The objectives of this study were to examine rumen fermentation and biohydrogenation altered by a methionine analog, branched-chain volatile fatty acids, or their combination in a condition of feeding high polyunsaturated fatty acids. An in vitro batch culture was conducted to determine the biohydrogenation of linoleic acid at 2, 4, 8, and 24 h and pH and VFA at 24 h. Dietary treatments included a typical diet (50:50 of forage to concentrate on a DM basis; CON), CON with 3.0% linoleic acid (DM basis; LA), LA with 0.1% of a methionine analog (HMTBa; Rhodiment, Adisseo Inc.), LA with isobutyrate, iso-valerate, and 2-methyl-butyrate (1 mmol/L of each; BCVFA), and a combination of HMTBa and BCVFA (COMBO). Data were analyzed using MIXED procedures of SAS with incubation as a random effect and treatment, time, and their interaction were fixed effects. At 24 h incubation, LA did not affect pH compared with CON. Compared with LA, BCVFA, and COMBO compared with LA. Linoleic acid supplementation (i.e., LA, HMTBa, BCVFA, and COMBO) decreased acetate and increased (P < 0.01) propionate concentration compared with CON. Compared with LA, there were minimal changes in VFA for HMTBa and BCVFA. Dry matter and NDF digestibility was lower (P < 0.01) for LA vs. CON without a difference among LA, HMTBa, BCVFA, and COMBO. Compared with LA, BCVFA had minimal effects on profile of long chain fatty acids. However, HMTBa and COMBO increased (P < 0.01) 18:1 t11 and 18:2 c9t11 at 4 h of incubation and tended to increase (P < 0.10) these intermediates at 8, 12, and 24 h compared with LA. However, 18:1 t10 and 18:2 t10c12 were not affected by HMTBa vs. LA. In conclusion, linoleic acid at 3% of DM depressed feed fermentation, which was alleviated by supplementation of BCVFA according to decreased pH and increased total VFA. Supplementation of a methionine analog altered microbial biohydrogenation pathways of linoleic acid.

Key Words: methionine analog, branched-chain VFA, biohydrogenation

The objective of this study was to evaluate the effect of palmitic, stearic, and oleic acid on NDF digestibility and rumen fermentation. Continuous culture fermenters (n = 8) were used in a replicated 4 × 4 Latin square design with 7 d of adaptation and 4 d of sampling. Treatments were: 1) control diet without fatty acids; 2) control diet plus 1.5% of palmitic acid (99% C16:0); 3) control diet plus 1.5% of stearic acid (99% C16:0); and 4) control diet plus 1.5% oleic acid (99% cis-9 C18:1). The control diet (60 g DM/day) was a 50:50 orchardgrass hay:concentrate mixture that provided 8.7 g CP, 21 g NDF, 11 g starch, and 1.5 g fatty acids fed twice daily. The fatty acid treatments maintained the same nutrient input into the fermenters as the control except for fatty acids. Daily fermenter effluent was collected over 24 h post-feeding and a 30% subsample was pooled by fermenter within period. Buffer solution was delivered continuously at rate of 10%/h. Data were analyzed using a mixed model including the fixed effect of treatment, and the random effects of period and fermenter. Data are reported as least squares means with differences declared at P ≤ 0.05 and tendencies at 0.05 < P ≤ 0.10. Compared with control, oleic acid tended to decrease NDF digestibility (36.6% vs. 43%, P = 0.09), whereas no effect was observed for palmitic (46.6% vs. 43%, P = 0.33) and stearic (44.5% vs. 43%, P = 0.68). Palmitic (P = 0.01) and stearic (P = 0.04) increased NDF digestibility compared with oleic acid; whereas no difference (P = 0.57) was observed between palmitic and stearic acid on NDF digestibility. Compared with control, total production of VFA was not affected (P > 0.10) by the fatty acid treatments (161.4, 168.9, 151.0, and 146.7 mmol for control, palmitic, stearic, and oleic, respectively); however, palmitic acid increased VFA production (P = 0.03) compared with oleic and tended to increase (P = 0.08) compared with stearic acid. Ammonia concentration was not affected by fatty acids (P > 0.10), nor was molar proportion of VFA (P ≥ 0.40). In conclusion, palmitic and stearic did not affect NDF digestibility nor VFA production compared with control diet, while oleic acid impaired both variables.

Key Words: fermenter, fiber digestibility, rumen fermentation

The objective was to investigate the effects of orally dosed lipopolysaccharide (LPS) and Na-butyrate on rumen cell proliferation in Holstein dairy calves. The hypothesis was that LPS and butyrate synergize to promote rumen development. Twenty-two bull calves arrived in one of 2 groups, spaced 2 wk apart. Within each group, calves were assigned to one of 4 treatments: control (CON; n = 5), butyrate (BUTY; n = 5), LPS ranging from 2.5 to 40 μg/mL (n = 6), or LPS plus butyrate (LPSB; n = 6). All treatments were administered orally twice daily and consisted of either: 0.9% saline (CON); 11 mM Na-butyrate (BUTY); LPS ranging from 2.5 to 40 μg/kg body weight (BW)0.75 (LPS), or both butyrate and LPS (LPSB). LPS dosage volume increased across weeks, ranging from 10 to 40 mL per dose. Calves were fed milk replacer (22%CP, 20% fat) and starter (20% CP, 3% fat) twice daily based on metabolic BW. Feed intake, fecal and respiratory scores, and rectal temperature were recorded daily. Calif BW, hip height, blood samples, and rumen content samples were collected weekly. Calves were weaned at 6 wk of age and euthanized at 8 wk of age, whereupon ruminal weights and ruminal samples for papillae area and epithelial thickness were collected. Blood and rumen samples were analyzed for blood metabolites (BHBA and glucose) and VFA concentrations, respectively. Feed intake, health measures, and blood metabolites did not differ by treatment. Calif BW increased by week (P < 0.0001). Irrespective of week, LPS weighed more and had higher ADG than BUTY (P = 0.020). Irrespective of week, withers height was higher in LPS compared with CON (P = 0.006). Rumen pH and rumen VFA concentrations did not differ by treatment but did decrease and increase, respectively, with week in conjunction with increased starter intake. Total empty stomach (P = 0.014) and reticulorumen weights
6. All calves were weaned at d 42. Pellets and water were fed ad libitum.

2.83 L of pasteurized milk 2 × /d during wk 1 to 5 and 1 × /d during wk post-weaning they were top-dressed on starter pellets. Calves were fed 1) control (CON) with no oil, 2) 80 g/d of flax oil (FLAX), and 3) in a 12-wk randomized complete block design study. Treatments were:

Profile. Thirty-six Holstein heifer calves in individual hutches were used to the effects of supplementing flax oil or soy oil in calves on metabolic status and increased plasma n-3 FA concentrations in the first week of life. Oxidative stress (OS) occurs when antioxidants fail to neutralize an overabundant concentration of reactive oxygen species, resulting in damage to cellular components. This phenomenon is prevalent in neonatal calves, potentially causing disease vulnerability and immune dysfunction. Past studies have shown the benefits of fish and flax oil on calf health and growth due to their omega-3 fatty acids (n-3 FA); these metabolites may mediate inflammation and OS through anti-inflammatory and antioxidant properties. We hypothesized a 60 mL fish and flax oil colostrum supplement would improve indicators of calf health and plasma concentrations of n-3 FA during the first week of life. Sixteen Holstein calves were blocked by sex and birth date and randomly assigned to control (no supplement; Con), or fish and flax oil (FFtrt) supplemented in first colostrum (3 L within 6 h, > 22% on Brix). FFtrt was a 60 mL:1:1 blend of oils with 200 mg α-tocopherol. Blood was sampled on d 1, 2, 4, 7, 14, and 21 after birth for assessment of passive transfer, oxidant status, and FA profile. Health was scored daily. Hip height and body weight were recorded weekly. Data were analyzed with a mixed procedure in SAS 9.4 including treatment, sex, and day as fixed effects and calf and block as random effects. FFTrt did not alter concentration of total protein in blood serum, prevalence of diarrhea, or rate of growth (P > 0.10), but tended to improve nasal scores (P = 0.07). FFtrt increased plasma concentrations of n-3 FA as much as 90% by 1 d of age (P < 0.01). FFtrt decreased oxidant status index (OSi) by 55% by 2 d of age (Con: 73, FFtrt: 32 OSi; P < 0.01) and remained decreased overall in the first week of life (Con: 74, FFtrt: 50 OSi; P < 0.01). OSi and FA concentrations returned to control values by d 14. In conclusion, a colostrum supplement of n-3 FA and α-tocopherol decreased oxidant status and increased plasma n-3 FA concentrations in the first week of life and has the potential to improve health of neonatal calves.

**Key Words:** omega-3, oxidative stress

34 Colosrum supplementation with omega-3 fatty acids and α-tocopherol decreases indicators of oxidative stress and alters plasma fatty acid profile in newborn calves during the first week of life. J. Oppenorth*, L. M. Sordillo, and M. J. VandeHaar, Michigan State University, East Lansing, MI.

36 Factors affecting dairy cattle protective grouping behavior, also known as bunching, against Stomoxys calcitrans (L.) on California dairies. W. R. El-Ashmawy*,1,2, D. R. Williams1, A. C. Gerry3, J. D. Champagne1, T. W. Lehenbauer1,4, and S. S. Aly1,4, 1Veterinary Medicine Teaching and Research Center, School of Veterinary Medicine, University of California Davis, Tulare, CA, 2Department of Internal Medicine and Infectious Diseases, Faculty of Veterinary Medicine, Cairo University, Giza, Egypt, 3Department of Entomology, University of California Riverside, Riverside, CA, 4Department of Population Health and Reproduction, School of Veterinary Medicine, University of California Davis, Davis, CA.

Bunching is the protective aggregating behavior of cattle against Stomoxys calcitrans (stable fly), where cattle bunch in a group with their heads to the center. Stable flies have a painful bite leading to stress which impacts productivity and welfare. Our objectives were to estimate stable fly intensity on dairies, threshold required to induce bunching, and the association of bunching with management and environmental factors. Between April and July 2017 we enrolled a convenience sample of 20 California dairies (herd size 2466 ± 1050), 13 Holstein, 4 Jersey and 3 were mixed. Data about feeding, manure management and cow cooling were collected using an in-person survey. Stable fly activity was recorded weekly using Alsynite traps and counts on cows. Bunching behavior was recorded weekly while recording fly activity. Data was analyzed using linear mixed models. At the dairy level bunching was associated with mean stable fly counts ≥150 flies/trap/week, months May and June (versus July), feeding wet distiller grains, and presence of wheat/corn or alfalfa crops on >2 sides of the dairy. Higher weekly mean ambient temperatures and cleaning the fence line managed to be protective against bunching. At the pen level bunching was associated with a stable fly count >1 fly/cow leg, >50 flies/trap-week on traps closest to the pen, ambient temperature ≤30°C, freestall pens (versus open lot pens), dry and lactating cows (versus close-up cows), pens fed a ration containing molasses (versus not) all had higher odds of bunching; however relative humidity >50% was protective. Findings from our study show that bunching on the study dairies varied by stable fly activity, environment, facility design, dairy surroundings and management factors, including feeding and manure management.

**Key Words:** bunching, dairy cattle, stable fly
Effect of molasses-based liquid feed supplementation through robotic milking systems on fresh cow behavior, health, and production. S. M. Moore*, M. T. M. King, A. J. Carpenter, and T. J. DeVries, Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada.

The objective of this study was to determine the effect of molasses-based liquid feed (LF) supplementation on the behavior, health, and production of early lactation cows in robotic herds. In 6 commercial robotic dairy herds, 400 dairy cows were randomly assigned, within farm, balanced by parity, to receive at calving 1 of 2 treatments: 1) control group (C) receiving standardized robotic pellet (mean = 4.3 kg/d, n = 200), or 2) standardized robotic pellet feeding (mean = 4.0 kg/d, n = 200) plus 1 kg DM/d of LF for MP cows (1.6 kg/d as fed) and 0.88 kg DM/d for PP cows (1.4 kg/d as fed). Across farms, cows were fed a partial mixed ration that were similar in ingredient and nutrient composition. Cows on LF received supplementation for the first 60 d post-calving.

Production, rumination time, and health status were monitored for 100 d post-calving. Blood samples were taken 2×/wk for the first 4 wk post-calving to assess energy balance (BHB). Samples with BHB ≥ 1.2 mmol/L were classified as a case of subclinical ketosis (SCK).

Using mixed-effect linear regression models, we analyzed the effect of treatment, parity, and their interaction (only if significant $P < 0.05$) on linear outcomes. Chi-squared tests were used to establish associations between treatment and health status.

Milk yield (LF = 36.8 kg/d, C = 36.6 kg/d; SE = 0.72; $P = 0.79$) and milking frequency (LF = 3.2×/d, C = 3.2×/d; SE = 0.07; $P = 0.48$) did not differ by treatment. Control cows had more daily robot visits overall compared with LF cows (LF = 5.1×/d, C = 5.8×/d; SE = 0.36; $P = 0.02$). Treatment affected the number of times cows tested positive for SCK ($P = 0.05$); cows on LF had fewer repeated occurrences of SCK, such that 15% of cows on LF had ≥3 cases of SCK out of 5 tests, compared with 27% of control cows. Overall, the results of this study suggest that supplementing molasses-based LF to robot-milked cows may help support the energy demands of milk production in early lactation and, thus, reduce the incidence of repeat SCK cases during that period.

Key Words: molasses, robotic milking, subclinical ketosis

Impact of commercial direct-fed microbial on cow performance during the calving transition. M. R. Steelreach*1, R. L. Hiltz1, A. Aguilar2, H. Nielsen3, and A. H. Laarman1, 1University of Idaho, Moscow, ID, 2Lallemand Animal Nutrition, Milwaukee, WI.

The objective of this study was to investigate the impact of feeding a commercial direct-fed microbial on primiparous and multiparous cows in the calving transition period. Primiparous (n = 22) and multiparous (n = 19) cows were fed a close-up TMR before calving and a lactation TMR after calving. Three weeks before expected calving, all animals were blocked to balance parity and body weight, then assigned to control group (CTRL; n = 21) or a direct fed microbial (DFM; n = 20). The DFM animals received a top-dressed DFM fed daily at 12.5 g per head. Weekly, DMI and milk production were measured. Data were analyzed using treatment as a fixed effect, block and parity as random effects, and week as a repeated measure. Pre-planned contrasts compared treatments weeks −3, 1, 5, and 9. Between primiparous and multiparous cows, there was no difference in DMI (29.2 ± 2.15 vs. 33.9 ± 2.32 kg/d, respectively, $P = 0.13$), but milk production was higher in multiparous cows (30.4 ± 1.18 vs. 41.2 ± 1.31 kg/d, respectively, $P < 0.01$). There was no difference in DMI between CTRL and DFM in week −3 (19.9 ± 2.01 vs. 18.7 ± 1.89 kg/d, $P = 0.64$), wk 1 (29.9 ± 1.71 vs. 30.8 ± 1.56 kg/d, $P = 0.64$), wk 5 (42.8 ± 1.72 vs. 43.7 ± 1.58 kg/d, $P = 0.65$), or wk 9 (44.0 ± 2.30 vs. 40.5 ± 2.33 kg/d, $P = 0.23$). There was no difference in milk production between CTRL and DFM in wk 1 (30.7 ± 1.43 vs. 31.5 ± 1.47 kg/d, $P = 0.68$), wk 5 (37.3 ± 1.40 vs. 39.4 ± 1.41 kg/d, $P = 0.27$), and wk 9 (39.2 ± 1.78 vs. 39.1 ± 1.87 kg/d, $P = 0.97$). Milk efficiency between CTRL and DFM tended to be higher for DFM in wk 1 (1.07 ± 0.09 vs. 1.20 ± 0.09 kg/kg, $P = 0.09$), but not wk 5 (0.93 ± 0.09 vs. 0.97 ± 0.09 kg/kg, $P = 0.60$), and wk 9 (1.01 ± 0.12 vs. 1.01 ± 0.11 kg/kg, $P = 0.99$). Supplementation of close-up TMR and early lactation rations did not affect DMI or milk production but tends to improve milk efficiency in the first week of lactation.

Key Words: direct-fed microbial (DFM), calving transition