

# Ruminant Nutrition: Fats, Fatty Acids, Oils, and Glycerin Supplementation I

**W21 Investigation of microbial diversity in the feces of cattle fed different diets.** M. Kim<sup>\*1</sup>, J. Kim<sup>2</sup>, L. Kuehn<sup>1</sup>, J. Bono<sup>1</sup>, E. Berry<sup>1</sup>, N. Kalchayanand<sup>1</sup>, H. Freetly<sup>1</sup>, A. Benson<sup>2</sup>, and J. Wells<sup>1</sup>, <sup>1</sup>USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE, <sup>2</sup>University of Nebraska, Lincoln.

Understanding of the bovine fecal microbiome could contribute to solving issues regarding animal production, cattle health and food safety. The objective of this study was to examine the influence of diet on the fecal microbiome in feedlot cattle. The next-generation pyrosequencing technology was used to investigate fecal microbiomes of 426 cattle fed one of 3 diets: finishing diet (83% dry-rolled corn, 13% corn silage, 4% supplement), late growing diet (66% dry-rolled corn, 26% corn silage, 8% supplement), and early growing diet (70% corn silage and 30% alfalfa haylage). A total of 2,149,008 16S rRNA gene sequences were obtained from 333 cattle with at least 2,000 sequence reads and classified into taxa using the RDP classifier. One-way ANOVA followed by Tukey's test was used to compare the mean abundance of a taxon among the 3 diet groups. *Firmicutes* was the first predominant phylum and accounted for more than 50% of total sequences in all 3 diet groups. *Bacteroidetes* was the second predominant phylum in the finishing and the late growing diet groups, while TM7 was the second predominant phylum in the early growing diet group. The genera *Fecalibacterium*, *Anaerovibrio*, *Prevotella*, *Parabacteroides* and *Pantoea* were significantly more abundant ( $P < 0.0001$ ) in the late growing diet group than in other 2 groups, while the genera *Oscillibacter*, *Turcibacter*, *Coprococcus*, *Clostridium*, *Blautia*, *Lactobacillus* and *Subdoligranulum* were significantly more abundant ( $P < 0.0001$ ) in the finishing diet group than other 2 groups. The abundance of the genera *Sporacetigenium*, *Anaerovorax*, *Propionibacterium* and *Akkermansia* was significantly higher ( $P < 0.0001$ ) in the early growing diet than other 2 diet groups. A principal coordinates analysis of the unweighted UniFrac showed that bovine fecal microbiomes were separated based on diets. The present study indicates that diet has an effect on the fecal microbiome of cattle, particularly between cattle fed forage-rich and grain-rich diets. USDA is an equal opportunity provider and employer.

**Key Words:** 16S rRNA, microbiome, pyrosequencing

**W22 Reproductive performance of beef heifers supplemented with saturated or unsaturated rumen bypass fat.** N. M. Long<sup>\*1</sup>, T. A. Burns<sup>1</sup>, S. K. Duckett<sup>1</sup>, and D. W. Schafer<sup>2</sup>, <sup>1</sup>Department of Animal and Veterinary Science, Clemson University, Clemson, SC, <sup>2</sup>Department of Animal Science, University of Arizona, Tucson.

Research on fat feeding to influence reproduction has shifted to feeding fat before and after breeding. Heifers ( $n = 118$ ) were blocked by age, breed, and BW and pen fed alfalfa hay (4.5 kg/head/d). Heifers were individually fed an isocaloric supplement that contained 90% beet pulp and 10% molasses at 1.0 kg (C) or either 0.5 kg of the C with 0.2 kg of StratG (SG) or EnerGII (EG) fed 5 d/wk. Heifers received treatments for 3 wk before 7 d controlled intravaginal drug release (CIDR) synchronization followed by visual estrus detection. Blood samples were collected 3 times 4 d apart before CIDR insertion. Heifers were AI 12 h after estrus was detected and remained on treatment supplementation regimen for 28 d after CIDR removal. A blood sample was collected at the end of treatment. Pregnancy was determined d 30 post AI via transrectal ultrasonography. Serum progesterone (P4) and leptin were measured by RIA

and serum triglycerides and cholesterol was measured by colorimetric procedures. Serum fatty acid (FA) profiles were measured by GLC. Serum lipids and hormones were analyzed using the MIXED model of SAS and binary reproductive data was analyzed using the GLIMMIX procedure. Heifers BW gain during supplementation was similar ( $P = 0.35$ ) between treatment groups ( $32 \pm 2$  kg). Percent of heifers cycling ( $P4 > 0.75$  ng/mg in any samples) tended to be less ( $P = 0.08$ ) for SG heifers compared with the other treatments (36 vs 55 and 56%, SG, C and EG). Rates of estrus after PGF2 $\alpha$  were similar ( $P = 0.19$ ) between treatments (53, 69, and 77%, C, SG and EQ). AI pregnancy rates of heifers detected in estrus were similar ( $P = 0.35$ ) between treatments (81, 77, and 63%, C, SG and EQ). Serum total and specific FA, cholesterol and triglycerides were different ( $P < 0.05$ ) between treatments at d 21 and 56. Serum leptin was increased ( $P < 0.05$ ) in both SG and EG at d 21 compared with C heifers. At d 56 of treatment, SG had greater ( $P < 0.05$ ) plasma leptin compared with EG with C heifers having further reduced serum leptin concentration. Feeding rumen protected FA led to no changes in reproduction, but changed circulating lipid composition and leptin with differences between fat types.

**Key Words:** fats, heifer, serum fatty acid

**W23 Effect of crude glycerin on carcass and meat characteristics of Nellore bulls.** E. H. C. B. van Cleef<sup>1</sup>, J. M. B. Ezequiel<sup>2</sup>, A. P. D'Aurea<sup>2</sup>, J. B. D. Sancanari<sup>2</sup>, D. A. V. Silva<sup>2</sup>, F. B. O. Scarpino<sup>2</sup>, and R. M. P. Pardo<sup>\*3</sup>, <sup>1</sup>Kansas State University, Manhattan, <sup>2</sup>São Paulo State University, Jaboticabal, São Paulo, Brazil, <sup>3</sup>Sucre University, Sincelejo, Colombia.

A study was conducted to determine the effect of crude glycerin on carcass and meat characteristics of Nellore bulls. Thirty animals ( $277.7 \pm 23.8$  kg BW) were fed experimental diets for 82 d. Treatments consisted of a control diet containing 30% corn silage, 35% corn grain, 19.2% soybean hulls, 14.6% sunflower meal, and 1.2% supplement, and diets containing 7.5, 15, 22.5 or 30% glycerin (dry matter basis). Crude glycerin replaced corn grain and soybean hulls. Bulls were stratified in a randomized block design, by initial BW, and assigned randomly to 30 individual pens. Over a period of 21 d, bulls were transitioned from diets containing 20% concentrate to their respective 70% concentrate diets, using 4 step-up diets. Cattle were harvested on d 103, carcass data was collected 24 h post chill, and meat was sampled from the 12th rib. Data were analyzed using the MIXED procedure of SAS, with the animal considered as the experimental unit. Contrasts were used to determine the linear and quadratic effects of glycerin, and 0% glycerin  $\times$  glycerin treatments. HCW ( $223.6 \pm 7.6$  kg), DP ( $53.4 \pm 0.6\%$ ) LM ( $64.3 \pm 3.3$  cm<sup>2</sup>), BF ( $3.8 \pm 0.8$  mm), carcass pH ( $6.1 \pm 0.1$ ), and commercial cuts weights were not affected ( $P > 0.05$ ) by the addition of crude glycerin to the diets. The estimated body fat was 2.85% greater ( $P \leq 0.05$ ) for treatments with glycerin. There were no difference on meat color ( $L^* = 32.6 \pm 2.2$ ;  $a^* = 12.3 \pm 0.8$ ;  $b^* = 3.2 \pm 0.6$ ), shear force ( $4.4 \pm 0.5$  kgf/cm<sup>2</sup>), cooking loss ( $32.4 \pm 2.2\%$ ), and water-holding capacity ( $74.4 \pm 2.1\%$ ), however, the cholesterol content of meat was decreased ( $P \leq 0.05$ ) from 36.8 mg/g (control) to 27.0 mg/g (30% glycerin). Feeding up to 30% crude glycerin to Nellore bulls can increase meat quality, decreasing cholesterol content without depreciating carcass characteristics.

**Key Words:** biodiesel, carcass, feedlot cattle

**W24 Effect of essential oils, monensin, and tylosin on performance and carcass characteristics of finishing heifers.** J. S. Schutz<sup>\*1</sup>, M. L. Hubbert<sup>1</sup>, C. J. Redding<sup>1</sup>, J. D. Caballero<sup>2</sup>, P. J. Guiroy<sup>3</sup>, and C. A. Loest<sup>2</sup>, <sup>1</sup>Clayton Livestock Research Center, New Mexico State University, Clayton, <sup>2</sup>Animal and Range Sciences, New Mexico State University, Las Cruces, <sup>3</sup>Cargill Incorporated, Minneapolis, MN.

Public perception regarding antimicrobial drug use in animal diets has increased investigations of alternative natural plant extracts to modify ruminal fermentation and potentially improve efficiency of feed utilization. This study evaluated the effects of plant extract products containing essential oils (EO) on performance and carcass traits of feedlot heifers fed diets with or without monensin and tylosin. Crossbred yearling heifers (n = 662; initial BW = 324 ± 3 kg) were assigned to 36 pens (18 or 19 heifers/pen) in a randomized complete block design (blocked by BW). Six treatments, in a 2 × 3 factorial arrangement, were finishing diets with (MED) or without (NON-MED) added monensin (300 mg/d) plus tylosin (90 mg/d), and top-dressed with a pellet (230 g/d) containing either plant extract-A (EOA; 300 mg/d active product), plant extract-B (EOB; 250 mg/d active product), or no EO (CON). Statistical analysis used the mixed procedure of SAS and orthogonal contrasts. Antimicrobial drug × EO interactions were not significant ( $P > 0.15$ ). Heifers fed MED diets had similar ( $P = 0.21$ ) ADG (1.48 vs. 1.46 ± 0.02 kg/d), lower ( $P < 0.01$ ) DMI (8.11 vs. 8.29 ± 0.11 kg/d), and greater ( $P < 0.01$ ) G:F ratio (0.183 vs. 0.176 ± 0.001) than heifers fed NON-MED diets during 134 (3 blocks) and 135 (3 blocks) DOF. Carcasses of heifers fed MED diets had lower ( $P = 0.04$ ) marbling scores, and tended to have greater ( $P = 0.14$ ) LM area than those fed NON-MED diets. Heifers receiving EOA and EOB had a tendency for lower ( $P = 0.11$ ) carcass-adjusted ADG, a tendency for greater ( $P = 0.12$ ) DMI from d 0 to 84 (and numerically greater DMI overall), and lower ( $P = 0.07$ ) G:F ratio than those receiving CON. Heifers given EOA had a tendency for more ( $P = 0.11$ ) carcasses to grade choice or better than those receiving CON (51.6% vs. 43.6%). Results indicated that the essential oils evaluated in this study were not as effective as monensin and tylosin for improving feed efficiency. Supplementing feedlot finishing diets with EOA could possibly improve quality grade.

**Key Words:** essential oil, antimicrobial, beef cattle

**W25 Traditional and novel feed additives for beef cattle.** F. G. Ribeiro<sup>\*1,2</sup>, C. C. Coutinho<sup>1,2</sup>, D. C. Rivaroli<sup>1,3</sup>, A. Cominotte<sup>1,4</sup>, E. Rodrigues<sup>1</sup>, A. M. Jorge<sup>1</sup>, E. A. Filgueiras<sup>5,2</sup>, and R. D. Sainz<sup>6,7</sup>, <sup>1</sup>Universidade Estadual de São Paulo, Botucatu, SP, Brazil, <sup>2</sup>CAPEs - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Brasília, DF, Brazil, <sup>3</sup>CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brasília, DF, Brazil, <sup>4</sup>FAPESP - Fundação de Amparo à Pesquisa do Estado de São Paulo, São Paulo, SP, Brazil, <sup>5</sup>Universidade Federal de Goiás, Goiânia, GO, Brazil, <sup>6</sup>Embrapa, Goiânia, GO, Brazil, <sup>7</sup>University of California, Davis.

Four diets were fed to 64 crossbred heifers (predominantly Angus and Red Angus) for 28 d (adaptation) plus 95 d (experimental). Treatments consisted of: C, Control diet; B, Control diet plus a probiotic + prebiotic premix (Bioformula, 2 g/day); M, Control diet plus Rumensin (120 mg monensin/day); BM, Control diet plus a combination of these 2 additives (Biofórmula + Rumensin). The concentrate:forage of the diet was 25:75 on a dry matter basis. Animals were weighed individually every 28 d after 12 h feed withdrawal. Feed offered was monitored daily, and feed refusals collected and weighed every 2 d. All animal care procedures were conducted according to the regulations of the Brazilian National Council on Control of Animal Experimentation (CONCEA). Performance variables were analyzed using the GLM procedure of Minitab

(Minitab, Inc., State College, PA, USA). Body weight data were analyzed by analysis of covariance, with treatment as a main effect, and days on feed as a covariate, with animal nested within treatment included as a random effect to correct for auto-correlation of repeated measures in the same animal. Individual feed intakes were estimated using the methodology of Perry and Fox (1997; *J. Anim. Sci.* 75:300–307). Estimated feed intakes were similar among treatments (9.91, 9.90, 9.83 and 9.81 kg/day for C, B, M and BM, respectively;  $P > 0.10$ ). However, ADG were greater in animals fed diets containing feed additives relative to controls (1.280, 1.322, 1.319 and 1.397 kg/day for C, B, M and BM, respectively;  $P = 0.054$ ). Likewise, these feed additives improved feed efficiency relative to controls (0.129, 0.134, 0.139 and 0.143 for C, B, M and BM, respectively;  $P < 0.001$ ). We conclude that supplementation with probiotics and prebiotics has potential to improve the performance of beef cattle, and that these effects are additive with those obtained using ionophores.

**Key Words:** probiotic, ionophore, feedlot

**W26 Effect of essential oils (Next Enhance 300) on fermentation characteristics of rumen microbiota in continuous culture.** N. F. Johnson<sup>\*1</sup>, M. C. Westerhold<sup>1</sup>, M. S. Kerley<sup>1</sup>, W. J. Sexten<sup>1</sup>, and T. J. Wistuba<sup>2</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Novus International Inc., St. Charles, MO.

Antibiotics and ionophores are used to improve feed efficiency by modifying rumen fermentation. Public concern with antibiotic use has increased interest in alternative modifiers. Essential oils are naturally occurring volatile plant compounds reported to improve ruminant N and/or energy utilization via rumen modification. Next Enhance 300 (NE, Novus International Inc.) is a combination of garlic (diallyl disulfide) and cinnamon (cinnamaldehyde) extracts which have demonstrated the ability to modify rumen fermentation. The objective of this experiment was to evaluate fermentation characteristics of rumen microbiota in continuous culture as NE inclusion increased. Treatment levels of 0, 15, 30, 60, 120, and 240 mg/kg DM were added to a corn (60.3%) and DDG (24.3%) diet. Two continuous culture fermentation runs were conducted using dairy cow rumen fluid inoculum. Fermenters were acclimated for 4 d followed by 3 d collections. Fermenter pH was measured and sampled at 0, 4, 8, and 12 h post feeding with daily effluent collection. Run was treated as a block with the experiment analyzed statistically as a randomized complete block. NE did not affect ( $P > 0.59$ ) microbial efficiency, ammonia, pH, or VFA concentrations. Increasing NE inclusion quadratically increased ( $P < 0.05$ ) OM and CP digestibility. Microbial nitrogen flow responded quadratically, but was not significant ( $P = 0.29$ ). Inclusion of NE at 30 and 60 mg/kg DM resulted in maximal OM and CP digestibility. Based on these results, it was concluded that Next Enhance 300 could affect ruminal fermentation of low fiber corn based diets by increasing digestibility and microbial protein flow from the rumen. The next step will be to determine the mechanism by which NE results in greater fermentation activity.

**Key Words:** essential oil, feed efficiency, rumen fermentation

**W27 Supplementation of rumen-protected PUFA in corn-fed beef steers.** C. M. Warner<sup>\*</sup>, S. L. Archibeque, T. E. Engle, J. J. Wagner, D. R. Woerner, I. N. Roman-Muniz, and H. Han, Colorado State University, Fort Collins.

Rumen bypass fat is commonly added to increase energy intake in dairy cattle. The objective of this study is to examine the addition of rumen bypass fat during finishing period on performance and carcass charac-

teristics in grain fed steers. This study was conducted as a completely randomized block design with 126 cross-bred steer calves (initial BW 529.5kg ± 10.7) randomly assigned to pens with 9 steers/pen (n = 7 pens / treatment). Each pen was randomly assigned to one of 2 treatment groups; the rumen bypass fat treatment (BF) and the control diet (CON). The diets were formulated to be isonitrogenous and isocaloric. Animals were fed twice daily at 110% of the previous daily ad libitum intake. Feed bunks were cleaned and orts were collected weekly. DM content was analyzed and diet samples were collected weekly for proximate analysis. Feedlot performance and carcass characteristics were assessed. Steers fed the CON diet had a greater level of performance for most of the parameters measured. The CON treatment had greater DMI (10.14 kg vs. 8.77 kg;  $P < 0.02$ ) and tended to have greater ADG (1.699 kg vs. 1.469 kg;  $P < 0.09$ ). Hot carcass weight was not significantly different between treatments ( $P < 0.19$ ). Marbling score ( $P < 0.04$ ) and quality grade ( $P < 0.02$ ) were greater for steers fed the CON diet than those fed BF. The L. dorsi area tended to be greater ( $P < 0.10$ ) in steers fed CON (87.60 cm<sup>2</sup>) than those fed BF (84.88 cm<sup>2</sup>). Gain:feed was slightly increased for the BF treatment group, but was not significant ( $P < 0.74$ ). These data suggest that rumen bypass fat can be added to finishing diets without significant reduction in final body weight, although there may be modest reductions in marbling and quality scores. More research is needed to elucidate the potential mechanism for these reductions.

**Key Words:** bypass fat, fatty acid composition, PUFA

**W28 Effects of extracts of cashew nut shell and castor oil on in vitro ruminal fermentation, gas production kinetics, and methane production.** C. T. Marino<sup>2</sup>, M. J. Ruiz-Moreno<sup>1</sup>, T. M. Schulmeister<sup>1</sup>, F. M. Ciriaco<sup>\*1</sup>, D. D. Henry<sup>1</sup>, V. R. G. Mercadante<sup>1</sup>, G. C. Lamb<sup>1</sup>, and N. DiLorenzo<sup>1</sup>, <sup>1</sup>North Florida Research and Education Center, University of Florida, Marianna, <sup>2</sup>Universidade de São Paulo, FMVZ, Pirassununga, Brazil.

Extracts of cashew nut shell oil contain anacardic acid, cardol and cardanol, which have been reported to have antimicrobial and antioxidant activity. Ricinoleic acid, one of the fatty acids from castor oil has been reported to have antimicrobial activity similar to that of ionophores. The objective with this study was to evaluate the effects of a mixture of extracts (EX) of cashew nut shell oil and castor oil on in vitro ruminal fermentation parameters, gas production kinetics and methane production. Two incubation substrates (80% concentrate and 100% forage) and 4 doses of EX (0, 40, 80 and 120 mg/L of fermentation fluid) were tested in a randomized complete block design with a 2 × 4 factorial arrangement of treatments. Incubations were conducted for 24 h in 3 d (replicates) with duplicate bottles each day and a 2:1 ratio of buffer:ruminal fluid. Total gas produced was collected in gas sampling bags and analyzed for methane and H<sub>2</sub>S concentration. No effect ( $P > 0.10$ ) of EX dose or diet × EX dose interaction was observed for any of the variables. Total gas production and fractional rate of gas production was greater ( $P < 0.01$ ) for concentrate vs. forage substrate. Concentrate substrate had greater ( $P < 0.01$ ) IVDMD (62.0 vs. 56.8%) and methane production (1.91 vs. 1.30 mmol) than forage. Concentration of NH<sub>3</sub>-N in the incubation fluid was greater (7.0 vs. 5.2 mM;  $P < 0.01$ ) in forage vs. concentrate substrate, likely as a result of N concentration in the incubation substrate. In conclusion, adding up to 120 mg/L of a mixture of extracts from cashew nut shell and castor oil did not affect in vitro ruminal fermentation or methane production in forage- or concentrate-based incubation substrates.

**Key Words:** fermentation, cashew nut, castor oil

**W29 Production performance parameters of early lactation dairy cows fed a diet supplemented with Megalac or a fatty acid prill containing high levels of palmitic acid.** E. Block<sup>\*1</sup>, L. Kung<sup>2</sup>, and C. Merrill<sup>2</sup>, <sup>1</sup>Arm & Hammer Animal Nutrition, Princeton, NJ, <sup>2</sup>University of Delaware, Newark.

Megalac (Church & Dwight Co. Inc., Princeton, NJ) calcium salts of fatty acids (palmitate 45%; oleate 37%; linoleate 6%; stearate < 3%; other fatty acids < 10%) was compared with a high palmitic acid fatty acid prill (Guarantee-palmitate (min) 80%; stearate 4–7%; oleate 8–12%; other fatty acids < 5.5%), in an early lactation feeding trial for 10 wk. Thirty multiparous cows (average of 45 DIM) were randomly assigned to 1 of 2 rations identical except for supplemental fat. Fat sources were supplemented on an equal fatty acid basis and were 1.2% of total DM added fatty acids. Daily milk weights and DMI were averaged by week. Milk components were assessed twice weekly, and these were averaged by week. All cows were placed on a common diet for one week before initiation of the trial. All data except body weight was analyzed using a GLM, with treatments as fixed effects, cows as the experimental unit (fixed) and replicated by weeks (random). Because there were no differences in pre-trial performance ( $P > 0.05$ ) between the 2 groups of cows, covariate analysis was not used. Body weights were analyzed as one way ANOVA. Results are provided in the table that follows. Milk and milk component yields were greater with Megalac than with palmitic fatty acid prill. Feed efficiency was also higher with Megalac. Although cows fed palmitic fatty acid prill gained more weight than cows provided with Megalac, weight changes were variable and failed to reach significance. Based on results we conclude that different fatty acids have different digestibilities, absorption and/or differing biological effects post absorption.

**Table 1.** Daily production parameters and body weight (BW) change over 10 wk for cows fed Megalac or a high palmitic acid fatty acid prill

Variable	Megalac	Palmitic prill	SEM	P > F
DMI, kg	28.08	27.89	0.189	0.496
Milk, kg	45.53	42.26	0.435	<0.001
Fat, kg	1.95	1.74	0.026	<0.001
Protein, kg	1.35	1.26	0.013	<0.001
Lactose, kg	2.14	1.98	0.022	<0.001
Solids, kg	5.82	5.37	0.061	<0.001
3.5% FCM, kg	51.32	46.61	0.573	<0.001
FCM/DMI	1.84	1.68	0.020	<0.001
ECM/DMI	1.77	1.62	0.018	<0.001
BW change, kg	24.3	37.3	6.35	0.317

**Key Words:** fat supplementation of cows, Megalac, palmitic acid

**W30 Effect of feeding milk fat rich in conjugated linoleic acid on immune response in BALB/c mice.** D. P. Bu, R. C. Zhang, and J. Q. Wang<sup>\*</sup>, State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.

Conjugated linoleic acid (CLA) has been shown to have immunoenhancing properties in mice. We examined the influence of milk fat enriched with CLA on the immune response of BALB/c mice. Seventy 2 BALB/c mice (female 36, 6 mo, BW 18–22g) were housed in 12 cages (n = 6) at constant temperature (22 ± 2°C) and were fed with a normal diets ad libitum, free access to water. Mice were infused either 0.4 mL of saline solution (CK), normal milk fat (P), milk fat enriched with CLA (CLA, contains c9t11 CLA of 2.77mg/g fat from cows supplemented with sunflower oil), Immunosuppression induced by cyclophosphamide (Cy), Cy plus normal milk fat

(CyP) or Cy plus milk fat enriched with CLA (CyCLA) through syringe. Mice in CK, P, CLA also received 0.3 mL intraperitoneal saline solution injection while mice in Cy CyFAT, CyFLA received intraperitoneal injection of 0.3 mL cyclophosphamide solution (30 mg/kg BW) every 5 d. Body weight of each mouse was recorded weekly. After 35 d feeding, all mice were killed by cervical dislocation. Spleen and thymus were removed and weighed. The abdomen splenocytes lymphocyte transformation test was conducted by MTT assay to concanavalin A (Con A) (10 mg/L). Compared with CK, weight of spleen and thymus in P and CLA increased ( $P < 0.05$ ). However, mice induced with cyclophosphamide decreased spleen and thymus weight ( $P < 0.05$ ). Ratios of spleen and thymus weight to body weight were not different among treatments. Mice infused with milk fat had greater lymphocyte transformation in response to Con A ( $P < 0.05$ ) than those in control. ConA index were  $1.56^c$ ,  $.98^b$ ,  $2.71^a$  in CK, P, CLA and  $1.30^c$ ,  $1.70^b$ ,  $2.06^a$  in Cy, CyP, CyCLA, respectively. Our results suggest that milk fat enriched with CLA improves some immune responses.

**Key Words:** milk fat, CLA, immune response

**W31 Does supplementing essential fatty acids in the late gestation and the preweaning periods influence future productivity of Holstein heifers?** M. Garcia\*, L. F. Greco, W. W. Thatcher, J. E. P. Santos, and C. R. Staples, *University of Florida, Gainesville.*

Information on the effect of feeding of long-chain fatty acids (LCFA) on future offspring productivity is lacking. Holstein cows ( $n = 96$ ) were fed (1) no fat supplement (control; 2.3% dietary fat), (2) hydrogenated LCFA (SFA, Energy Booster 100, Milk Specialties, Eden Prairie, MN; 1.7% of dietary DM), or (3) Ca salts of LCFA containing essential LCFA (EFA; Megalac-R, Arm and Hammer Animal Nutrition, Princeton, NJ; 2.0% of dietary DM) from dry-off to calving. Heifers ( $n = 56$ ) born from these cows were fed a milk replacer (MR) of low linoleic acid (LLA, 0.56% LA, DM basis) or high LA (HLA, 1.78% LA, DM basis) during the first 60 d of life. A single grain mix was offered between 31 and 60 d of life. Performance of replacement heifers that went on to complete at least 290 DIM ( $n = 33$ ) was evaluated. Diets did not affect culling rate. Body weight at birth was not influenced by dam diet but ADG for the first 60 d of life was greater for heifers born from dams fed SFA vs. EFA (0.45, 0.48, and 0.42 kg/d for heifers born from control, SFA-, and EFA-fed dams, respectively). Sixty-day intake of LA averaged 6.2 and 12.1 g/d for LLA and HLA heifers, respectively. Type of MR did not influence ADG (0.45 vs. 0.45 kg/d) during the first 60 d of life. After weaning and during the first lactation, heifers were fed diets formulated to meet nutritional requirements. Heifers born from dams supplemented with either fat source (control vs. (SFA + EFA)), tended to have a greater number of AI at first conception (2.6 vs. 1.7,  $P = 0.06$ ) and were older at first calving (24.2 vs. 22.9 mo,  $P = 0.02$ ). Heifers born from dams fed fat prepartum produced more ( $P = 0.02$ ) mature equivalent milk during their first lactation ( $10,605 \pm [CS1] 458$ ,  $11,745 \pm 486$ , and  $12,559 \pm 568$  kg for heifers born from control ( $n = 13$ ), SFA- ( $n = 11$ ), and EFA-fed dams ( $n = 9$ ), respectively). Heifers fed HLA MR did not produce more milk than those fed LLA MR ( $12,011 \pm 423$  vs.  $11,262 \pm 403$  kg). Fat supplementation during the last 2 mo of pregnancy can “program” calves in utero to produce more milk during their first lactation.

[CS1]Special key strokes

**Key Words:** heifer, fatty acid, fetal programming

**W32 Performance and health responses of dairy calves offered different milk replacer allowances.** A. Bach\*<sup>1,2</sup>, M. Terré<sup>2</sup>, and A. Pinto<sup>2</sup>, <sup>1</sup>ICREA, Institut de Recerca i Estudis Avançats, Barcelona, Spain, <sup>2</sup>Department of Ruminant Production, IRTA, Caldes de Montbui, Spain.

Eighty female Holstein calves ( $12 \pm 4$  d old and  $41.7 \pm 4.3$  kg of BW) were blocked by age and assigned to either a maximum of 6 L/d daily milk replacer (MR) allowance (LMR) or a 8 L/d (HMR). Calves were kept individually until 52 d of age and then moved into pens forming groups of 10. All calves had ad libitum access to a mash starter feed (20.4% CP, 18.5% NDF). Calves in the LMR group received 6 L of MR/d in 3 separate doses whereas calves in the HMR received 8 L of MR/d also distributed in 3 separate feedings. At 52 d of age, calves were moved to pens and pre-weaned by offering 2 L of the same MR/calf twice daily in a trough until the age of 59 d, when MR was further reduced to a single dose of 2 L until the age of 73 d when all calves were weaned. Individual starter feed and MR consumption was recorded on a daily basis until 52 d of age, and on a group-basis until weaning time. Body weight was measured at the beginning of the study and at 52 (pre-weaning), 73 (weaning), 110, 160, and 228 d of age. Data from entrance until pre-weaning were analyzed using an ANOVA ( $n = 40$ ). The data from pre-weaning to completion of study were analyzed using a 2-level mixed-effects model that accounted for the dependence of calves within pen ( $n = 4$ ). Solid feed consumption was greater ( $P < 0.01$ ) in LMR ( $821 \pm 42.1$  g/d) than in HMR calves ( $462 \pm 42.1$  g/d) between 42 and 52 d of age (pre-weaning). Solid feed consumption increased, and LMR showed a more ( $P < 0.001$ ) marked increase than HMR calves. However, HMR calves grew faster ( $P < 0.05$ ) than LMR calves ( $805$  vs.  $703 \pm 30.7$  g/d, respectively) until pre-weaning time, but from pre-weaning to weaning, LMR calves grew more ( $P < 0.05$ ) than HMR calves ( $977$  vs.  $857 \pm 30.7$  g/d, respectively). No differences in feed efficiency and incidence of disease were observed between treatments. It is concluded that before pre-weaning, HMR calves grow more than LMR calves, but between pre-weaning and weaning, LMR grow more than HMR calves overcoming the difference in BW at pre-weaning. As a result, there are no differences in BW at weaning and at 228 d of life and no differences in incidence of disease.

**Key Words:** efficiency, intake, starter

**W33 Consequences of essential oils (cinnamaldehyde and garlic oil) on rumen fermentation and performance of lactating dairy cattle.** M. Blanch\*<sup>1</sup>, A. Viso<sup>1</sup>, and A. Bach<sup>2,3</sup>, <sup>1</sup>Novus International Inc., St Charles, MO, <sup>2</sup>ICREA, Barcelona, Spain, <sup>3</sup>Department of Ruminant Production, IRTA, Caldes de Montbui, Spain.

The objective of this study was to determine the effect of Next Enhance 300 (NE300; cinnamaldehyde and garlic oil encapsulated product) on rumen fermentation and milk production of dairy cows. Sixteen lactating dairy cows (8 rumen-cannulated) participated in a switch-back design with three 4-wk periods and 2 treatments: control (unsupplemented) and NE300 (300 mg NE300/cow/d). Cows were housed in 2 different pens (blocked for parity, DIM, and level of milk production) and received the same TMR diet (16.0% CP, 31.4% NDF). Individual milk production and feed intake were collected throughout the study. All cows were sampled for milk components (fat, protein, lactose, urea, and SCC) on d 0, d 7, d 14, d 21, d 27, and d 28. Cannulated animals were used to collect rumen fluid to determine VFA and ammonia-N concentrations and monitor rumen pH using indwelling pH probes for 3 consecutive days within period. On d 28, rumen samples were collected at 0, 2, 4, 6, and 8 h after the morning feeding. In addition, cows were blood-sampled to determine glucose and insulin concentrations on d 0, d 7, d 14, d 21, and d 28 at 4 h after the morning feeding. Data were analyzed using a mixed-effects model with time entering the model as a repeated measure using each cow within period and treatment as subject. Period and sequence had no effect on any dependent variable measured. In terms of milk yield, there was a significant triple interaction ( $P < 0.05$ ) between treatment, parity, and days on treatment; basically, after 15 d on treatment, multiparous cows

on NE300 produced more milk (approximately 3 kg/d) than multiparous cows on control. Overall feed efficiency was numerically greater ( $P = 0.11$ ) in NE300 than in control cows (1.46 and 1.33, respectively). In general, blood and rumen parameters were not affected by treatments. Results of this study indicate that NE300 could be an alternative to increase milk yield and feed efficiency in lactating dairy cows.

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

**W34 Milk fatty acid profile in dairy cows fed with fatty acids unsaturated sources.** R. V. Barletta\*<sup>1</sup>, J. E. Freitas Jr.<sup>1</sup>, M. D. S. Oliveira<sup>2</sup>, R. Gardinal<sup>1</sup>, V. G. C. Lacuna<sup>1</sup>, V. P. Bettero<sup>2</sup>, B. C. Benevento<sup>1</sup>, B. C. Venturilli<sup>1</sup>, E. Ferreira de Jesus<sup>2</sup>, G. D. Calomeni<sup>1</sup>, J. R. Gandra<sup>1</sup>, and F. P. Rennó<sup>1</sup>, <sup>1</sup>University of São Paulo, São Paulo, SP, Brazil, <sup>2</sup>University Jlio de Mesquita, Jaboticabal, SP, Brazil.

The aim of this study was to evaluate the milk fatty acid profile in dairy cows supplemented with unsaturated fatty acids sources. Eight Holstein cows in the mid lactation ( $80 \pm 20$  d in milk; mean SD) cannulated in the rumen and abomasums ( $580 \pm 20$  kg of weight; mean  $\pm$  SD) with milk yield of 25 kg/d were assigned randomly into two  $4 \times 4$  Latin squares, fed the following diets: (1) control (C); (2) refined soybean oil (SO) (inclusion of 3% in the total dry matter); (3) whole soybean raw (WS) (inclusion of 16% in the total dry matter); and (4) calcium salts of unsaturated fatty acids (CSFA) (inclusion of 3% in the total dry matter). Milk yield and the dry matter intake were measured daily throughout the experimental period. The milk samples used for evaluating fatty acids profile were obtained at the 16th day of each experimental period, each sample coming from the 2 daily milkings, and were quantified by gas chromatography (Shimadzu GC 2010). Data were analyzed using PROC MIXED of SAS 9.1 according with the orthogonal contrasts (C vs. SO + WS + CSFA), (SO vs. WS + CSFA) and (WS vs. CSFA). No effect of sources of fat in the diets on fatty acid concentrations of short, medium and long chain, varying the carbon number of 6 to 18, total C18 saturated, fully unsaturated C18, and total of saturated and unsaturated ( $P < 0.05$ ). The concentrations of the isomers C18: 1 *trans*-11 (vaccenic acid), CLA *cis*-9,*trans*-11 CLA and *trans*-10,*cis*-12 were not altered by the experimental diets. No effect was observed in the fat sources used in this study on the profile of fatty acids in milk.

**Key Words:** linoleic acid, abomasum, whole soybean

**W35 Incorporation of n-6 and n-3 fatty acids into plasma lipid fractions of lactating cows: acute effect of abomasal infusions of linoleic and linolenic acids.** L. C. Nagengast\*, C. L. Preseault, J. C. Ploetz, C. M. Klein, and A. L. Lock, Michigan State University, East Lansing.

The effect of abomasal infusions of linoleic (18:2) and linolenic (18:3) acids on the concentration of n-6 and n-3 fatty acids (FA) in plasma lipid fractions over a 24-h period were evaluated in a repeated measures design. Six rumen-fistulated Holstein cows ( $252 \pm 33$  DIM and  $44 \pm 6$  kg milk/d) were randomly assigned to 1 of 2 FA treatments. Treatments were abomasal infusions (67 g/d of total FA) of (1) n-6 FA blend (N6) providing 43 g/d 18:2 and 8 g/d of 18:3; or (2) n-3 FA blend (N3) providing 43 g/d 18:3 and 8 g/d 18:2. FA were provided by infusion at 6 h intervals over 24 h. Blood samples were collected on d -2, d -1, and 0 h before the first infusion and 1, 3, 6, 12, and 24 h after initiation of infusions. FA concentration of plasma phospholipids (PL), cholesterol esters (CE), triglycerides (TG), and NEFA was determined. Data were analyzed using PROC MIXED in SAS with hour as the repeated measure. Total FA in each fraction was not altered by treatment. There were marked differences in the FA composition of the individual plasma fractions and in the distribution of n-6 and n-3 FA among fractions. N3 increased the

concentration of 18:3 and total n-3 FA in TG, NEFA, and PL ( $P < 0.01$ ). In TG and NEFA the concentration of 18:3 was highest at 3 h with a 126 and 76% increase compared with N6, respectively ( $P < 0.001$ ). In PL, 18:3 concentrations started to increase at 3 h, and continued to increase to 24 h when it was 175% higher compared with N6 ( $P < 0.001$ ). There was a trend for N3 to increase the concentration of 18:3 in CE ( $P = 0.08$ ), which was 23% higher compared with N6 at 24 h ( $P < 0.001$ ). Treatment did not affect the concentration of 18:2 or total n-6 FA in TG, NEFA, or CE ( $P > 0.20$ ), with a trend for N6 to slightly increase the concentration of 18:2 in PL ( $P = 0.09$ ). Results demonstrate that within 24 h of abomasally infusing 18:3 the concentration of n-3 FA in plasma TG, NEFA, and PL was increased; however, no such increases were observed for n-6 FA in these fractions with 18:2 infusion over a 24-h timeframe.

**Key Words:** dairy cow, plasma lipid, polyunsaturated fatty acid

**W36 Performance, intestinal modulation and blood parameters of calves supplemented with an essential oils blend.** F. H. R. Santos<sup>1,2</sup>, M. R. Paula\*<sup>1,4</sup>, D. Lezier<sup>1,3</sup>, J. T. Silva<sup>1,3</sup>, G. Santos<sup>1,3</sup>, and C. M. M. Bittar<sup>1,3</sup>, <sup>1</sup>ESALQ/USP, Piracicaba, Sao Paulo, Brazil, <sup>2</sup>Fapesp, Sao Paulo, Sao Paulo, Brazil, <sup>3</sup>CNPq, Brasilia, DF, Brazil, <sup>4</sup>Capes, Brasilia, DF, Brazil.

The objective was to evaluate the use of an essential oils blend (EO) via milk-replacer or starter concentrate, with regard to improvements in overall performance and occurrence of diarrhea, as well as intestinal microbiota and blood parameters of calves until 10 weeks of age. The blend of essential oils (Activio Grasp) consisted of cinnamon essential oil, rosemary, oregano and pepper extract. Twenty-seven calves from 1 to 4 d of age were distributed in a randomized block in the following treatments: Control = No EO; MR = 400 mg/kg of EO in milk replacer; and MRS = 200 mg/kg of EO in milk replacer and 200 mg/kg of EO in concentrate starter. Animals were individually housed, received 6 L of milk-replacer/d (20:16; Sprayfo Violeta, Sloten do Brasil Ltda) in 2 meals, and had water and starter concentrate (18% CP; 80% TDN) free-choice. Fecal scores and starter intake were evaluated daily. From the second week until the 10th week of life blood parameters were determined from weekly drawn blood samples. Fecal samples were collected weekly for enterobacteria enumeration. Treatments comparisons, as well as, orthogonal contrast (control vs. MR+MRS) show that feeding EO in milk replacer or starter concentrate did not affect ( $P > 0.05$ ) performance, blood parameters or intestinal modulation (Table 1).

**Table 1.** Performance, fecal score and blood parameters of calves supplemented with EO

	Treatment <sup>1</sup>				$P <$	
	C	MR	MRS	EPM	T	C vs. OE
Starter intake, g/d	589.10	545.70	450.93	55.9	0.205	0.235
Live weight, kg	50.68	43.32	46.61	1.5	0.179	0.185
Daily gain, g	395.5	398.1	378.3	36.1	0.908	0.873
Fecal score	1.8	1.7	1.8	0.09	0.527	0.443
Hematocrit, %	20.2	19.9	21.0	0.62	0.395	0.450
Total protein, g/dL	7.45	6.79	6.90	0.40	0.442	0.362
Glucose, mg/dL	107.21	107.21	102.93	6.06	0.883	0.747
BHBA, mmol/L	0.14	0.14	0.19	0.02	0.925	0.739
Enterobacteria, log cfu/g feces	4.5	4.5	4.3	0.24	0.652	0.873

<sup>1</sup>C = control; MR = 400 mg/kg of EO in milk replacer; MRS = 200 mg/kg of EO in milk replacer and 200 mg/kg of EO in concentrate starter; T = treatment effect; C vs. OE = orthogonal contrast control vs. MR+MRS.

**Key Words:** diarrhea, enterobacteria, hematocrit

**W37 Glycerol to improve alfalfa utilization: Effects on in vitro gas production and microbial protein synthesis.** Á. R. Alfonso Ávila<sup>\*1,2</sup>, É. Charbonneau<sup>2</sup>, C. Lafrenière<sup>1</sup>, and R. Berthiaume<sup>3</sup>, <sup>1</sup>*Agriculture and Agri-Food Canada, Sherbrooke, Qc, Canada*, <sup>2</sup>*Département des Sciences Animales, Université Laval, Québec, Qc, Canada*, <sup>3</sup>*Valacta, Ste-Anne-de-Bellevue, Qc, Canada*.

The increased production of biodiesel in recent years has renewed the interest for the use of glycerol as an energy source in livestock diets. However, when it comes to assessing glycerol in association with forages, data are scarce. The objective of this project is to determine if interactions between glycerol and forages do exist. A 2 × 3 factorial design which consisted of 2 non-structural carbohydrate (NSC) concentrations in alfalfa (high [HNSC] or low [LNSC]) and 3 glycerol treatments (control, 15% crude glycerol [CG] and 15% pure glycerol [PG]), plus one additional treatment (AT: LNSC with 5% sucrose + 5% starch) were evaluated. Five pre-planned contrasts were tested using the 7 treatments: 1) HNSC vs. LNSC alfalfa; 2) with vs. without glycerol; 3) interaction alfalfa and glycerol; 4) CG vs. PG and 5) AT vs. HNSC. Last contrast verified if the addition of exogenous sugars to LNSC had the same effects as feeding HNSC alfalfa. Using in vitro 24-h batch culture with rumen fluid, incubations were performed in triplicates and measured gas production each 10 min for a total of 24 h, whereas ammonia, pH, volatile fatty acids, microbial N (MN) and microbial mass (MM), in vitro DM and NDF, and in vitro true digestibility (IVTD) were determined after 24 h. Statistical differences were declared at  $P \leq 0.05$ . A decrease in the acetate:propionate ratio was observed with HNSC in comparison to LNSC (2.87 vs. 3.27) and with the addition of glycerol vs. no glycerol (2.78 vs. 3.65). No interaction was observed between alfalfa type and glycerol. Glycerol had no effect on IVTD. Reductions in MM (185.5 vs. 240.5 mg/g DM) and MN production (16.8 vs. 25.8 mg/g of OM apparently digested) were observed with CG in comparison to PG. Also CG tended to produce more CH<sub>4</sub> after 24 h, which agrees with the larger acetic acid production found for CG in comparison to PG. The AT had lower microbial protein synthesis and propionic acid production in relation to HNSC. Although no effect was observed for the degradation and metabolism of alfalfa when using glycerol, results clearly show that the rumen does not respond as well to the addition of CG vs. PG.

**Key Words:** forage, glycerol

**W38 Effect of feeding reduced fat dried distillers grains with solubles on lactation performance of Holstein cows.** E. Castillo-Lopez<sup>\*1</sup>, K. M. Algya<sup>1</sup>, T. J. Klopfenstein<sup>1</sup>, D. Hostetler<sup>1</sup>, K. Karges<sup>2</sup>, S. C. Fernando<sup>1</sup>, and P. J. Kononoff<sup>1</sup>, <sup>1</sup>*University of Nebraska-Lincoln, Lincoln*, <sup>2</sup>*Dakota Gold Research Association, Sioux Falls, SD*.

The objective of this experiment was to evaluate the effect of feeding reduced fat dried distillers grains with solubles (RFDG) on milk production and milk composition. Twelve multiparous lactating Holstein cows (mean and SD, 89 ± 11 DIM and 674 ± 68.2 kg BW) were randomly assigned in 4 × 4 Latin squares over 21-d periods. Treatments (DM basis) were (1) CONTROL, 0% RFDG; (2) 10% RFDG; (3) 20% RFDG; and (4) 30% RFDG. Cows were milked twice daily at 0730 and 1930 h. Milk production was recorded daily and milk samples were collected during the AM and PM milkings of d 19, 20 and 21 of each period for analysis of milk components. Cows were fed once daily at 0930 to allow for approximately 5% refusals and were allowed access to feed at all times except during milking. Total DMI increased linearly ( $P < 0.01$ ) with the inclusion of RFDG, with estimates of 25.0, 23.8, 25.9 and 27.9 ± 1.38 kg/d for CONTROL, 10, 20 and 30% RFDG, respectively. Milk yield was not affected ( $P = 0.78$ ) by increasing levels of RFDG and aver-

aged 34.0 ± 1.29 kg/d. The percent of milk protein tended ( $P = 0.07$ ) to increase with RFDG inclusion with estimates of 3.08, 3.18, 3.15, and 3.19 ± 0.06% for CONTROL, 10, 20 and 30% RFDG treatments, respectively. The yield of milk protein, however, was similar ( $P = 0.23$ ) across treatments with an average of 1.05 ± 0.04 kg/d. The percent ( $P = 0.66$ ) and the yield ( $P = 0.53$ ) of milk fat were not affected by treatment and averaged 3.66 ± 0.09% and 1.24 ± 0.05 kg/d across treatments, respectively. Results of this experiment indicate that dairy rations can be formulated to include up to 30% RFDG while maintaining lactation performance, demonstrating that RFDG is an effective alternative energy and protein feed source for the dairy industry.

**Key Words:** by-product, dairy, lactation

**W39 Use of crude glycerin for dairy cows.** M. I. Marcondes<sup>\*1</sup>, T. R. Pereira<sup>1</sup>, M. Valverde da Silva<sup>2</sup>, T. E. da Silva<sup>1</sup>, A. S. Trece<sup>1</sup>, and W. L. Cardoso<sup>1</sup>, <sup>1</sup>*Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil*, <sup>2</sup>*Master Alimentos LTDA, Rio Pomba, Minas Gerais, Brazil*.

The current concern about global warming, and the increasing share of biodiesel in the global energy matrix have increased interest in cultivation and processing of oil seeds. Therefore, this study aimed to evaluate the inclusion of crude glycerin replacing corn grain for medium-low production dairy cows. Twelve Holstein cows were distributed into three 4 × 4 Latin squares, according to milk production. Animals were fed 70% corn silage in dry matter basis, plus concentrate. Corn was replaced in the concentrate by a mixture of crude glycerin and a protein corn co-product called Mazoferm, in the proportion of 0, 33, 66, and 100% in dry matter basis, and those represented inclusions of 0, 4, 8, and 12% of crude glycerin in the diets (%DM). Dry matter and nutrient intake were evaluated, as well as their digestibilities. Milk production and composition were also evaluated. The statistical analysis were carried out using proc MIXED (SAS) with 10% of probability for type I error. The inclusion of glycerin did not affect ( $P > 0.10$ ) DM, NDF and TDN intakes. DM and NDF digestibilities were also not affected by glycerin inclusion ( $P > 0.10$ ). Intake and digestibility of crude protein (CP) have decreased linearly ( $P < 0.10$ ). Ether extract and non-fiber carbohydrate intake have increased linearly ( $P < 0.10$ ). Milk production (MP) and MP corrected for 4% fat (PL4G) were not affected by diets ( $P > 0.10$ ). There was also no significant diet effect ( $P > 0.10$ ) on milk composition (fat, protein, lactose, total solids and somatic cell score). Serum levels (HDL, LDL, VLDL, triglycerides, and glucose) have not been affected significantly by glycerin in the diet ( $P > 0.10$ ), apart from total cholesterol, which decreased linearly with the increasing inclusion of crude glycerin ( $P = 0.091$ ). Crude glycerin can totally replace corn grain ground in diets for cows producing 15 kg of milk.

**Key Words:** digestibility, intake, milk

**W40 Performance, digestion, milk fatty acids, and plasma amino acids in response to the supplementation of methionine and plant extracts to dairy cows.** G. G. S. Salvati<sup>1</sup>, N. N. Morais Junior<sup>1</sup>, F. C. F. Lopes<sup>3</sup>, R. A. N. Pereira<sup>2</sup>, and M. N. Pereira<sup>\*1</sup>, <sup>1</sup>*Universidade Federal de Lavras, Lavras, MG, Brazil*, <sup>2</sup>*Empresa de Pesquisa Agropecuária de Minas Gerais, Lavras, MG, Brazil*, <sup>3</sup>*Empresa Brasileira de Pesquisa Agropecuária, Juiz de Fora, MG, Brazil*.

Rumen microbial yield and PUN were reduced when 2-hydroxy-4-methylthio butanoic acid isopropyl ester (HMBi, MetaSmart, Adisseo) was added to 15.8% CP, soybean based diets. A mixture of cardol, cardanol (phenolic from the cashew nutshell) and ricinoleic acid (C18:1 c9 hydroxylated at C12 from castor oil) (Essential, Oligobasics) may

affect rumen fermentation. The response of lactating cows to HMBi (35g/d), associated to Essential (10g/d), was evaluated. Twenty-eight Holsteins (211 ± 103 DIM) were fed a common diet for 14d and then a treatment for 29d, in a covariate adjusted randomized block design. Response was evaluated on the last 7d. Treatments were a 2x2 factorial arrangement of the 2 factors, orally dosed to each cow twice per day. Diets had 17% soybean meal, 5.8% raw soybeans, and 18.3% CP. Milk yield did not differ (30.5kg/d,  $P > 0.64$ ), similarly to solids yield, DMI, and total tract digestibility ( $P > 0.25$ ). Milk protein was increased from 3.25% to 3.35% by HMBi ( $P = 0.03$ ). Methionine and histidine as a % of plasma amino acids were increased by HMBi without Essential ( $P < 0.04$  for interaction) and Essential decreased isoleucine ( $P = 0.03$ ). Essential without HMBi reduced C15:0 anteiso as a % of milk FA ( $P = 0.05$  for interaction) and as a % of odd and branched chain FA (OBCFA) ( $P = 0.03$  for interaction). Essential decreased C17:0 iso as a % of FA ( $P = 0.02$ ) and the summations of C15:0 iso + C17:0 iso ( $P < 0.01$ ) and of C15:0 anteiso + C17:0 anteiso ( $P = 0.02$ ). HMBi also reduced C15:0 iso + C17:0 iso as a % of FA ( $P = 0.04$ ). Although OBCFA profile of milk fat indicated a depression in rumen microbes synthesis in response to both HMBi and Essential, the daily excretion of urinary allantoin was similar ( $P > 0.70$ ). HMBi reduced the mean PUN along the day from 18.2 to 15.6mg/dL ( $P = 0.03$ ), markedly at sampling times 0, 1, 2, 3, and 6 h post-feeding, and ruminal ammonia content 12 h post-feeding ( $P < 0.01$ ). HMBi increased milk protein content and decreased PUN, while plant extracts did not induce detectable animal response.

**Key Words:** essential oil, methionine, odd- and branched-chain fatty acids

**W41 Sources of rumen protected fat supplementation on milk yield and composition and ruminal parameters of dairy cows grazing a tropical pasture.** F. Batistel<sup>\*1</sup>, J. De Souza<sup>1</sup>, K. C. Welter<sup>2</sup>, M. M.V. Silva<sup>1</sup>, A. V. Pires<sup>1</sup>, V. N. Gouvea<sup>2</sup>, D. F. A. Costa<sup>1</sup>, and F. A. P. Santos<sup>1</sup>, <sup>1</sup>University of São Paulo, Piracicaba, SP, Brazil, <sup>2</sup>University of São Paulo, Pirassununga, SP, Brazil.

The objective of this experiment was to investigate the effects of supplementation of lactating cows grazing a tropical pasture with diets containing calcium salts of palm oil (CSPO) or calcium salts of soybean oil (CSSO) on ruminal fermentation and milk production. Five rumen-cannulated cows (90 ± 12 DIM) were used in a 5x5 Latin square and subjected to the following treatments: a) control (no fat); b) 400 g CSPO cow<sup>-1</sup> d<sup>-1</sup>; c) 700 g CSPO cow<sup>-1</sup> d<sup>-1</sup>; d) 400 g CSSO cow<sup>-1</sup> d<sup>-1</sup>; and e) 700 g CSSO cow<sup>-1</sup> d<sup>-1</sup>. Treatment periods were 24 d in length. Cows grazed paddocks of *Pennisetum purpureum* and received 8 kg cow<sup>-1</sup> d<sup>-1</sup> (DM) of concentrate twice daily. Milk yield was measured every 2 d and milk composition was analyzed every 6 d. Rumen fluid samples were collected on d 22 at 0, 1, 2, 4, 6, 8, 12, 18 and 24 h after feeding concentrate in the morning and analyzed for pH and VFA. Data were analyzed as repeated measures using a mixed model with animal and period as random effects. Both levels of CSPO increased milk yield (17.7 kg d<sup>-1</sup>). The use of 700 g CSSO decreased milk production (15.9 kg d<sup>-1</sup>) compared with control and 400 g CSSO (16.7 and 17.1 kg d<sup>-1</sup>, respectively). Fat supplementation did not affect milk protein, milk casein and milk lactose concentrations. The CSSO reduced milk fat concentration and yield. Addition of 700 g d<sup>-1</sup> of CSSO decreased milk fat yield at 22% in comparison to control (0.48 vs. 0.62 kg d<sup>-1</sup>). Both CSPO levels increased milk fat, protein and lactose yield when compared with control and CSSO. Ruminal pH was not affected by fat supplementation. Acetate and butyrate concentrations were higher for 400 g CSPO than 700 g CSSO (70.5 vs. 65.9 mmol ml<sup>-1</sup> and 13.1 vs. 12.6 mmol ml<sup>-1</sup>). In addition, valerate and isobutyrate were higher for 400 g CSPO than for 400 g and 700 g of CSSO (1.35 vs. 1.04; 0.98 and 1.30 vs. 1.04; 1.06 mmol ml<sup>-1</sup>). The decreased concentration of branched-chain fatty acids suggests that microbial growth was affected negatively by CSSO supplementation. Dairy cows grazing tropical pasture supplemented with fat can have an increased milk yield depending of level and source of fat.

**Key Words:** palm oil, soybean oil, milk