# Ruminant Nutrition: Dairy: Starch, Amino Acids and By-Products Supplementation

**466 The effect of arginine supplementation during pregnancy on uterine blood flow in dairy heifers.** C. Yunta*[1], B. R. Mordhorst[2], K. A. Vonnahme[2], C. Parys[3], and A. Bach1,4, *[1]Department of Ruminant Production-IRTA, Caldes de Montbui, Barcelona, Spain, [2]Center for Nutrition and Pregnancy, Department of Animal Science, North Dakota State University, Fargo, [3]Evonik Industries AG, Hanau, Germany, [4]ICREA, Barcelona, Spain.*

We hypothesized that arginine (Arg) supplementation during early pregnancy would increase uterine blood flow. The objective of this study was to evaluate the effects of Arg supplementation on uterine artery hemodynamics from d 40 to 140 of gestation in dairy heifers. Catheters were surgically placed into the peritoneal cavity on d 41 of gestation in Holstein heifers (n = 17; 448 ± 73.9 kg) and every 12 h, infusions of 40 mg of Arg/kg of BW (ARG; n = 9) or an equivalent volume of buffered saline (CTRL; n = 8) were administered until d 146. Animals were fed ad libitum, and DM intake (DMI) was recorded daily. Blood samples were obtained, heifers were weighed, and uterine artery hemodynamics [flow volume (FV), heart rate, pulsatility index (PI), and resistance index (RI)] were recorded on d 41, 62, 83, 104, 125, and 146. Plasma concentrations of amino acids (AA) were analyzed. Data from d 41 of pregnancy were considered as a baseline and the remainders of the data were then analyzed using a mixed-effects model that accounted for the fixed effects of treatment, day of gestation, and their interaction, with age and BW at d 41 as covariates, plus the random effect of heifer within treatment. There were no differences in DMI. Overall, FV increased ($P < 0.001$) with pregnancy day (172 ± 44.5 mL/min on d 41; 954 ± 45.8 mL/min on d 146). Uterine blood FV evolved differently between treatments, with CTRL heifers having a greater ($P < 0.05$) FV (1104 ± 65.42 mL/min) at 146 d of pregnancy than ARG heifers (806 ± 65.3.2 mL/min). PI and RI decreased throughout pregnancy but did not differ between treatments. Heart rate was less ($P < 0.05$) in ARG (74 ± 1.4 beats/min) than CTRL heifers (81 ± 1.5 beats/min). Plasma concentrations of Arg tended ($P = 0.09$) to be greater in ARG than in CTRL heifers, but Car, Val, Ile, Leu, Phe and Trp were less ($P < 0.05$) in ARG than in CTRL heifers and so was the proportion of essential AA in plasma (65 ± 2.3 vs. 73 ± 2.4%). Contrary to our hypothesis, Arg did not increase uterine blood flow but did alter heart rate and maternal concentration of some plasma AA.

**Key Words:** arginine, blood flow, heifer

**467 Protein source and amino acid balance for dairy calves fed milk replacer.** G. H. Hwang*[1], J. J. Castro[1], A. Saito[2], D. A. Vermeire[3], and J. K. Drackley[1], *[1]University of Illinois, Urbana, [2]Zen-Raku-Ren, Tokyo, Japan, [3]Nouriche Nutrition Ltd., Lake St. Louis, MO.*

Amino acid (AA) balance and content of non-milk proteins may be important for calves fed milk replacers for intensified growth. Our objectives were to determine: 1) if essential AA might be limiting in milk replacers containing skim milk and whey proteins; 2) effects of replacing whey protein concentrate (WPC) with hydrolyzed wheat protein (HWP); and 3) if essential AA balance might limit growth in calves fed milk replacer formulated with skim milk proteins and HWP. Calves (12–13 females, 7–10 males per diet) were assigned randomly at d 2 of life to 5 milk replacer diets in a continuous design. Calves were fed only milk replacers (28.5% CP, 15% fat) to 28 d; then starter was introduced. Milk replacers were fed at 600 g/d in wk 1, 800 g/d in wk 2, and 1200 g/d in wk 3 and 4. Diet A was formulated to contain 2.6% Lys from skim milk and WPC; other diets were supplemented with Lys-HCl to 2.6% Lys. Diet B was as Diet A but with added Met, Thr, His, Phe, Val, and Leu to achieve a dietary AA profile suggested to optimize growth recommended by Van Amburgh (Cornell Univ.). Diets C and D contained 4.5% and 9.0% HWP, with Met, Thr, His, Phe, Val, Leu, Ile, and Trp added to meet diet B profile. Diet E was as diet D but with only Lys, Met, and Thr balanced. Skim milk protein was constant across diets; HWP replaced half (diet C) or all (diet D) of the WPC. Calves were weaned at 56 d, with final measurements at d 90. Data were subjected to ANOVA and regression analysis. Mean BW tended to be lower for calves fed diet E than for those fed diet B at 8 wk (77.8 vs. 80.7 kg, $P = 0.08$). The linear effect of age on BW from wk 1 to 13 was less ($P < 0.05$) for diet E than for diets A and C but did not differ from diet B ($P = 0.19$). Linear and quadratic effects of increasing MWP on ADG were not significant ($P = 0.78$, $P = 0.73$). Growth did not differ between diets A or B. Starter intake was lower for diet B than for diet A, but did not differ among other diets. In conclusion, addition of essential AA to a milk protein-based milk replacer did not increase growth. Inclusion of 4.5 or 9% HWP in milk replacer for intensified growth did not decrease growth when essential AA were balanced.

**Key Words:** calf, amino acid, modified wheat protein

**468 Effect of dietary starch concentration in primiparous dairy cows in early lactation.** H. Gencoglu*[1], G. Yilmazbas-Mecitoglu[2], A. Keskin[2], I. Cetin[1], C. Kara[1], A. Orman[3], E. Karakaya[2], G. Deniz[1], A. Gumen[2], I. I. Turkmen[1], and R. D. Shaver[4], *[1]Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine University of Uludag, Bursa Turkey, [2]Department of Obstetrics and Gynecology, Faculty of Veterinary Medicine University of Uludag, Bursa, Turkey, [3]Department of Zootechnics, Faculty of Veterinary Medicine University of Uludag, Bursa, Turkey, [4]Department of Dairy Science, University of Wisconsin-Madison, Madison.*

The objective of this trial was to determine the effect of dietary starch concentration on locomotion and body condition scores and performance of early lactation dairy cows fed diets of different starch concentrations. Twenty-four primiparous Holstein cows were randomly assigned to 1 of 3 treatments in a completely randomized design from calving through 72 d DIM. Diets contained 30% corn silage, 20% chopped alfalfa hay, and 50% concentrate/mineral/vitamin/additive mixtures (on DM basis). The concentrate mixtures were formulated by partially replacing dry ground shelled corn with wheat bran. Cows were fed the low (LS), medium (MS) and high-starch (HS) diets as total mixed ration. The dietary starch contents were 16.2, 19.8, and 24.1% for low LS, MS, and HS, respectively (DM basis). Body condition score (BCS), body weight (BW) and locomotion scores were measured weekly throughout the trial. Dry matter intake and milk yield were recorded daily on individual cows milked 3×. Data were analyzed according mixed models procedure. There was a tendency ($P = 0.07$) for locomotion scores to be greater for MS compared with LS. Milk yield averaged 29.4 kg/d and was unaffected ($P > 0.10$) by treatment. Values for milk urea nitrogen ranged from 12.4 to 13.0 mg/ dL across the treatments and was lower for cows fed MS than for cows fed the LS. The BW, BCS, and milk fat and protein percentage measurements were unaffected ($P > 0.10$) by treatment. Dry matter intake for cows fed the LS diet was 1.1 and 2.3 kg/d greater than for cows fed the MS ($P < 0.05$) and HS ($P < 0.01$) diets, respectively. It was concluded that when partially replacing corn grain with wheat bran to formulate

reduced-starch diets, increased dry matter intake for dairy cows fed LS may reduce feed efficiency (kg of milk/kg of dry matter intake).

**Key Words:** dairy cow, milk production, starch

**469 Milk fat depression caused by feeding distillers grains and corn oil to dairy cows was partially alleviated by supplementing potassium carbonate.** K. C. Lamar* and W. P. Weiss, *The Ohio State University, Wooster.*

In vitro experiments have found that added $K_2CO_3$ decreased concentrations of biohydrogenation intermediates associated with milk fat depression, such as trans-10, cis-12 CLA. These intermediates are often produced when diets are fed to cows with high concentrations of polyunsaturated fatty acids such as those found in distiller's grains. We hypothesized that adding $K_2CO_3$ to a high fat diet based on distillers grains would alleviate milk fat depression. Sixteen Holstein cows averaging 157 DIM were placed into 4 blocks; each block comprised a 4 × 4 Latin square with 21-d periods and a 2 × 2 factorial arrangement of treatments. The basal diet (no added K or fat) contained 25% distillers grain with corn silage as the sole forage and contained 22% starch, 32% NDF, 3.4% long chain fatty acids, and 1.5% K (DM basis). Treatments were 0 or 1.9% added fat from corn oil (in high fat diets, distillers +corn gluten meal + corn oil = 25%) with 0 or 0.85% added K (from DCAD Plus; Church & Dwight Co., Inc., Princeton, NJ). Dry matter intake was reduced with supplemental K (20.9 vs. 22.3 kg/d; $P < 0.01$) and fat (21.1 vs. 22.2 kg/d; $P < 0.01$) but no interaction was observed. Likely in response to lower DMI, milk production tended to decrease with added K (31.1 vs. 32.2 kg/d $P < 0.09$). Added fat decreased milk fat percent (2.78 vs. 2.97%; $P < 0.01$) and added K increased it (3.00 vs. 2.75%; $P < 0.01$) but no interaction was observed. Milk fat yield was reduced by fat supplementation but an interaction between fat and K was observed ($P < 0.05$). Supplemental K increased fat yield with high fat (0.92 vs. 0.84 kg/d; $P < 0.01$) but had no effect with the lower fat diet (0.96 vs. 0.97 kg/d; $P > 0.1$). Milk protein percent (3.35 vs. 3.43% $P < 0.05$) and yield (1.04 vs. 1.10 kg/d; $P < 0.01$) decreased with added K, perhaps in response to reduced DMI. Dietary fat reduced milk protein concentration (3.43 vs. 3.36%; $P < 0.06$) but not yield. Supplemental $K_2CO_3$ overcame some of the negative effects of polyunsaturated fats on milk fat production but milk fat concentrations were still low compared with breed average.

**Key Words:** milk fat depression, potassium, distillers grains

**470 Effects of replacing soybean meal with canola meal for lactating dairy cows fed three different ratios of alfalfa to corn silage.** A. Faciola*[1] and G. Broderick[2], [1]*University of Nevada, Reno,* [2]*ARS, USDA, USDFRC, Madison, WI.*

Previous research suggested that CP from canola meal (CM) was used more efficiently that CP from solvent soybean meal (SBM) by lactating dairy cows. We wished to test whether CM was more effective than SBM on different ratios of alfalfa to corn silage. Forty-eight lactating Holstein cows were blocked by DIM and parity into 4 pairs of blocks of 6 cows each in a 3 × 2 arrangement of treatments in a cyclic changeover design trial with 6 experimental diets. Cows within blocks were randomly assigned to the experimental diets and fed for 4-wk periods before switching treatments over a total of 16 weeks. Treatments were 3 ratios of alfalfa to corn silage ratios (1:5, 1:1, and 5:1; DM basis), each supplemented with protein from SBM or CM. Diets contained (DM basis): 60% forage, 8–15% high moisture corn, 2–5% soy hulls, 1.3% mineral-vitamin premix, 16.5% CP, and 31–33% NDF. Data from the last week of each period were analyzed using the mixed procedure in SAS. Least squares means are reported in the table. When CM replaced SBM, improved yield of milk and milk protein ($P = 0.03$) and SNF ($P = 0.05$) was observed. There also was a trend for increased lactose yield ($P = 0.07$). Moreover, MUN decreased ($P < 0.01$) when CM replaced SBM. No significant interaction of protein source and forage source was observed. Production of milk and milk components was improved as alfalfa silage was replaced by corn silage.

**Table 1.** Production data

| | Protein source | | Alfalfa to corn silage ratio | | | *P*-value | |
|---|---|---|---|---|---|---|---|
| Item | SBM | CM | 5:1 | 1:1 | 1:5 | Protein source | Forage source |
| DMI, kg | 23.5 | 23.8 | 23.7 | 24.0 | 23.4 | 0.4 | 0.42 |
| Milk yield, kg/d | 36.4 | 37.3 | 34.6 | 37.2 | 38.7 | 0.03 | <0.01 |
| ECM, kg/d | 35.6 | 36.1 | 33.9 | 36.4 | 37.2 | 0.24 | <0.01 |
| Milk N/N intake, % | 27.3 | 27.5 | 25.1 | 27.2 | 29.9 | 0.66 | <0.01 |
| Fat, % | 4.0 | 3.94 | 4.09 | 3.99 | 3.82 | 0.25 | <0.01 |
| Fat, kg/d | 1.45 | 1.46 | 1.41 | 1.49 | 1.47 | 0.69 | 0.02 |
| Protein, % | 3.02 | 3.02 | 2.96 | 3.02 | 3.07 | 0.92 | <0.01 |
| Protein, kg/d | 1.1 | 1.12 | 1.02 | 1.12 | 1.19 | 0.03 | <0.01 |
| Lactose, % | 4.85 | 4.84 | 4.81 | 4.86 | 4.87 | 0.86 | 0.03 |
| Lactose, kg/d | 1.77 | 1.81 | 1.66 | 1.81 | 1.89 | 0.07 | <0.01 |
| SNF, % | 8.75 | 8.74 | 8.64 | 8.76 | 8.83 | 0.63 | <0.01 |
| SNF, kg/d | 3.19 | 3.26 | 2.99 | 3.26 | 3.42 | 0.05 | <0.01 |
| MUN, mg/dL | 14.0 | 12.9 | 13.8 | 13.2 | 13.4 | <0.01 | 0.03 |

**Key Words:** alfalfa silage, canola meal, soybean meal

**471 Milk production responses to a change in dietary starch concentration vary by production level in dairy cattle.** J. C. Ploetz*, S. E. Burczynski, M. J. VandeHaar, M. S. Allen, and A. L. Lock, *Michigan State University, East Lansing.*

The effects of dietary starch concentration on yield of milk and milk components were evaluated in a crossover design experiment. Holstein cows (n = 32; 115 ± 22 DIM) with a wide range in milk yield (28 to 62 kg/d) were assigned randomly, within level of milk yield, to treatment sequence. Treatments were diets containing 30% dry ground corn (CORN) or 30% soyhull pellets (HULLS) on a DM basis. Cows were fed a diet intermediate to the treatments during a preliminary 14-d period. Diets containing corn silage and alfalfa silage were formulated to contain 16% CP, 27 or 44% NDF, and 30 or 12% starch for CORN and HULLS, respectively. Treatment periods were 28 d with the final 5 d used for data and sample collection. The statistical model included the random effect of cow, the fixed effect of treatment, period, and linear and quadratic interactions between treatment and preliminary milk yield. Compared with HULLS, CORN increased (all $P < 0.001$) DMI (26.6 vs. 28.0 kg/d), milk yield (36.0 vs. 40.2 kg/d), milk protein concentration (3.15 vs. 3.30%) and yield (1.11 vs. 1.31 kg/d), milk fat yield (1.32 vs. 1.47 kg/d), and ECM yield (36.9 vs. 41.4 kg/d). Treatment did not affect milk fat concentration ($P = 0.56$). Yields of de novo and preformed milk fatty acids increased with CORN ($P < 0.0001$ and $P = 0.02$, respectively), whereas yield of 16-carbon fatty acids increased with HULLS ($P < 0.0001$). Treatment interacted with level of preliminary milk yield for several response variables (yields of milk, milk

protein, milk fat, ECM, and 3.5% FCM). For ECM, lower producing cows benefited from the HULLS diet while there was an increasingly positive response to CORN as milk yield increased up to ~50 kg/d (quadratic interaction $P = 0.04$). CORN increased feed efficiency (ECM/DMI; 1.40 vs. 1.48, $P = 0.02$) and BW (697 vs. 704 kg, $P = 0.01$) compared with HULLS, however BCS was unaffected ($P = 0.23$). In conclusion, higher producing cows benefited from the high starch diet, and lower producing cows were better able to maintain production when fed the lower starch diet.

**Key Words:** feed efficiency, starch concentration, variation in response

**472 Interactive effects between dietary grain source and oil supplement on feeding behavior and lactational performance of Holstein cows.** S. Kargar*[1,3], G. R. Ghorbani[1], M. Khorvash[1], and D. J. Schingoethe[2], *[1]Isfahan University of Technology, Isfahan, Iran, [2]South Dakota State University, Brookings, [3]University of Wisconsin-Madison, Madison.*

Effects of grain source and dietary oil supplement on dry matter intake (DMI), feeding, chewing behavior, and productivity of lactating dairy cows were evaluated. Eight multiparous Holstein cows (77 ± 22.1 d in milk) were used in a duplicated 4 × 4 Latin square design with a 2 × 2 factorial arrangement of treatments. Experimental diets contained either ground barley or ground corn supplemented with either fish oil or soybean oil at 2% of dietary dry matter (DM). Geometric mean particle size of dietary treatments was 4.1 mm. Dry matter intake tended ($P < 0.09$) to be greater for barley- vs. corn-based diets (23.2 vs. 22.3 kg/d), but was reduced for the fish oil compared with soybean oil supplemented diets ($P < 0.01$; 21.1 vs. 24.3 kg/d). This reduction in DMI was attributed to smaller meal size ($P < 0.01$; 1.24 vs. 1.55 kg of DM) and slower eating rate ($P < 0.01$; 0.082 vs. 0.098 kg of DM/min) for fish oil compared with soybean oil supplemented diets. Sorting index was not influenced by dietary treatments, but grain source interacted by oil supplement to affect DMI of particles retained on 19 mm sieve ($P < 0.01$). Although not significant, milk yield tended to be greater when cows were fed barley- compared with corn-based diets (42.5 vs. 41.3 kg/d) with no changes in milk composition. Compared with soybean oil, fish oil negatively affected milk yield ($P < 0.01$; 40.4 vs. 43.4 kg/d), and thereby, milk fat ($P < 0.01$; 0.91 vs. 1.26 kg/d) and protein ($P < 0.01$; 1.23 vs. 1.33 kg/d) production. However, feed efficiency (milk yield/DMI) was greater in fish oil- compared with soybean oil supplemented diets ($P < 0.01$; 1.94 vs. 1.80). The grain source did not affect meal patterns, but rumination time was greater for barley- compared with corn-based diets as result of longer rumination duration ($P < 0.01$; 32.5 vs. 28.5 min/meal). Also, dietary grain source and oil supplement tended ($P < 0.09$) to interact for total chewing time. Results indicated that grain source and oil supplement can interact to affect intake and total chewing activity, but not productivity of lactating cows.

**Key Words:** grain, oil, dairy cow

**473 Effects of starch level and monensin in fresh cow diets on subclinical endometritis and indices of immune function.** T. Yasui*[1], M. M. McCarthy[1], C. M. Ryan[1], R. O. Gilbert[1], M. J. B. Felippe[1], G. D. Mechor[2], and T. R. Overton[1], *[1]Cornell University, Ithaca, NY, [2]Elanco Animal Health, Greenfield, IN.*

Primiparous and multiparous cows (n = 70) were used to determine the effects of starch level in the early postcalving diet (wk 1 to 3 postcalving) and monensin supplementation throughout the periparturient period and early lactation on subclinical endometritis and aspects of immune function. Cows were randomly assigned to one of the following postcalving dietary treatments: (1) High starch (HS), no monensin; (2) HS, monensin; (3) Low starch (LS), no monensin; (4) LS, monensin. Monensin was supplemented within a topdress pellet at 400 mg/d for 3 wk precalving period and 450 mg/d for 9 wk of lactation. Endometrial cytology as characterized by low volume uterine lavage at 7 d postcalving (7 d) and on one day between 40 and 60 d postcalving (40–60 d) was not affected by treatments. Phagocytosis (PHG) and oxidative burst (OB) activities at 7 d and 40–60 d were analyzed for blood neutrophils (PMN) and monocytes (MON). At 7 d, cows fed HS tended ($P = 0.06$) to have increased percentage of MON conducting PHG and had ($P = 0.05$) greater MON index [positive % × MFI (mean fluorescence intensity)] compared with cows fed LS. Cows fed monensin tended ($P = 0.10$) to have higher MFI in MON conducting PHG at 7 d. Effects of HS treatment on OB stimulated by PMA (phorbol myristate acetate) at 7 d showed a trend ($P = 0.07$) for increased MON index. For PHG activity at 40–60 d, MFI and index in PMN tended ($P = 0.09$ and 0.06) to have an interaction of starch and monensin such that cows that were previously fed LS and were concurrently being fed monensin had increased MFI and index. For OB activity at 40–60 d, monensin treatment increased the percentage of PMN ($P = 0.02$) and MON ($P = 0.03$) and the index of MON ($P = 0.05$) stimulated by *E. coli* and tended to increase the percentages of PMN ($P = 0.06$) and MON ($P = 0.07$) stimulated by PMA. Blood PMN glycogen content at 7 d was not affected by treatments; however, at 40–60 d cows previously fed high starch had higher ($P = 0.02$) glycogen content. The results suggest both starch level and monensin treatment can affect aspects of immune function in early lactation cows.

**Key Words:** immune function, monensin, starch

**474 Effects of starch and rumen-protected amino acid supplementation on rumen microbial protein synthesis and milk performance in lactating dairy cows fed corn stover.** W. Zhu*[1], C. H. Tang[1], X. P. Sun[1], J. X. Liu[1], Y. M. Wu[1], Y. M. Yuan[2], and X. K. Zhang[2], *[1]College of Animal Sciences, Zhejiang University, Hangzhou, China, [2]Shanghai Bright Holstan Co., Ltd., Shanghai, China.*

This study was conducted to evaluate the effects of supplementing starch and rumen-protected (RP) AA on lactation performance, rumen fermentation, and nitrogen (N) utilization efficiency of lactating dairy cows fed corn stover. Twelve multiparous (parity = 3.5 ± 1.0) Chinese Holstein dairy cows (BW = 661 ± 46.3 kg; DIM = 133 ± 13.5) were used in a 3 × 3 Latin square design. The basal diets were isonitrogenous and isocaloric, with a ratio of forage to concentrate of 45:55. The 3 diets contained the following forage ingredients (%, DM basis): alfalfa 19, and Chinese wild rye grass 6 (AH); corn stover 22, and alfalfa 6, supplemented with starch 8 (CSS); and CSS supplemented with RP Met and RP Lys (CSSAA). All the diets contained 17% corn silage (DM basis). The daily DMI ($P = 0.68$) and milk yield ($P = 0.20$) did not differ among the treatments. Compared with CSS, supplementation of RPAA increased the 4% FCM (26.9 vs. 28.6, $P = 0.06$) and milk efficiency (milk yield / DM intake) (1.34 vs. 1.43, $P = 0.08$), with no difference between AH and CSSAA or CSS. Contents of milk protein, fat, and lactose were not different among the treatments. Milk protein yield was greater ($P = 0.07$) for cows fed AH than those fed CSS (0.895 vs. 0.833kg), with CSSAA at an intermediate position (0.891kg). Rumen ammonia N concentration was lower ($P < 0.01$) for AH diet than for CSS and CSSAA. Rumen pH, volatile fatty acids, microbial protein yield, and MP did not differ among the treatments. The urinary urea N was greater ($P = 0.03$) for CSS than for AH, while feeding CSSAA diet resulted in a lower urea N concentration in milk ($P = 0.02$) and blood ($P = 0.03$) than CSS. Greater N conversion ($P < 0.01$) was

detected for CSSAA than for CSS (0.282 vs. 0.262), with no difference between CSSAA and AH. It is inferred that a sufficient supply of energy for microbial protein synthesis benefits lactation performance in lactating cows fed low-quality forage such as CS, and that RPAA supplementation would further improve the lactation performance and N utilization.

**Key Words:** corn stover, starch, amino acid

**475 Effects of varying periparturient dietary starch amount on primiparous dairy cow performance, lipid metabolism and health.** Z. Sawall*[1], W. Weich[1], D. Lobao da Silva[1], T. Parrott[2], and N. B. Litherland[1], *[1]University of Minnesota, St. Paul, [2]Dupont Industrial Biosciences, Waukesha, WI.*

Thirty Holstein and Holstein-cross primiparous dairy cows were used in a completely randomized design to determine if periparturient diets varying in starch content alter nutrient intake, lipid mobilization and milk production. Cows were balanced by breed and assigned to one of 4 treatments 42 d prepartum (PRE). Dietary treatments (low (LS) vs. high starch (HS)); low starch PRE 13.1% CP; 15.5% starch; 47.6% NDF) and postpartum (POST) 16.5% CP; 20.1% starch; 36.5% NDF) or 2) high starch PRE (13.2% CP; 26.7% starch; 39.2% NDF) and POST (16.8% CP; 29.7% starch; 27.7% NDF). Dietary starch was altered by replacing corn silage and soy hulls with ground corn. Data were analyzed using PROC MIXED in SAS as a completely randomized design with model including starch, week and breed. PRE and POST data were analyzed separately. We hypothesized that LS would have greater DMI resulting in greater milk production and reduced lipid mobilization. PRE DMI (starch, $P = 0.41$) averaged 11.6 and 12.1 ± 0.4 kg/d and POST DMI ($P = 0.91$) averaged 20.1 and 19.9 ± 0.8 kg/d for LS and HS respectively. HS tended ($P = 0.09$) to increase 3.5% FCM yield (31.8 vs. 28.9 ± 1.1 kg/d) and at wk 1 and 6 POST increased significantly ($P = 0.05$, $P < 0.01$). HS group had higher Serum NEFA at 12 h ($P = 0.02$) and on d 7 (starch × d, $P = 0.05$). On D 1 Serum BHBA was greater (starch × d, $P < 0.01$) for HS vs. LS and POST liver total lipids for the average of d 7 and d 14 ($P = 0.02$) averaging 4.8 and 6.8 ± 0.6% and were significantly greater on d 14 (starch x d, $P = 0.05$). Liver triacylglycerols in HS were greater ($P = 0.04$) than LS and averaged 0.9 and 1.9 ± 0.3%. Colostrum yield of HS group was higher than LS ($P = 0.07$) averaging 3.5 and 4.8 ± 0.5 kg for HS and LS group respectively. However, LS group colostrum had higher ($P < 0.01$) IgG concentration than HS (5487.1 and 3953.4 ± 343.5). In conclusion, increased dietary starch concentration did not alter PRE or POST DMI but tended to increase 3.5% FCM yield. Results indicate that higher dietary starch increased milk production, but not DMI, leading to greater lipid mobilization in primiparous cows.

**Key Words:** transition cow, starch, lipid

**476 Bacteria populations in grain-, sugar-, and histidine-challenged cattle.** H. M. Golder*[1,2], S. E. Denman[3], C. McSweeney[3], A. R. Rabiee[1,2], P. Celi[2,4], and I. J. Lean[1,2], *[1]SBScibus, Camden, NSW, Australia, [2]University of Sydney, Faculty of Veterinary Science, Camden, NSW, Australia, [3]CSIRO Animal, Food and Health Services, Queensland Bioscience Precinct, St. Lucia, QLD, Australia, [4]Melbourne School of Land and Environment, The University of Melbourne, Parkville, VIC, Australia.*

We hypothesized that distinct bacterial communities would develop among starch, fructose and/or histidine fed heifers during a single non-life threatening but substantial challenge. Holstein heifers (n = 30) were assigned to 5 grain-based groups: (1) control (no grain); (2) grain [fed at a dry matter intake (DMI) of 1.2% of bodyweight (BW)]; (3) grain (0.8% of BW DMI) + fructose (0.4% of BW DMI); (4) grain (1.2% of BW DMI) + histidine (6 g/head/d); and (5) grain (0.8% of BW DMI) + fructose (0.4% of BW DMI) + histidine (6 g/head/d). Rumen fluid samples were collected using a stomach tube 5, 115 and 215 min after ingestion of the rations. Genomic DNA 454 tag amplicon pyrosequence data were processed using QIIME software. Microbiomes were not different; however, distinct bacterial populations between substrate groups were evident in a principal components between-group analysis ($P < 0.001$). Bacterial diversity for the fructose or histidine treated heifers was large compared with changes in a tight group of *Bacteroidetes* for the grain only fed heifers. *Streptococcus bovis* had a median abundance of 0.25% in the fructose cattle and appeared to be the primary bacteria shifting in this short-term carbohydrate challenge. *Levilinea*, capable of lactate production, had a median relative abundance of 0.15% and was associated with the grain + fructose heifers. *Selenomonas* and *Lactobacillus* were present in only low abundances and were not distinctly associated with a particular substrate group. *Megasphaera elsdenii* were not closely associated with any groups. Co-inertia analysis showed a strong positive relationship between bacterial composition in the fructose fed groups and the percentage of offered fructose consumed, total lactate and butyrate concentrations and a negative relationship with rumen pH. Bacterial composition in the grain and grain + histidine groups had a positive relationship with the percentage of offered grain consumed and rumen ammonia, valerate and histamine concentrations. Rapid changes in bacterial populations can occur in a short period after a single substrate challenge and the nature of these changes may influence ruminal acidosis risk.

**Key Words:** fructose, lactate, rumen bacteria

**477 Effect of supplementing sunflower cake in dairy diet on milk production and composition.** G. Pirlo*, L. Migliorati, M. Capelletti, F. Abeni, L. Degano, A. Bruni, M. Povolo, G. Cabassi, and G. Contarini, *Consiglio per la ricerca e sperimentazione in agricoltura (CRA), Lodi, Italy.*

Economic valorization of by-products is critical for the sustainability of biodiesel production. There is little information about the use of sunflower cake (SC) in lactating dairy cow diet. Two groups of 16 Italian Holstein cows were kept in 2 experimental farms for evaluating the effect of partial substitution of soybean meal (SBM) with SC, obtained from mechanical squeezing (95.6% DM and 12.8% EE on DM). All cows were of second or third lactation and of early or late stage of lactation. In both farms cows were allotted to 2 groups, according to age and lactation stage; cows of half a group were fed SBM, and the others were fed SC. Diets were isoenergetic and isonitrogenous and 2 kg of SC substituted 1 kg of SBM. The experimental design was a change-over, replicated in 2 farms, with periods of 3 wk: the first 2 for adaptation and the third wk for sample collection. Data were processed with the GLM procedure of SAS. Partial substitution of SBM with SC did not influence milk production. However, SC decreased milk protein concentration (3.52 vs. 3.43, $P < 0.001$), percentage of palmitic acid (31.5 vs. 28.2, $P < 0.001$), and total saturated fatty acids (70.0 vs. 67.9, $P < 0.001$). Sunflower cake increased percentage of stearic acid (8.66 vs. 10.31, $P < 0.001$), oleic acid (21.3 vs. 22.9, $P < 0.001$), vaccenic acid (0.87 vs. 1.21, $P < 0.001$), CLA (0.47 vs. 0.63, $P < 0.001$), linoleic acid (2.59 vs. 2.95, $P < 0.001$), monounstatured and polyunsatured fatty acids (25.6 vs. 27.1 and 4.39 vs. 4.90 respectively, $P < 0.001$). Treatment did not influence proportion of arachidonic acid and n-3 fatty acids. Fat globule size was not affected. Introduction of SC has some beneficial effects on nutritional characteristics of milk, in particular CLA and polyunsaturated fatty acids concentration. This experiment is the first step for evaluating the suitability of diets containing SC for long-ripening cheese production.

**Key Words:** sunflower cake, milk fatty acid