consequence of a greater ($P < 0.01$) consumption of soybean full fat by CH calves (159 g/wk) and a lesser ($P < 0.01$) consumption of corn (194 g/wk) and oats (12 g/wk) compared with CTR calves (15, 573, and 133 g/wk, respectively). It is concluded that calves showed a marked preference for soybean full fat and rejected carbohydrate-rich ingredients such corn and oats. Further research is needed to determine whether this preference was due to hedonic or metabolic control.

Table 1. Nutrient composition of total solid DM consumed (g/d) as affected by treatment

	DM	CP	EE	FND	NFC
Control	247	44[a]	10[a]	50	159
Choice	261	77[b]	16[b]	61	137

[ab]Values with different superscripts within column differ at $P < 0.05$.

Key words: regulation, nutrient, intake

M342 Duodenal flows and milk yields of odd- and branched-chain fatty acids in response to N underfeeding and energy source in dairy cows. R. Gervais*[1], B. Vlaeminck[2], A. Fanchone[3], P. Nozière[4], M. Doreau[4], and V. Fievez[2], *[1]Département des sciences animales, Université Laval, Québec, Québec, Canada, [2]Lanupro, Ghent University, Melle, Belgium, [3]Unité de Recherches Zootechniques, INRA, Petit Bourg, Guadeloupe, France, [4]Unité de Recherche sur les Herbivores, INRA, Theix, St-Genès-Champanelle, France.*

To assess the effects of a decrease in dietary N supply in dairy cows and its interaction with the nature of energy (E) on the duodenal flows of odd- and branched-chain fatty acids (OBCFA), and secretions in milk, 4 Holstein cows, fitted with rumen, duodenum, and ileal cannulas, were used in a 4 × 4 Latin square design (28-d periods). Treatments were 2 N levels (low and high) combined with 2 E sources rich in starch (S) or fiber (F). The high level of N met 110% of N requirements, with an adequate supply in rumen degradable N, whereas the low level covered 80% of N requirements with a shortage in rumen degradable N. The 4 isoenergetic diets had a forage:concentrate ratio of 60:40. No interaction between level of N and E source was observed for OBCFA duodenal flows, and milk yields. Compared with high N, low N diets reduced the duodenal flows of iso (7.2 vs. 9.4 g/d; $P < 0.01$), and linear odd-chain fatty acids (FA; 7.6 vs. 9.6; $P < 0.01$) and tended to reduce the flow of anteiso FA (8.0 vs. 10.0; $P = 0.06$). Low N diets decreased milk yield of iso FA (7.5 vs. 9.1 g/d; $P < 0.05$) and tended to reduce milk anteiso (7.4 vs. 8.8; $P = 0.09$) and linear odd-chain FA (12.7 vs. 14.5; $P = 0.08$). Compared with S, F diets increased duodenal flow of iso FA (8.9 vs. 7.7 g/d; $P < 0.05$), and tended to increase the flow of linear-odd chain FA (9.3 vs. 7.9; $P = 0.06$). Feeding F diets increased milk iso (9.6 vs. 6.9 g/d; $P < 0.01$) and linear odd-

chain FA (15.2 vs. 12.1; $P < 0.05$), and tended to increase milk anteiso FA (9.0 vs. 7.3 g/d; $P = 0.08$). N supply had no effect on the apparent transfer of duodenal iso, anteiso, and linear odd-chain FA to milk, and no interaction with E source was observed. Compared with F, S diets decreased the apparent transfer of anteiso FA by 25% ($P < 0.05$), and tended to reduce transfer of iso FA (−17%; $P = 0.07$). In conclusion, because the apparent transfer of some OBCFA from the duodenum to milk was affected by treatments, further research is needed to establish which milk OBCFA can be used as robust markers to estimate OBCFA and microbial protein flow at the duodenum and/or which corrections should be applied.

Key words: duodenal flow, milk fatty acids, OBCFA

M343 Effects of a direct-fed microbial and fibrolytic enzyme product on somatic cell counts in milk produced by crossbred dairy cows in the Brazilian Cerrado. R. D. Sainz*[1,2], C. U. Magnabosco[3,4], E. A. Filgueiras[5], R. Guimarães[3], F. M. C. Freitas[4,6], and L. R. Mattos[4,6], *[1]University of California, Davis, [2]Embrapa, Brasilia, DF, Brazil, [3]Embrapa Cerrados, Planaltina, DF. Brazil, [4]Embrapa Arroz e Feijão, Santo Antonio de Goiá, GO, Brazil, [5]Biofórmula, Goiânia, GO, Brazil, [6]Embrapa Gado de Leite, Juiz de Fora, MG, Brazil.*

Two experiments were conducted on commercial dairy farms to test the effect of a product (Bioformula, Goiania, Brazil) containing direct-fed microbial (DFM) and fibrolytic enzymes on milk quality. In Exp. 1, 38 Holstein cows were fed corn silage on an *ad libitum* basis, and received up to 6 kg/d concentrate according to production level. In Exp. 2, 22 Girolando (crossbred Holstein x Gir) cows grazed *Panicum maximum* cv. Mombaça pastures plus corn silage and received up to 5 kg/d concentrate according to production level. In both experiments, cows were blocked by age, parity, stage of lactation and current production level into control and treated groups. Treated group cows received 2 g/d of a product containing live yeast (1 × 109 cfu/g), mannan oligosaccharide (10%), and *Lactobacillus acidophilus*, *Bacillus subtilis*, and *Enterococcus faecium* (2 × 107 total cfu/g), plus cellulose (6 U/g), hemicellulase (10 U/g), and xylanase (3U/g) while controls received 2 g/d of the vehicle alone. Milk composition was monitored weekly for 16 wk. Data were analyzed by ANOVA, with treatment as main effect and initial composition as the covariate. Somatic cell counts were log-transformed to overcome non-normality, but back-transformed data are presented here. There were no differences in milk production, or in the percentages of fat, protein, lactose, and non-fat solids, nor in total bacterial count, throughout both experiments ($P > 0.10$). In Exp 1 SCC in milk increased ($P < 0.05$) over time in both experiments, from 247,172 to 606,736 (controls) or 260,016 (treated). In Exp. 2 it increased ($P < 0.05$) from 117,490 to 584,490 (controls) or 270,396 (treated). In both experiments, SCC were similar ($P > 0.10$) for the first 8 weeks, then diverged. These results suggest that DFM may enhance immune function and improve milk quality in crossbred dairy cows under tropical conditions.

Key words: direct-fed microbials, somatic cell counts, tropics

M344 Effects of abomasal dosing of ferrous lactate in lactating dairy cows. O. N. Genther*, J. A. Zyskowski, T. H. Herdt, and D. K. Beede, *Michigan State University, East Lansing.*

We hypothesize that the majority of Fe naturally occurring in drinking water is in the ferrous (Fe^{2+}) state, and if present in great enough concentrations, could negatively affect Fe status and potentially cause toxicity. Our objective was to evaluate the short-term effects of abomasally infused ferrous lactate on Fe status of mid-lactation dairy cows given amounts to simulate total daily Fe intake from high-Fe drinking water. Six mid-lactation Holstein cows were assigned in a replicated 3 × 3 Latin Square balanced for treatment sequences. There were 7 d between experimental periods. Treatments were: 1) 0 mg Fe; 2) 0.75 mg of Fe from ferrous lactate per kg BW; and, 3) 1.5 mg of Fe from ferrous lactate per kg BW. Treatments were calculated to approximate 0, 4.5 and 9 ppm Fe concentrations in drinking water, respectively. All treatments were iso-lactate. Treatments were dosed in ~1 min directly into the abomasum via the ruminal fistula in 1 L of deionized water to avoid any potential ruminal impacts on Fe valence. Blood samples were taken hourly before dosing via jugular catheter for 6 h, and post-dosing hourly for 12 h. Liver biopsies were taken at 0 (before dosing), 18 and 36 h of each period. Mean of the pre-dosing blood samples was used as a covariate for each dependent variable in statistical analysis. There were no treatment by time interactions ($P > 0.10$) for serum Fe, unsaturated iron-binding capacity (UIBC), total iron-binding capacity (TIBC), percent Fe saturation, α-tocopherol, and Cu concentrations, as well as for liver Fe, Cu and Zn. There was no main effect of treatment on any response variables. There was an effect of hour pooled across treatments on serum Fe ($P = 0.022$), UIBC ($P = 0.012$), percent Fe saturation ($P < 0.0001$); and, for liver Cu ($P = 0.023$) and Zn concentrations ($P = 0.022$). There was a treatment by time interaction for serum Zn concentration ($P = 0.055$) and a tendency for liver Cu concentration ($P = 0.155$). Results indicate that infusion of ferrous Fe at rates used in this study do not have major impacts on short-term Fe status of lactating dairy cows.

Key words: iron, lactating dairy cows, iron status

M345 Glycerin as a replacement for corn in dairy Holstein cows diets. J. B. D. Sancanari*[1,2], J. M. B. Ezequiel[1], E. H. C. B. van Cleef[1,2], V. R. Fávaro[1], A. P. D'Áurea[1,2], A. C. Homem[1], Z. F. Silva[1], D. A. V. Silva[1,2], and J. W. Cattelan[1], *[1]São Paulo State University, Jaboticabal, São Paulo, Brazil, [2]FAPESP, São Paulo, São Paulo, Brazil.*

Six multiparous dairy Holstein cows cannulated in the rumen, after the peak of lactation, were used to evaluate the effect of inclusion of glycerin, originated from the biodiesel production, replacing the dietary corn on milk production (MP), milk composition and DMI. Cows were housed at individual tie-stall barn and fed with 3 isoenergetic and isonitrogenous diets containing 0 (G0), 15 (G15) and 30% (G30) of crude glycerin in diets dry matter. The experiment was a double 3 × 3 Latin Square, where each period lasted 23 d. Milk samples were obtained from 2 milking on the 18th and 19th d of each period. The MP obtained were 17.1, 16.4, and 18.9 kg/d ($P > 0.05$) for G0, G15, and G30, respectively. DMI was depressed ($P < 0.05$) in the G30 without affecting the MP, resulting in increased feed efficiency ($P < 0.05$). Cows fed with G0 and G15, respectively, the DMI showed 17.1 and 13.8% higher than G30. This effect could be attributed to the high salt content (6%, which 99% were NaCl) present in glycerin. Furthermore, it was observed that the milk urea nitrogen (MUN) was influenced ($P < 0.05$) by treatments, being 31% higher in G15 compared with G30, indicating greater efficiency of utilization of dietary protein on the G30. The concentrations of milk fat were 3.2, 3.3, and 3.2%, respectively, for G0, G15, and G30 ($P > 0.05$). Lactose obtained in G15 (4.7%) were 4% higher ($P < 0.05$) than the other treatments (4.5%). The crude protein of milk was 15.6 and 12.9% higher ($P < 0.05$) in G0 (3.2%) and G15 (3.1%), respectively, than in G30 (2.7%). This reduction can be caused by NFC deficiency in the diets and decrease in digestibility due to the high ratio NDF/NFC caused by replacement

of corn (main source of NFC in the diet) by glycerin. Possible deficiencies of essential amino acids, particularly methionine and lysine in duodenal digesta, must also be taken into account. It was concluded that the inclusion of 30% of glycerin in the diet improves feed efficiency, but may alter some components of milk. Further studies are needed to elucidate this mechanism.

Key words: biodiesel, co-products, milk composition

M346 Rolled barley grain treated with lactic acid and heat altered postprandial rumen mineral availability in lactating dairy cows. U. Farooq*, A. Mazzolari, S. M. Dunn, and B. N. Ametaj, *University of Alberta, Edmonton, Alberta, Canada.*

Presence of phytic acid (PA) in the grain kernels is associated with decreased bioavailability of phosphorus (P), calcium (Ca), and magnesium (Mg) as well as increased P loss in feces of dairy cow. Treating grain with lactic acid and heat might increase bioavailability of those minerals. Therefore, the objective of this investigation was to evaluate rumen mineral bioavailability in cows fed rolled barley grain steeped in lactic acid (LA) and treated with heat. Eight clinically healthy, rumen-fistulated primiparous Holstein cows (153 - 179 DIM) were assigned to a paired 2 × 2 crossover design. Each period consisted of 11 d of adaptation and 10 d of measurements. All cows were fed once daily a TMR containing rolled barley grain (31.5% in DM) steeped for 48 h in equal quantity of tap water (CTR) or in 1.0% LA and heat at 55°C (LAH). Rumen fluid samples were taken on the last day of the experimental period (d 21) at 0, 2, 4, 6, 8, 10, and 12 h after the morning feeding. Samples were analyzed by atomic absorption spectrometry for Ca, Mg, sodium (Na), and potassium (K) and a modified colorimetric method for inorganic P (P*i*). Statistical analyses were performed by JMP using the GLM procedure. Because there was a carryover effect only results from the 1st period were considered. Overall data showed that concentrations of P*i* ($P < 0.05$; CTR, 278.5; LAH, 231.1 mg/L), Ca ($P < 0.01$; CTR, 87.35; LAH, 64.55 mg/L), and Mg ($P < 0.01$; CTR, 98.13; LAH, 75.52 mg/L) in the ruminal fluid were lower in LAH cows versus CTR group. Furthermore, concentration of Na in the ruminal fluid was greater ($P < 0.01$; CTR, 80.15; LAH, 90.09 Meq/L) in LAH cows, whereas no changes in the concentration of K were observed among the 2 groups. Postprandial time influenced ($P < 0.01$) concentrations of all ruminal minerals, except for P*i*. In conclusion, results of this study indicated that treating rolled barley grain with LA and heat increased the bioavailability of P*i*, Ca, and Mg and has the potential to be used by dairy industry to lower mineral supplementation and environmental pollution.

Key words: barley grain, lactic acid and heat, rumen minerals

M347 Phosphorus feeding for second lactation dairy cows. V. R. Moreira*[1], L. K. Zeringue[1], C. Leonardi[2], and M. E. McCormick[1], *[1]Louisiana State University Agricultural Center, Franklinton, [2]Louisiana State University - Health Sciences Center, New Orleans.*

The objective of this experiment was to evaluate the effect of dietary P on production performance of 28 s lactation cows. Cows were fed either 0.38% or 0.42% ± 0.01% P (DM basis; averages ± standard deviation) from 3 to 45 DIM (treatment period). Both groups of cows were fed 0.42% ± 0.01% P thereafter until the end of the experiment at 110 DIM (carry-over period). Both treatment diets contained 16.5% ± 0.52% CP, and 0.80% ± 0.12% Ca. Pregnant cows were brought to the barn at least 21 d before expected calving. Cows were housed in a free-stall barn fit with electronic gates. Close-up TMR containing 0.28% ± 0.05% Ca and 0.34% ± 0.03% P (DM basis) was fed until 2 d after calving date. Treatments were randomly assigned to cows before their first lactation, when these cows were subjected to similar treatments. Intake and milk yield were recorded daily. Weekly averages during treatment period (wk 3 to 6) and carry-over period (wk 7 to 15) were analyzed as repeated measurements using the Mixed procedure (SAS, version 9.2). Cows fed diet containing 0.42% P tended ($P = 0.09$) to eat more than those fed 0.38% diet during the treatment period but intake was similar ($P = 0.86$) during carry-over period. Milk yield was not significantly ($P = 0.12$) different throughout the experiment, although cows fed 0.42% P produced 3.5 kg more than those in the treatment containing 0.38% P. Following a similar pattern from their first lactation, the 2 groups of cows peaked in milk production 2 weeks apart, on wk 4 and 6, respectively for treatments 0.42% P and 0.38% P. Percentages of milk components were similar ($P \geq 0.16$) between the 2 treatments. Milk fat and protein percentages averaged 3.42% and 2.83%, respectively. Performance of second lactation cows was not significantly different between the 2 levels of P fed during this trial.

Key words: phosphorus, dairy cow, second lactation

M348 Biochemical blood parameters of dairy cows fed with increasing concentration of glycerin. J. B. D. Sancanari*[1,2], J. M. B. Ezequiel[1], E. H. C. B. van Cleef[1,2], V. R. Fávaro[1], A. P. D'Áurea[1,2], A. C. Homem[1], Z. F. Silva[1], D. A. V. Silva[1,2], and J. W. Cattelan[1], *[1]São Paulo State University, Jaboticabal, São Paulo, Brazil, [2]FAPESP, São Paulo, São Paulo, Brazil.*

Blood parameters have been used to assess the health status of animals. The blood biochemical composition reflects the balance between the inflow, the discharge and the metabolism of nutrients in animal tissue. Six multiparous Holstein cows cannulated in the rumen, after the peak of lactation were used in this trial. The animals were distributed in a double 3 × 3 Latin Square to evaluate the effect of inclusion of 0 (G0), 15 (G15), and 30% (G30) of crude glycerin in the diet dry matter (replacing corn) on the blood biochemical parameters. The cows were fed 3 isoenergetic and isonitrogenous diets twice daily. Blood samples were taken on 23 d of each period, by puncturing the coccygeal vein 3 h after the morning milking. There was no effect ($P > 0.05$) on the liver enzymes alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP), with average values of 34.6, 65.6 and 142.7 U/mL, respectively, however, the enzyme gamma-glutamyltransferase (GGT) was changed ($P < 0.05$). GGT concentrations obtained for G0, G15 and G30 were 40.7, 34.4 and 46.8 U/mL, with a superiority of 14.7 and 35.5% in G30 ($P < 0.05$) compared with G0 and G15, respectively. Thus, this can indicate that possible liver changes may have occurred, however, the animals did not showed clinical symptoms of intoxication, probably due to short supplementation period. There were no differences ($P > 0.05$) on plasma concentrations of total protein (TP), albumin (ALB), urea (U), creatinine (CREA), glucose (GLUC), triglycerides (TG) and cholesterol (COL) suggesting no effects on protein and energy metabolism. The average values were 8.4 and 2.1 g/dL, 24.5, 1.2, 70.4, 13.1 and 71.1 mg/dL, respectively, for TP, ALB, U, CREA, GLUC, TG and COL. Further studies are needed to evaluate the effect of inclusion of glycerin in the diet on the metabolism of dairy cows, with particular attention to the supplement for longer periods.

Key words: biodiesel, blood, ruminants

M349 Treating barely grain with lactic acid and heat modulated pre-prandial rumen calcium and magnesium availability in lactating dairy cows. U. Farooq*, A. Mazzolari, S. M. Dunn, and B. N. Ametaj, *University of Alberta, Edmonton, AB, Canada.*

Phytic acid (PA), present in grain kernels, is able to bind minerals and lower their availability to the host, especially those of calcium (Ca) and magnesium (Mg). Treating barley grains with lactic acid and heat might increase rumen degradation of PA, consequently increase availability of Ca and Mg in the rumen fluid. Therefore, this study sought to evaluate rumen availability of selected minerals in lactating dairy cows fed rolled barley grain steeped in lactic acid (LA) and treated with heat. Eight, rumen-fistulated primiparous Holstein cows (153 - 179 DIM) were assigned to a paired 2 × 2 crossover design. Each period consisted of 11 d of adaptation and 10 d of measurements. All cows were fed once daily a TMR containing barley silage (40% DM basis) and rolled barley grain (31.5% DM basis) steeped for 48 h in equal quantity of tap water (CTR) or in 1.0% LA and heat at 55°C (LAH). Rumen fluid samples were taken on d 1, 3, 5, and 7 before morning feeding. Samples were analyzed by atomic absorption spectrometry for Ca, Mg, sodium (Na), and potassium (K) and a modified colorimetric method for inorganic phosphorous (P*i*). Statistical analyses were performed by JMP using the GLM procedure. Results of this study demonstrated that concentrations of Ca ($P < 0.01$; CTR, 39.21; LAH, 24.91 mg/L), and Mg ($P < 0.05$; CTR, 15.21; LAH, 8.02 mg/L) in the ruminal fluid were lower in LAH cows versus the CTR group. Moreover, there was an interaction between treatment and day of sampling for Ca ($P < 0.05$), Mg ($P < 0.01$), and Na ($P < 0.01$). Furthermore, day of sampling effected ($P < 0.01$) concentrations of all minerals, whereas no changes in the concentrations of P*i*, Na, and K were observed among the 2 groups. Overall, treating rolled barley grain with LA and heat improved the bioavailability of Ca and Mg and has the potential to be used by dairy industry to lower mineral supplementation and pollution of the environment.

Key words: barley grain, lactic acid and heat, rumen minerals

M350 Performance variables of dairy cattle fed a commercial micronutrient supplement during the peripartum period. N. Barkley*, A. Kenny, E. Adkins, X. Revelo, and M. Waldron, *University of Missouri, Columbia.*

A time course study was completed to determine the effects of feeding the nutritional supplement OmniGen AF on dry matter intake (DMI), body condition score (BCS), body weight, milk yield, feed to milk conversion efficiency, milk composition [fat, protein, solids–not–fat (SNF), milk urea nitrogen (MUN), 4.0% fat-corrected milk (FCM), somatic cell score (SCS)], plasma concentrations of the metabolites glucose, nonesterified fatty acids (NEFA) and β–hydroxybutyrate (BHBA) in peripartum dairy cattle. Twenty multiparous Holstein cows were fed diets formulated to meet or exceed NRC recommendations for the appropriate physiologic state. Cows were randomly assigned to one of 2 treatment groups (control 56g/cow/day soybean hulls; n = 12 or supplemented 56g/cow/day OmniGen AF; n = 8) balanced for mature equivalent 305-d milk production. Treatment was issued with 225g of sweet feed as a top dressing from d –46 ± 1 through d +31 relative to calving. Feed issue and refusal weights were collected daily to determine DMI. Average BCS (assessed by 2 independent evaluators) and body weights were collected weekly. Blood was sampled on d –47 ± 1, –30 ± 1, –20 ± 1, –11 ± 1, 1, 7, 14 and 30 relative to parturition for plasma glucose, NEFA, and BHBA analysis. Milk yield was recorded daily and milk composition samples were collected during 2 consecutive milkings weekly. All performance variables were analyzed in SAS using mixed model ANOVA procedures with repeated measures. Pretreatment covariates were utilized for BCS, body weight, and all plasma metabolites. No treatment differences or treatment by time interactions were observed for DMI, BCS, body weight, milk yield, feed to milk conversion efficiency, milk composition and plasma metabolites glucose, NEFA and BHBA ($P > 0.10$). Feeding OmniGen AF as a micronutrient supplement during the peripartum period had no statistical effect on the performance variables examined within this study.

Key words: OmniGen AF, micronutrient, dairy

M351 Effect of whole versus chopped sugar cane on dry matter intake in dry dairy cows. J. E. Pérez-De La Ossa[1] and R. P. Lana*[1,2], *[1]Univesidade Federal de Viçosa, MG, Brazil, [2]CNPq and INCT-CA, Brasília, DF, Brazil and Viçosa, MG, Brazil.*

The objective was to evaluate the possibility of use non processed sugarcane in the diet of dry dairy cows. Four crossbred Holstein-Gyr cows with 450 ± 10 kg body weight were used to evaluate the effect of whole vs. chopped sugar cane on intake in dry dairy cows. The animals were housed in individual stalls (24 m^2) with free access to water. Diets consisted in either chopped or whole ad libitum sugarcane plus low intake supplement (400 g/cow/day) containing 25% urea, 25% mineral salt and 50% of a mix of corn meal and soybean meal as nitrogen source. Cows were randomly allocated to a crossover design with 2 animals per treatment in 2 periods of 20 d. In the second period, the treatments changed between the animals, totalizing 4 replicates per treatment or 8 experimental units. Each period consisted of 10 d for adaptation and 10 d for data collection. The experiment was analyzed as a complete randomized design. There was no effect ($P > 0.10$) of sugar cane processing on intake, with values of 22.8 versus 25.5 kg as fed/cow/day for whole and chopped sugarcane, respectively, or 5.24 versus 5.86 kg dry matter/cow/day. Therefore, sugarcane can be fed in a whole form to dry dairy cattle. Feeding whole sugarcane may help to reduce feed costs by reducing machinery use and labor. Also, without processing, the sugarcane decreases losses by fermentation and increases life time of conservation in the feedbunk.

Key words: dry cows, feed, sugarcane

M352 On-farm dry matter testing to improve feed delivery precision on dairy farms. K. R. French* and R. A. Kohn, *University of Maryland, College Park.*

Silage comprises a major portion of total mixed rations (TMR) in most dairy operations. The content of the TMR that is offered to the animals differs from the intended ration. The uncertainty of rations may affect feed efficiency, and consequently milk production, feed expenses, and environmental losses. When silage is measured by weight, unaccounted for changes in silage dry matter (DM) content may substantially change a fed ration. The objective of this study was to measure variation in silage DM on selected dairy farms and determine the potential usefulness of an electronic method of on-farm DM analysis. A field survey of 31 Maryland dairy producers obtained data about on-farm DM analysis frequency, DM analysis methods, ration analysis frequency, feeding regimen, milk production, and number of cows. Of those surveyed, 83% reported testing forage DM more than once per year by any method, and 63% reported testing DM by an on-farm method; mean number of cows was 103, and mean reported RHA was 22,100 lbs. Eight surveyed producers volunteered to collect

on-farm DM data for 21 d. Producers performed daily DM analysis using a Farmex 1210 electronic silage tester, recorded observations on rain events, and recorded ration changes related to the daily DM analysis. Silage samples corresponding to the on-farm DM analyses were retained, and were analyzed for DM after drying at 55°C followed by 100°C (as standard method) and electronic tester (in-lab). There were large differences among farms in how well different methods of DM analysis compared. The difference between on-farm DM (electronic) and standard DM had a mean of 1.82% and SD of 4.99%. Ninety-five percent of observations fell within the limits of agreement (1.96 x SD ± mean) of −7.97 and 11.60%. The electronic method did not compare well to laboratory DM analysis for most farms.

Key words: dry matter, silage, total mixed ration

M353 Effects of the source and amount of sulfur in prepartum diets on plasma metabolites of periparturient Holstein cows. E. Manidari, H. Amanlou, M. Frozanmehr, H. Mirzaei Alamouti*, and M. Shahir, *Department of Animal Science, University of Zanjan, Iran.*

The objective of this study was to determine the effects of concentration and source of sulfur in close-up diets on plasma metabolites in periparturient period. Twenty-four multiparous Holstein cows (body weight (BW), 687.9 ± 32.33 kg) were used in a completely randomized design and assigned to 3 diets: 1) 0.21% sulfur (control, without sulfur supplementation), 2) 0.41% sulfur (with 0.79% magnesium sulfate) and 3) 0.41% sulfur (with 0.57% magnesium sulfate + rumen protected methionine (25 g/d, Mepron, Degussa Corp., Kennesaw, GA)). Cows were individually fed the total mixed ration with similar net energy for lactation (1.58 Mcal/kg dry matter), crude protein (13.3%) and dietary cation-anion difference (−32 mEq/kg dry matter) from 21.9 ± 2.47 d relative to expected calving until calving. After calving, all cows received the same lactation diet until 21 d in milk. Blood metabolites were measured at −21, 1 and 21 d relative to calving. Data were analyzed using MIXED Procedure from SAS and cows nested in the diets were as random effects. Different variance-covariance error structures were tested. Diet with 0.41% sulfur from magnesium sulfate (diet 2) compared with diets 1 and 3 significantly decreased dry matter intake at periparturient period (8.7 vs. 7.4 and 9.7 ± 0.36 at prepartum and 10.7 vs. 8.1 and 10.9 ± 0.65 kg/d at postpartum, for the diets 1, 2,and 3, respectively). The Diet 2 significantly decreased plasma concentration of calcium, cupper, albumin, glucose; although increased urea, bilirubin, β-hydroxybutyrate, aspartate aminotransferase, creatin phosphokinase in periparturient period. The Diet 2 also significantly increased phosphorus, total protein and nonesterified fatty acids concentration of plasma in prepartum period. In summary, increasing sulfur concentration (0.41% of DM) using magnesium sulfate in close-up diets compared with other diets used in this study compromised metabolism of periparturient cows.

Key words: Holstein cows, prepartum diet, sulfur

M354 Intake, digestibility and metabolism of nitrogen compounds of dairy cows fed with different urea levels in diets based on sugar cane. A. M. F. Santiago*[1], J. M. de S. Campos[2], A. S. Oliveira[3], S. A. Santos[4], and S. M. Souza[4], *[1]Instituto Federal de Tecnologia, Rio Pomba, MG, Brazil, [2]Universidade Federal de Pernambuco, Guaranhus, PE, Brazil, [3]Universidade Federal de Mato Grosso, Sinop, MT, Brazil, [4]Universidade Federal de Viçosa, Viçosa, MG, Brazil.*

Twelve multiparous Holstein cows (12.6 ± 0.5 kg/d of yield milk, 225 ± 90 DIM and 589 ± 53 kg BW) were distributed in 3 4x4 Latin squares by DIM, with 4 periods of 18 d to evaluate the effect of 4 levels of the mixture urea:ammonium sulfate (9:1) (urea) in diet (0, 1, 2 and 3% of DM) on intake, digestibility and metabolism of N. Diets TMR were isonitrogen (11.8% of CP), containing 74.7% of DM sugar cane (*Saccharum officinarum*, L., RB 73–9735, 21.9o Brix, 28.3% of DM, 2.6% of CP, 42.2% of aNDFom and 50.5% of NFC.). Fecal samples were collected once daily at 1000, 1200, 1400, 1600 e 1800 h, of 12 to 16 d of each period. Indigestible NDF (after 264 h of ruminal incubation) was used to estimate fecal. Milk samples were collected on 14 and 15 d of each period at am and pm milking. Spot urine samples were obtained approximately 4 h postfeeding on 13 d of each period. Urine volume was estimated using creatinine concentration as marker. Data were analyzed using model mixed (PROC MIXED, SAS Inst. Inc., Cary, NC). The urea inclusion increased NNP diet (10.8, 31.6, 51.7 and 69.4% of N). DM (14.1 kg/d), CP (1.6 kg/d), aNDFom (4.8 kg/d) and NFC (7.8 kg/d) intakes were not affected by urea ($P > 0.05$). DM (72.1%), OM (73.3%), CP (80.0%), NDF (44.1%) and NFC (92.2%) digestibility of diets were not affected by urea ($P > 0.05$). The urea used (0% vs. 1 + 2 + 3% of DM) increased ($P < 0.05$) blood urea-N (7.76 vs. 13.15 mg/dL), urinary N-urea (46.7 vs. 98.8 g/d), urinary N (37.8 vs. 53.0% of N intake) and urinary N/yield milk (7.7 vs. 11.2 g of N/kg of milk). However, the urea level (1 at 3% of DM) did not affect ($P > 0.05$) N excretion and efficiency of N utilization for milk production. Although of linear increase ($P < 0.05$) of blood urea-N with urea level from 1 to 3% of DM, the maximum observed (14.31 mg/dL) was below the recommended borderline maximum by NRC (2001) of 20 mg/dL. In diets based on sugar cane with higher NFC, the increased of urea level of 1 to 3% of DM can be used in dairy cows with production below 15 kg/day, without affecting intake, digestibility and efficiency of N diet.

Key words: nitrogen non-protein

M355 Effects of barley grain processing on milk yield and composition of early lactating Holstein cows. H. Amanlou, H. Mirzaei Alamouti*, and A. Aslani, *Department of Animal Science, University of Zanjan, Iran.*

To determine the effects of barley grain processing on milk yield and composition, 12 multiparous Holstein dairy cow; body weight, 560 ± 48.5 kg and days in milk, 31 ± 11.9, were used in an incomplete block design with 4 diets, 3 periods, 4 blocks and 3 cows per block. The diets were different in size of ground barley grain. 1) coarse size with 92.2% processing index (PI), volume weight of barley after processing as a percentage of whole barley, 2) medium size with 76% PI, floury size with 73% PI, and floury and extruded with 54% PI. Cows were individually fed diets containing 70% concentrate and 30% alfalfa hay during 63 d (21 d in each period). Daily milk yield and composition and periodically blood metabolites were determined. Apparent nutrients digestibility of the diets were determined. Data were analyzed using the MIXED procedure of SAS. Dry matter intake, milk yield and composition, and blood metabolites were not different between diets. Extruded barley grain increased ($P < 0.05$) the apparent dry matter digestibility, neutral detergent fiber and non-fiber carbohydrates. Cows fed the extruded barley grain had higher ($P < 0.05$) feed efficiency. Effective rumen degradability of organic matter and protein were increased ($P < 0.05$) by extruding of barley grain. In general, this study showed that although different size of grounded barley grain did not influence milk production and composition, extruding of barley grain can increase the total digestible nutrients.

Key words: barley grain, cows, feed processing

M356 Fate of phosphorus in large intestine of dairy heifers. P. P. Ray*, M. D. Hanigan, and K. F. Knowlton, *Virginia Polytechnic Institute and State University, Blacksburg.*

The objective was to investigate the disappearance of phosphorus (P) from the large intestine of dairy heifers. Uncertainty about the availability of P in different feeds may limit implementation of dietary strategies to reduce fecal P excretion by dairy cows. Derivation of intestinal P digestion and total tract P absorption data are limited by our lack of knowledge of the dynamics of P digestion and absorption in the large intestine. Data on the fate of organic P flowing to the large intestine are especially scarce. Eight ruminally and ileally cannulated Holstein heifers were used in two 4 × 4 Latin squares with 9 d periods including 3 d of washout. All heifers were fed a high forage diet containing 0.14% total P. Ytterbium-labeled corn silage and Co–EDTA were dosed daily as particulate and liquid phase markers, respectively, to measure ileal digesta flow. Markers were mixed with rumen digesta 4 times daily throughout the study. On d 1 to 4 of each period heifers were infused ileally with 0, 5, 15, and 25 g/d of phytate-P solution (0, 1.41, 4.22, and 7.04 g/d P, respectively). Total fecal collection was conducted during the 4 d infusion. When infusion ceased (d 5 and 6) ileal digesta was sampled to measure P flow to the ileum from the basal diet. Feces and digesta samples were dried and ground, digested (nitric-perchloric), and analyzed for total P with the molybdovanadate yellow method. The effect of phytate infusion on fecal P excretion was evaluated using solution statements in Proc Mixed, with basal ileal P flow as a covariate. Fecal excretion of total P increased with increasing phytate P infused ($P \leq 0.0001$). The slope coefficient for infused phytate P to feces was 1.09 ± 0.21 indicating complete P transfer to feces. In contrast, the slope coefficient for the flow of ileal P (from the basal diet) to feces was 0.22 ± 0.24 indicating net absorption from the large intestine. Thus the form of P (e.g., phytate, inorganic, microbial) entering the large intestine may affect absorption from that segment. These data will support mechanistic modeling efforts to improve prediction of P digestion allowing more accurate estimation of P bioavailability in feeds.

Key words: heifer, large intestine, phosphorus

M357 Peripheral blood leukocyte population dynamics during the peripartum period in dairy cattle fed a commercial micronutrient supplement. A. Kenny*, N. Barkley, X. Revelo, and M. Waldron, *University of Missouri, Columbia.*

A time course study was conducted to determine the effects of a dietary micronutrient supplement on blood leukocyte populations in peripartum dairy cows. Twenty Holstein cows were offered diets formulated to meet or exceed NRC recommendations and randomly assigned to one of 2 treatment groups from d –46 ± 1 through d 31 relative to calving: Control (56g/cow/day soybean hulls; n = 12) or Supplemented (56 g/cow/day OmniGen-AF; n = 8). Blood was sampled on d –47 ± 1, –30 ± 1, –20 ± 1, –11 ± 1, 1, 7, 14 and 30 relative to parturition. Leukocytes were isolated and incubated with monoclonal antibodies that identified cells positive for CD4, CD8α, CD14, CD21 or TcR1-N12 markers which represented helper T cells, cytotoxic T cells, monocytes, B cells and γδ T cells, respectively. The percentage of leukocytes positive for these markers was determined by flow cytometry and analyzed using SAS by mixed model ANOVA with repeated measures. A treatment by time interaction was detected with lower percentages of γδ T cells observed in supplemented cows on d –47 and 1 ($P < 0.05$). The proportion of γδ T cells on d –47 was greater ($P < 0.05$) and on d 1 was less ($P < 0.05$) than most time points. A decrease ($P < 0.05$) in the percentage of lymphocytes and an increase ($P < 0.05$) in the percentage of neutrophils was also observed on d 1 compared with most time points. The percentage of cytotoxic T cells on d 1 and 7 decreased ($P < 0.05$) compared with d –30, –11 and 30. The proportion of B cells was greater ($P < 0.05$) during all prepartum samples than all postpartum samples, and was greater ($P < 0.05$) in supplemented cows on d 30. The percentage of helper T cells was greater ($P < 0.05$) on d –47, –20 and 30 than on d –1 and 14. However, the percentage of monocytes on d –47 and –30 was less ($P < 0.05$) than all other time points. The percentage of monocytes was decreased ($P < 0.05$) in supplemented cows on d –30. OmniGen-AF had minimal effects on the blood leukocyte populations of peripartum dairy cattle. However, changes in the proportion of each cell type over time were observed, especially on the day after parturition.

Key words: OmniGen-AF, leukocyte, dairy

M358 Peripheral blood leukocyte population dynamics in peripartum dairy cattle managed under different dry period nutritional strategies. A. Kenny*, N. Barkley, X. Revelo, and M. Waldron, *University of Missouri, Columbia.*

A time course study was conducted to determine changes in blood leukocyte populations in peripartum dairy cows managed under a one– or 2–group dry period nutritional strategy. Twenty-three Holstein cows were randomly assigned to receive a single diet from d –51 ± 2 to parturition (OG; n = 12) or a far–off diet from d –51 ± 2 to d –28 ± 2 and a close–up diet from d –28 ± 2 to parturition (TG; n = 11). The NE_L of the OG diet was 1.43 Mcal/kg and the NE_L for the far–off and close–up diets of TG was 1.21 and 1.32 Mcal/kg, respectively. Blood was sampled on Days –51 ± 2, –29 ± 1, –18 ± 1, –8 ± 1, 1 and 7 relative to parturition. Leukocytes were isolated and incubated with monoclonal antibodies that identified cells positive for CD4, CD8α, CD14, CD21 or TcR1-N12 markers which represented helper T cells, cytotoxic T cells, monocytes, B cells and γδ T cells, respectively. The percentage of leukocytes positive for these markers was determined by flow cytometry and analyzed using SAS by mixed model ANOVA with repeated measures. A treatment by time interaction ($P < 0.05$) was observed in B cells and cytotoxic T cells. The proportion of B cells on d –18 and –8 was greater ($P < 0.05$) in the TG treatment group, and on d 7 the proportion of cytotoxic T cells increased in the TG group and decreased in the OG group ($P = 0.03$). The B cell percentage on d 7 of both treatment groups was less ($P < 0.05$) than on d –51, –29 and –8. On d 1 the proportion of lymphocytes was lower ($P < 0.05$) and the proportion of neutrophils was greater ($P < 0.05$) than all other sample days. The percentage of monocytes was less on d –51 and –29 than all other sample days ($P < 0.05$) and was also less on d –18 and –8 than on d 1 ($P < 0.05$). The proportion of helper T cells was greater on d –51 and –29 than on d 1 and 7. No differences were detected in γδ T cells. The dynamics of most peripheral blood leukocyte populations was similar between dairy cattle managed under a one– or 2–group dry period nutritional strategy. Variations in B cell dynamics were detected during the dry period and also in cytotoxic T cells after parturition.

Key words: far-off, close-up, leukocyte

M359 Digestion and rumen fermentation in precision-fed dairy heifers on low or high forage rations at four levels of dry distillers grain. F. X. Suarez-Mena*, G. J. Lascano, and A. J. Heinrichs, *The Pennsylvania State University, University Park.*

The objective of this study was to determine the effects of forage to concentrate ratio (F:C) and corn dry distillers grain with solubles (DDGS) at various inclusion levels in precision-fed dairy heifer diets on digestion and rumen fermentation. A split plot design with F:C as whole plot and DDGS inclusion level as sub–plot was administered in a 4-period (19 d) 4 × 4 Latin square. Eight ruminally cannulated Holstein heifers (344 ± 15 kg BW) housed in individual stalls were allocated to 2 F:C (50:50 LF or 75:25 HF; DM basis) and to a sequence of DDGS inclusion (0, 7, 14 and 21%; DM basis). Diets were fed to provide equal amounts of nutrients allowing 800 g/d BW gain and fed 1X/d. Ruminal contents were sampled at –2, 0, 2, 4, 6, 8, 10, 12, and 20 h after feeding. Statistical analysis was conducted using the MIXED procedure of SAS. LF rations had greater apparent digestibility (AD) of DM (66.7 vs. 63.2 ± 0.8%; $P = 0.02$) and OM (69.0 vs. 65.2 ± 0.6%; $P < 0.01$). AD responded quadratically for DM, OM, ADF and NDF with 14% DDGS inclusion level having the highest values. Rumen concentration of ammonia tended to be higher for HF (7.68 vs. 6.48 ± 0.44 mg/dL; $P = 0.07$) and tended to increase as DDGS increased (6.46 to 8.14 ± 0.62 mg/dL; $P = 0.08$). Molar proportions (% of total VFA) of acetate tended to be greater for HF (65.8 vs. 64.0 ± 0.6%; $P = 0.07$) and decreased as DDGS increased (65.4 to 63.9 ± 0.5%; $P < 0.01$); propionate increased as DDGS increased (18.8 to 20.6 ± 0.3%; $P < 0.01$). Acetate to propionate ratio decreased as DDGS increased (3.49 to 3.11 ± 0.06; $P < 0.01$). Rumen protozoa count decreased as DDGS increased (24.42 to 11.94 ± 3.15 × 10^4/mL; $P < 0.01$). We conclude that nutrient AD had a greater response when included at 14% DDGS. Ammonia concentration and molar proportion of propionate increased; while molar concentration of acetate, acetate to propionate ratio, and rumen protozoa number decreased with increasing levels of DDGS. LF rations had greater DM and OM AD.

Key words: digestion, dry distillers grain with solubles, fermentation

M360 Effect of live-cell yeast at two dosages on lactation performance by dairy cows. L. F. Ferraretto*, R. D. Shaver, and S. J. Bertics, *Department of Dairy Science, University of Wisconsin-Madison, Madison.*

The objective of this trial was to evaluate the effect of live-cell yeast (LCY; Procreatin-7; Lesaffre Feed Additives) at 2 dosages in high starch (HS) diets (30% starch DM basis) on lactation performance by dairy cows versus HS and low starch (LS; 20% starch DM basis) control diets. Sixty-four multiparous Holstein cows, 114 ± 37 DIM and 726 ± 74 kg BW at trial initiation, were randomly assigned to 32 electronic gate feeders, which were randomly assigned to 1 of 4 treatments in a completely randomized design; a 2-wk covariate adjustment period with cows fed a 50:50 mixture of the HS and LS diets followed by a 12-wk treatment period with cows fed their assigned treatment diets. The HS diets were fed without (HS0) and with 2 (HS2) or 4 (HS4) g/cow/d of LCY. The LS diet did not contain LCY (LS0) and was formulated by partially replacing dry ground shelled corn with soy hulls. Data were analyzed using Proc Mixed in SAS with covariate, treatment, wk and treatment x wk interaction as fixed effects and gate (treatment) as a random effect. Cows fed LS0 consumed ($P < 0.01$) 2.5 kg/d more DM than HS2, and tended ($P < 0.07$) to consume 1.7 kg/d more than HS4. Milk yield averaged 44.3 kg/d and was unaffected ($P > 0.10$) by treatment. Solids- and energy- corrected milk yields tended ($P < 0.09$) to be 2.2 kg/d greater for HS4 than HS2. Milk fat content was greater ($P < 0.03$) for LS0 than HS0, and tended ($P < 0.09$) to be greater for HS2 and HS4 than HS0. Milk fat yield for cows fed LS0 was greater ($P < 0.05$) than HS0 and HS2, but not different than HS4 ($P > 0.10$). Milk protein content tended ($P < 0.08$) to be greater for HS4 than LS0. The MUN contents were greater ($P < 0.02$) for cows fed LS0 than the HS diets. Feed conversion (kg Milk / kg DMI) was 9% greater for HS2 than LS0 ($P < 0.05$), and tended ($P < 0.08$) to be 8% greater for HS0 than LS0. The BW, BW change, and BCS measurements were unaffected by treatment ($P > 0.10$). The LS0 diet increased DMI and milk fat content and yield, but reduced feed conversions. The addition of LCY to HS diets tended to increase milk fat content in dairy cows.

Key words: yeast, lactating cow, starch

M361 Differences in nutrients formulated and nutrients supplied on three California dairies. H. A. Rossow[1], R. J. van Hoeij[2], and G. Acetoze*[1], *[1]University of California, Davis, [2]Utrecht University, Utrecht, the Netherlands.*

Computer models used in ration formulation assume that nutrients supplied by a ration formulation are the same as the nutrients presented in front of the cow in the final ration. Deviations in nutrients due to feed management effects such as dry matter changes (i.e., rain), loading, mixing and delivery errors are assumed to not impact delivery of nutrients to the cow and her resulting milk production. To estimate how feed management impacts nutrients supplied to the cow, weekly total mixed ration (TMR) samples were collected and analyzed (Analab, Fulton, IL) for 4 pens (close up cows, fresh cows and 2 high milk producing cows pens) for 7 weeks on 3 California dairies. Differences among nutrient analyses from these samples and nutrients from the formulated rations were analyzed by GLM procedure of SAS (SAS Institute, 2007). Deviations in nutrients formulated and supplied were significantly different ($P > 0.05$) among dairies except for fat % (mean 0.25, 0.047, 0.074, SE 0.13, 0.12, 0.11), ash % (mean 0.048, 0.39, 1.2, SE 0.28, 0.26, 0.24), magnesium % (mean 0.036, 0.020, 0.015, SE 0.015, 0.014, 0.013) and chloride % (mean 0.071, 0.00097, 0.14, SE 0.026, 0.025, 0.023). Therefore feed management practices on all 3 dairies impacted nutrients supplied to the cow. Differences among all formulated and supplied nutrients were also significantly different among pens and were 6.14 for DM %, 1.39 for crude protein %, 0.55 for ADF %, 2.2 for NDF %, 3.1 for starch %, 0.088 for fat %, 0.67 for lignin % and 0.60 for ash %. However, differences among nutrients supplied due to diet changes for a pen were not significant. Therefore feed management impacts nutrient delivery to the cow but most diet adjustments are small relative to differences among pen rations.

Key words: feed management, nutrient supply, ration formulation

M362 Effect of dietary protein level and rumen-protected amino acids supplementation on ruminal fermentation and nitrogen utilization in lactating dairy cows. C. Lee*[1], A. N. Hristov[1], K. Heyler[1], T. Cassidy[1], H. Lapierre[2], G. A. Varga[1], and C. Parys[3], *[1]Pennsylvania State University, University Park, [2]Agriculture and Agri–Food Canada, Sherbrooke, QC, Canada, [3]Evonik Degussa GmbH, Hanau, Germany.*

The objective of this experiment was to investigate the effect of dietary protein level and rumen–protected amino acid supplementation on ruminal fermentation and N utilization in lactating dairy cows. The experiment utilized 8 ruminally cannulated Holstein cows (102 ± 28 DIM) in a replicated 4 × 4 Latin square design trial with 21-d periods. Treatments were: 15.6% CP diet [HighCP; metabolizable protein (MP) balance: –24 g/d], 14.0% CP diet (LowCP; MP balance: –283 g/d), 14.0% CP diet supplemented with 100 g/cow/d rumen-protected Lys (AminoShure-L, 24 g/d estimated digestible Lys supply; LowCPLys),

and 14.0% CP diet supplemented with 100 g/cow/d rumen-protected Lys plus 24 g/cow/d rumen-protected Met (Mepron, 15 g/d estimated digestible Met supply; LowCPLysMet). Dry matter intake (26.0 ± 0.79 kg/d), milk yield (40.9 ± 1.46 kg/d), milk composition, and rumen fermentation (pH, VFA and ammonia concentrations) were not affected by diet. Blood and milk urea-N concentrations were lower ($P = 0.03$) for the LowCP diets compared with HighCP. Cows on the LowCP diets had lower N intake (585 vs. 641 g/d, $P < 0.001$) than on HighCP. Apparent total tract N digestibility tended to be decreased ($P = 0.07$) with the LowCP diets compared with HighCP. Milk N secretion and fecal N excretion were not affected by diet. Compared with HighCP, the LowCP diets decreased urinary N excretion (by 29%; $P = 0.01$) and as proportion of N intake (by 22%, $P = 0.04$). Supplementation with rumen–protected amino acids did not further decrease N losses. Whole animal N retention did not differ among diets. Ammonia emission from manure was decreased (by 35%; $P = 0.001$) by the LowCP diets compared with HighCP. In this short-term experiment, dietary CP level or rumen-protected Lys and Met supplementation had no effect on ruminal fermentation, nutrient digestibility (except N), and cow productivity. However, urinary N losses as well as ammonia emission from manure were significantly reduced with the LowCP diets.

Key words: dairy cow, dietary protein, rumen-protected amino acid

M363 Effects of additive treatment and glycerol supplementation on in vitro digestibility and fermentation of a total mixed ration. J. H. Han*[1,2], S. C. Kim[2], D. H. Kim[1,2], J. J. Romero[1], H. J. Lee[1,2], J. H. Shin[1], O. C. M. Queiroz[1], K. G. Arriola[1], C. R. Staples[1], and A. T. Adesogan[1], *[1]Department of Animal Sciences, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, [2]Department of Animal Sciences, Institute of Agricultre and Life Sciences, Gyeongsang National University, Gyeongnam, Jinju South Korea.*

Little is known about effects of glycerol supplementation on ruminal fermentation and whether additives can mitigate potential negative impacts. The objective was to estimate effects of additive treatment and glycerol addition on the in vitro DM and NDF digestibilities and fermentation of a TMR for lactating dairy cows. Two isonitrogenous corn silage (34.5%) and alfalfa hay (10.8%)-based TMR containing 0 or 10% glycerol (DM basis) were treated without (Control, CON) or with 4 additives (0.35 g/L of Procreatin 7 yeast, Prince Agri, YE; 500 mg/L of Dry Apex essential oil, EO, BFI Liquid Feeds; 5 mg/kg of monensin, MO, Sigma; or 3.75 mg/L of sodium bicarbonate, SB, Sigma) and incubated for 48 h in buffered-rumen fluid in triplicate. The experimental design was completely randomized. Treatments had a 2 (glycerol) × 5 (additives) factorial structure and both terms and the interactions were included in the statistical model. No glycerol x additive interaction was detected. Adding glycerol tended to increase molar proportion of propionate ($P = 0.07$, 20.7 vs. 19.5), tended to decrease pH ($P = 0.06$, 6.57 vs. 6.75), and decreased molar proportions of acetate ($P = 0.04$, 46.5 vs. 49.4), and iso-butyrate ($P = 0.05$, 5.46 vs. 5.79). In vitro DMD (67.2 vs. 60.1%) and NDFD (63.5 vs. 26.9%) were greatest ($P < 0.05$) for SB and least for MO-treated fermentation. Compared with other treatments, EO and MO produced greater pH ($P < 0.05$, 6.83 vs. 6.62), lower total VFA concentrations ($P < 0.001$, 92.2 vs. 104.0 mM), and less methane ($P < 0.001$; 22.3 vs. 27.7 mol/100 mol of VFA) whereas MO resulted in lower NH3-N ($P < 0.05$; 13.8 vs. 16.3 mg/dl). Butyrate and valerate molar proportions were lowest for MO-treated fermentations ($P < 0.05$; 9.35 vs. 10.2 and 4.07 vs. 4.85). *Streptococcus bovis* counts on de Man, Rogosa, Sharpe broth were greater for EO than for other treatments ($P < 0.05$; 1.7 vs. 1.43 log cfu/ml). Glycerol addition improved the energetic efficiency of ruminal fermentation. SB produced the greatest DMD and NDFD values but MO and EO decreased the extent of fermentation and YE had minimal effects on the fermentation.

Key words: glycerol, essential oil, monensin

M364 Use of an anti-inflammatory additive in preweaning Holstein calves. L. A. Borunda*[1], D. Domínguez[1], G. Villalobos[1], I. Arteaga[1], E. Santellano[1], M. Cook[2], and M. Yang[2], *[1]Universidad Autónoma de Chihuahua, Chihuahua, Chihuahua, México, [2]Aova Technologies Inc., Madison, WI.*

The use of anti-inflammatory additives to regulate the excess of gut inflamation in Holstein calves is a modern approach to maximize nutrient utilization on growth and production. The objective was to determine the impact on animal performance when BIG CALF (Aova Technologies) was fed at 0% (T0), 1% (T1; 5.54 g/a/d) or 2% (T2; 9.08 g/a/d) to Holstein calves during the preweaning period. Forty-four Holstein female calves averaging 35.2 kg (±6.04) were randomly assigned to treatments after colostrum feeding. Calves were housed in individual hutches and fed daily 3 L of raw milk during the first 15 d of trial and then 4 L until weaning. Half daily doses of BIG CALF were mixed with both of the 2 raw milk meals. Calves received ad libitum a commercial starter concentrate (18% CP) after 5 d of age. The length of experimental period was 56 d. Starter concentrate and water intake were recorded daily and individually, as well as disease incidence, body weight, average daily gain, and feed conversion every 14 d. Statistical analysis of animal performance data was done by repeated measures, and disease incidence by chi-squared analysis. Starter concentrate intake (kg) tended ($P \leq 0.10$) to increase by 30.3% in calves of T1 (0.524 ± 0.052) vs. T0 (0.402 ± 0.050). Average daily gain (kg) was not affected by treatments, means for T0, T1 and T2 were 0.417 ± 0.049, 0.529 ± 0.052, and 0.402 ± 0.049, respectively. However, average daily gain during the last period of trial (42 to 56 d) was 46.8% higher ($P \leq 0.01$) for T1 (0.963 ± 0.090) vs. T0 (0.656 ± 0.087). Final body weight (kg) was superior by 14.3% ($P \leq 0.0003$) for calves of T1 (64.4 ± 1.51) vs. T0 (56.3 ± 1.46), and 12.9% ($P \leq 0.0008$) for calves of T1 vs. T2 (57.04 ± 1.46), respectively. Feed conversion tended ($P \leq 0.10$) to improve by 16.3% in animals of T1 vs. T0 (1.751 ± 0.150 vs. 2.094 ± 0.145). Feeding BIG CALF did not affect daily water intake (L), means were 2.785 ± 0.236, 2.386 ± 0.248, and 2.808 ± 0.237 for T0, T1 and T2, respectively. Diarrhea incidence was 28.9% lower ($P \leq 0.046$) in calves of T1 (23.9%) vs. T0 (33.6%). Feeding BIG CALF at 1% increased animal performance compared with control treatment, but did not at 2%.

Key words: animal performance, anti-inflammatory, Holstein calves

M365 Effect of dietary *trans* fatty acids on milk yield and milk composition of early lactating dairy cows. J. S. Watts*, D. L. Sevier, S. M. Clark, M. A. McGuire, and P. Rezamand, *Department of Animal and Veterinary Science, University of Idaho, Moscow.*

Trans fatty acids (tFA) result from either industrial hydrogenation of oils or from biohydrogenation of unsaturated fat in the rumen. The objective was to determine the effect of supplemental dietary tFA on milk yield and composition compared with saturated fat (sFA). Holstein dairy cows 7 d in milk (n = 12) were randomly assigned to a sequence of treatments in a 3x3 Latin square design. Three treatments containing 0, 1.5, and 3% tFA (Virtus Nutrition; Corcoran, Ca), and 3, 1.5, and 0% sFA (Virtus Nutrition; Corcoran, Ca) respectively were

included in a lactation ration. Animals were fed individually and feed intake and milk yield were recorded daily. Each period lasted 14 d. Milk samples were collected on d 10 and 14 of each period with a baseline sample taken on d 0 (pretreatment). Milk composition was determined by near-infrared analysis (Washington DHIA; Burlington, WA) and milk fatty acid (FA) composition was determined by gas chromatography (GC). Data were analyzed with the MIXED procedure of SAS with significance at $P < 0.05$. Addition of tFA had no detectable effect on milk yield or dry matter intake. Additionally, supplementation of tFA did not significantly affect percentages of milk fat, protein, lactose, SNF, or somatic cell count. Dietary tFA linearly increased the total percentage of unsaturated FA in milk ($P = 0.001$) but had no effect on total percentage of saturated FA. Within the saturated FA, C15:0 and C20:0 increased with increasing tFA ($P < 0.02$), whereas C16:0 decreased. Within the unsaturated FA, tFA increased monounsaturated FA ($P = 0.002$), but not polyunsaturated FA. Importantly, total concentrations of 18:1 trans isomers increased in milk with increasing tFA ($P < 0.0001$) with 18:1 t6-t12 all increasing linearly. Overall, inclusion of tFA up to 3% of DM had a significant effect on the FA composition of milk, increasing the percentage of unsaturated FA including 18:1 *trans* isomers. These changes in the FA composition of milk could have negative implications for human health, as consumption of *trans* fat from industrial hydrogenation is associated with increased risk of several chronic diseases.

Key words: *trans* fatty acid, milk composition, transition cow

M366 Effect of nicotinamide on milk yield and retention of cows on commercial California dairies. P. D. French*[1], M. A. DeGroot[2], and J. C. Woodworth[3], *[1]French Consulting, Bon Air, VA, [2]DeGroot Dairy Consulting, Visalia, CA, [3]Lonza Inc., Enterprise, KS.*

A field study was carried out on 8 commercial dairy farms located around Hanford, CA from July 2008 to January 2009. Average herd size was 2,000 milking cows and ranged from 1000 to 5000 milking cows. Farm was the experimental unit and 2 treatments were equally randomized across farm with a 6-wk period sequence of on-off-on-off and off-on-off-on in a double reversal design; where on is close-up dry cow rations with 4 g of added nicotinamide (NM) per kg DM and off is rations without supplemental NM. Supplementation was targeted to deliver 48 g NM/cow/day during the last week of gestation. Data were edited to include only those cows that received the prepartum ration for a minimum of 17 d. Individual cow data were collected using DairyComp 305. All data, except for culling and pregnancy, were analyzed using the MIXED procedure of SAS. Culling and reproductive data were analyzed using the GLIMMIX procedure of SAS. One farm was excluded from the analysis because of failure to follow the daily feeding protocol. Although the culling percentage from calving through 30 DIM did not differ, cull rate from calving through 60 DIM was lower for NM (6.21 vs. 8.81%; $P < 0.05$). Cows that received NM during the prefresh period were 0.68 times as likely to be culled during the first 60 DIM ($P < 0.05$) compared with the controls. Milk fat percentage at 30 DIM was greater ($P < 0.01$) for cows the received NM prefresh and tended ($P < 0.10$) to be greater at 60 DIM. The difference in milk fat percentage along with a numerical difference in milk yield at 30 DIM lead to a very significant increase of 3.4 kg of 3.5% FCM for NM ($P < 0.01$). Nicotinamide did not affect mortality, DIM at culling, or pregnancy rate. Results of this study indicate that feeding nicotinamide during the close-up period reduces early lactation culling and increases FCM yield.

Key words: niacin, prefresh, culling

M367 Periparturient supplementation of saturated and unsaturated fat sources differentially alters the fatty acid profile of colostrum and milk fat of Holstein cows. M. Garcia*[1], L. F. Greco[1], A. Lock[1,2], J. E. P. Santos[1], and C. R. Staples[1], *[1]University of Florida, Gainesville, [2]Michigan State University, East Lansing.*

Information is limited on the effect of supplemental fat on the fatty acid (FA) profile of colostrum. Fat supplements were saturated free FA (SAT; 38% C16:0, 41% C18:0, 7% C18:1cis-9, and 0.7% C18:2n-6 of total FA) or Ca salts of primarily unsaturated FA (USFA) of palm and soybean oil (32% C16:0, 5% C18:0, 23% C18:1cis-9, 27% C18:2n-6, and 3.5% C18:3n-3 of total FA). Prepartum cows (n = 27 fed no supplemental FA; n = 26 fed SAT at 1.7% of dietary DM; n = 24 fed USFA at 2% of dietary DM) were allocated randomly to diets (1.7% FA for base diet, DM basis) starting at 60 d before calculated calving date through 90 DIM. Within 2 h of calving, cows were milked and colostrum was sampled and stored at −20C for later analysis of FA using gas-liquid chromatography. Concentration of total FA (7.4, 6.0, and 7.2% of DM for control, SAT, and USFA, respectively) and proportion of individual shorter chain (C4:0 to C14:0) saturated FA (19.9, 18.9, and 18.1% of FA) were not affected by supplement. Feeding fat decreased ($P < 0.05$) proportion of C14:1 (1.89, 1.70, and 1.57% of FA) and C16:1 (0.54, 0.43, and 0.40% of FA), increased proportion of C18:0 (8.4, 9.6, and 9.6% of FA), but had no effect on proportions of C16:0 (38.1, 37.4, and 37.1% of FA) and C18:1 cis-9 (22.2, 22.6, and 22.1% of FA). Colostrum from cows fed USFA had greater proportions of C18:2n-6 (2.25, 2.31, and 3.35% of FA), total C18:1 trans (1.60, 1.58, and 2.06% of FA), and CLA cis-9, trans-11 (0.20, 0.17, and 0.27%) but not of C18:3n-3 (0.38, 0.39, and 0.41%). The effect of dietary fat source on the FA profile of milk collected wk 5 to 7 postpartum from cows fed the same 3 dietary supplements was different compared with their effects on colostrum. Proportion of each medium chain FA (C10:0, C12:0, and C14:0) was lower and that of C18:0 was elevated by fat supplementation to lactating cows. As with colostrum, feeding USFA increased proportions of total C18:1 trans, C18:2n-6, and CLA cis-9, trans-11 in milk fat. In conclusion, fat supplementation influenced the FA profile of colostrum fat and milk fat differently.

Key words: colostrum, milk, fatty acids

M368 Effects of reduced dietary protein and supplementing rumen protected amino acids on the nitrogen efficiency of dairy cows. A. L. Bell*[1], M. J. de Veth[2], T. R. Wiles[1], O. Becvar[3], and M. D. Hanigan[1], *[1]Virginia Polytechnic Institute and State University, Blacksburg, [2]Balchem Corporation, New Hampton, NY, [3]Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, VA.*

When fed to meet National Research Council (2001) protein recommendations, dairy cows consume an excess of many amino acids (AA) resulting in approximately 75% of dietary nitrogen (N) being lost to the environment as urine and feces. Reductions in environmental N release could be attained through an improvement of N efficiency in dairy cows. The objective of this study was to determine if the typical reduction in milk yield associated with feeding a low protein diet to lactating dairy cows could be avoided by dietary supplementation with one or more ruminally protected (RP) AA. Fourteen multiparous and 10 primiparous Holstein cows and 24 multiparous Holstein × Jersey crossbred cows were used in a Youden square design consisting of 8 treatments and 3 periods. The 8 dietary treatments were 1) a standard diet containing 17% crude protein (CP) (+Con), 2) a 14% CP diet (-Con), 3) -Con plus RP methionine (+Met, 16g/d), 4) -Con plus RP lysine (+Lys, 47g/d), 5) -Con plus RP leucine (+Leu, 181g/d), 6) -Con

plus RP methionine and lysine (+Met+Lys), 7) -Con plus RP methionine and leucine (+Met+Leu), and 8) -Con plus RP methionine, lysine, and leucine (+Met+Lys+Leu). Cows given the -Con and +Met+Lys+Leu diets had significantly lower milk production and milk protein yield than the +Con cows. The yield of milk and milk protein for all other AA treatments were not different from either the -Con or +Con treatments. Dry matter intake decreased for cows given the +Met+Leu diet, but all other treatments were not different from the +Con treatment. Milk urea N was significantly decreased for all diets compared with the +Con indicating N efficiency was improved for the low protein diets. Plasma isoleucine and valine were significantly reduced when CP was reduced. Leucine concentrations increased for the +Met+Leu treatment compared with -Con. All other AA were unchanged. In conclusion, supplementation of the individual AA or combinations of 2 AA, but not a combination of all 3 prevented a reduction in milk yield when dietary protein levels were reduced to 14% of dietary dry matter.

Key words: nitrogen efficiency, rumen-protected amino acids, milk production

M369 The effect of direct-fed microbial supplementation on reproductive and production performance of primiparous Holstein heifers. M. B. Cattell[1], A. J. Nelson[1], J. E. Nocek[2], and L. C. Solórzano*[3], *[1]Dairy Research and Technology LLC, Windsor, CO, [2]Spruce Haven Farm and Research Center, Union Springs, NY, [3]Chr. Hansen Inc., Milwaukee, WI.*

The effects of supplementing a direct-fed microbial (DFM) to primiparous dairy cows during the transition period were evaluated. Approximately 2 hundred Holstein primiparous cows were group housed and fed close-up and lactating diets without or with 2 g/cow/d of DFM. Direct-fed microbial supplementation contained approximately 5×10^9 cfu of bacteria (2 specific *Enterococcus faecium* strains) and 2×10^9 cfu of live viable yeast (*Saccharomyces cerevisiae*) incorporated into a limestone carrier. Supplemented cows were fed the DFM at least 7 d before calving and continued through 60 d postpartum. Statistical analyses were conducted by SAS JMP utilizing split-plot-in-time ANOVA for repeated measures. A Wilcoxon test was used to test treatment effects. Although no significant ($P > 0.1$) reproductive responses were observed, cows supplemented with DFM had 5 less days open than non-supplemented cows (140 vs. 145 d) and a lower incidence of retained placentas (2 vs. 5.3%). In addition, cows supplemented with DFM had a numerical ($P > 0.1$) decrease in the incidence of displaced abomasums (2 vs. 6.4%). Cows supplemented with DFM produced milk containing a higher ($P < 0.05$) percentage of milk fat (3.58 vs. 3.49%) and milk protein (3.04 vs. 2.99%), and a higher ($P < 0.1$) milkfat yield than nonsupplemented cows (1.01 vs. 0.98 kg/cow/d). Data suggests that DFM supplementation improves the transitional health of primiparous cows and their subsequent lactational performance.

Key words: direct-fed microbial, reproduction, production

M370 Rumination behavior and its relationship to feeding behavior in Holstein dairy cows prepartum. K. Schirmann*[1,2], N. Chapinal[1], D. M. Weary[1], W. Heuwieser[2], and M. A. G. von Keyserlingk[1], *[1]Animal Welfare Program, Faculty of Land and Food Systems, The University of British Columbia, Vancouver, BC, Canada, [2]Clinic for Animal Reproduction, Faculty of Veterinary Medicine, Freie Universität Berlin, Berlin, Germany.*

The objective of this study was to describe the rumination behavior, feeding behavior and feed intake in dairy cows. Rumination was monitored electronically using Vocal Tags and feeding behavior and intake were monitored using Insentec feed bins, by 2-h period, for 42 multiparous Holstein cows for a minimum of 9 d in the early dry period. Pearson correlations used to test the association, within cow, among 2-h periods, first examining the relationship within a single period, and then modeling how this relationship changes with a lag of 2, 4 or 6 h. We then investigated if daily rumination times were associated with feeding time and DMI among cows. Periods when cows spent more time ruminating were associated with lower feeding times and lower DMI ($r = -0.71$, $P < 0.001$, and $r = -0.72$, $P < 0.001$, respectively), likely because cows were unable to feed and ruminate simultaneously. The correlations with rumination time changed from negative to positive when lags of 2, 4 and 6 h were modeled ($r = -0.09$, 0.24, 0.15, $P < 0.01$, and $r = -0.16$, 0.23, 0.17, $P < 0.001$ for feeding time and DMI at lags of 2, 4, and 6 h, respectively). The results indicate that following periods of high feeding times and intakes cows spent more time ruminating, and that this relationship peaks at approximately 4 h after feeding. Among cows, animals that spent more time spend ruminating per day, spent less time feeding ($r = -0.34$, $P = 0.03$) with no effect on DMI ($r = 0.11$, $P = 0.48$). Overall these data indicate that rumination time can be used to estimate within cow variation in DMI, but that the use of daily summaries of rumination behavior to estimate DMI should be viewed with caution.

Key words: feeding time, dry matter intake, welfare

M371 Performance of dairy calves offered alternative preweaning feeding programs. S. L. Gelsinger*, P. C. Hoffman, and D. K. Combs, *University of Wisconsin, Madison.*

Sixty Holstein or Holstein × Jersey heifers were randomly assigned at birth to one of 3 milk feeding programs: (1) Control - calves fed 3.8 L/d whole pasteurized milk (WPM) and ad libitum complete calf starter from 3 d to 6 wk of age (2) Limit starter - calves offered a maximum of 115 g DM/d of calf starter from 3 d of age until 3 d before weaning and 3.8 L/d WPM during wk 1, 5.7 L/d WPM during wk 2 and 3, and 7.6 L/d WPM during wk 4, 5 and 6, and (3) Hay - calves offered alfalfa hay, but no calf starter until 3 d before weaning and fed WPM similarly to Limit starter calves. For 3 d before weaning, calves were fed 0.9 L WPM per feeding and provided ad libitum calf starter. Dry hay was replaced by calf starter for Hay treatment calves. The study was from November, 2010 to February, 2011. Calves were in individual calf hutches and fed milk twice daily and provided water. Body weight, body measurements and starter intake were recorded. Data was analyzed as a completely randomized design by the proc mixed procedure in SAS with treatment a fixed effect and calf the random effect. Calves assigned to the 3 treatments had similar (mean +/− SE) body weight, heart girth, hip height and body length at birth (39.5 kg +/− 0.9, 80.6 cm +/− 0.8, 77.6 cm +/− 0.9, and 69.9 cm +/− 1.1, respectively). At 6 weeks of age, weaning weights of calves fed Control (68.2 kg) and Limit (70.5 kg) were similar, but greater ($P < 0.05$) than calves on Hay (65.5 kg). Limit starter calves had higher ($P < 0.05$) 6wk hip height (93.7 cm) than Control calves (90.9 cm) and hip height of Hay calves (89.5 cm) was less ($P < 0.05$) than either other treatment. Total starter consumption during the first 5 weeks was 11.6, 3.6 and 0 kg per calf on Control, Limit and Hay, respectively. Starter consumption during the week of weaning was highest ($P < 0.01$) for Control (6.7kg/7 d), intermediate for limit (1.9 kg/7d) and least (1.1 kg/7d) for Hay. Calves on the Limited starter treatment protocol performed similarly to calves limit fed milk and calf starter ad libitum. Calves consuming no starter until 3 d before weaning were smaller, and consumed the least starter during the week of weaning.

Key words: calf, feeding, weaning

M372 Effect of *Origanum vulgare* L. leaves on production and milk fatty acid composition in lactating dairy cows. A. N. Hristov*[1], C. Lee[1], T. Cassidy[1], K. Heyler[1], J. A. Tekippe[1], G. A. Varga[1], and B. Corl[2], *[1]Pennsylvania State University, University Park, [2]Virginia Polytechnic Institute and State University, Blacksburg.*

This experiment investigated the effects of dietary supplementation with *Origanum vulgare* L. leaves (oregano; OL) on production and milk fatty acid (FA) composition in dairy cows. The experimental design was a replicated 4 × 4 Latin square with 8 ruminally-cannulated Holstein cows (DIM, 160 ± 38) and 20-d experimental periods. Treatments were: control (no OL supplementation), 250 g/cow/d OL (LOR), 500 g/d OL (MOR), and 750 g/d OL (HOR). The oregano leaves were supplemented to the basal TMR replacing an alfalfa-cottonseed hulls mix. The basal TMR (14.7% CP, 36.2% NDF) contained (DM basis) 58% forage (corn silage, alfalfa haylage, and a grass-straw mix). Oregano supplementation linearly decreased ($P = 0.02$; SEM = 1.80) DMI: 28.3, 28.3, 27.5, and 26.7 kg/d, control, LOR, MOR, and HOR, respectively. Milk yield tended to increase ($P = 0.07$; SEM = 7.43) quadratically with OL supplementation: 43.4, 45.2, 44.1, and 43.4 kg/d, respectively. As a result, feed efficiency was increased ($P < 0.001$) for all OL diets (1.59, 1.60, and 1.63, respectively) compared with the control (1.46). Milk protein and lactose concentrations and yields and FCM yield were not different among diets. Milk fat content tended to be increased ($P = 0.07$) by HOR compared with the control (3.57 vs. 3.26%, respectively), but OL tended to linearly reduce ($P = 0.07$) milk fat. Milk urea-N concentrations were lower ($P = 0.04$) for all OL diets (7.95 to 8.49 mg/dL) compared with the control (9.26 mg/dL). Rumen fermentation (pH, VFA, and ammonia concentrations) was not affected by treatment. Apparent total tract digestibility of nutrients was also not affected by OL, except NDF digestibility was slightly decreased ($P = 0.04$) by all OL diets compared with the control (49.3 vs. 51.3%, respectively). OL had no effect on milk FA composition. In this short-term study, oregano leaves fed at 250 to 750 g/d decreased linearly DMI and tended to quadratically increase milk yield in dairy cows. Feed efficiency was increased with all OL inclusion levels. Oregano leaves had no effect on ruminal fermentation and milk FA composition.

Key words: *Origanum vulgare*, feed efficiency, dairy cow