# Ruminant Nutrition: Dairy: Protein and Fats

**127 Effect of linoleic acid supplementation to Holstein dams and calves on immune measures of calves.** M. Garcia*, L. F. Greco, J. E. P. Santos, and C. R. Staples, *University of Florida, Gainesville.*

The aim of this study was to evaluate supplementing linoleic acid (LA) to cows during the last 2 mo of pregnancy and their calves from birth to 60 d of age on calf immune measures. Cows (n = 96) were fed a basal diet formulated to supply a minimum amount of LA and supplemented without fat, with saturated fatty acids (SFA at 1.75% of dietary DM, or with Ca salts of primarily unsaturated fatty acids enriched in LA (EFA; Megalac-R, Church and Dwight, Co.) at 2% of dietary DM. Within 2 h of birth, calves were fed 4 L of colostrum from their own dam or from a dam of the same dietary treatment using an esophageal feeder. Calves were blocked by gender and dam diet and assigned randomly to receive a milk replacer (MR) with low (0.56% LA; LLA) or high concentration of LA (1.78% LA; HLA, DM basis) for 60 d. Milk replacer was fed twice daily at 6.7 g of fat per kg of metabolic BW and amounts were adjusted weekly. A single grain mix of minimum LA concentration was offered in ad libitum amounts starting at 31 d of age. The effect of feeding HLA-MR to calves was not influenced by fat supplementation of their dams (interaction of MR by dam diet was not detected). Calves born from cows fed fat tended ($P = 0.06$) to have a greater plasma concentration of haptoglobin (1.05 vs. 0.94 OD x 100). Blood neutrophils from calves born from cows fed EFA had greater ($P = 0.04$) mean florescence intensity for phagocytosis of *E. coli* (122 vs. 113). Concentration of WBC was not affected by diet of cows or calves, but calves fed HLA-MR had greater ($P = 0.04$) concentration of blood lymphocytes (4608 vs. 4201/uL) and tended ($P = 0.07$) to have greater concentration of eosinophils at 7 and 14 d than calves fed LLA-MR. Mean plasma concentration of acid soluble protein was lower ($P = 0.01$) for the HLA-MR group (94.3 vs. 106 ug/mL). Production of interferon-gamma by isolated peripheral blood mononuclear cells stimulated with Con-A in vitro tended ($P = 0.13$) to be increased (27.8 vs. 17.6 pg/mL) in calves fed HLA-MR. Supplementing LA to pregnant cows and to newborn calves appeared to have some pro-inflammatory effects in the calves.

**Key words:** calves, fat, immunity

**128 Effect of replacing solvent-extracted canola meal with high-oil traditional canola, high-oleic acid canola, or high-erucic acid rapeseed meals on milk production and milk fatty acid composition in lactating dairy cows.** A. N. Hristov*[1], C. Domitrovich[1], A. Wachter[1], T. Cassidy[1], C. Lee[1], K. J. Shingfield[2], P. Kairenius[2], J. Davis[3], and J. Brown[3], [1]*Pennsylvania State University, University Park,* [2]*MTT Agrifood Research Finland, Jokioinen, Finland,* [3]*University of Idaho, Moscow.*

The objective of this experiment was to investigate the effects of replacing solvent-extracted conventional canola meal (Control) with high-oil content, mechanically-extracted conventional canola meal (Canola), high-oleic, low-polyunsaturated fatty acids (FA) canola meal (HOLL), and high-erucic acid, low-glucosinolate rapeseed meal (Rape) on milk production, rumen function, digestibility, and milk FA composition in lactating dairy cows. The experiment was a replicated 4 × 4 Latin square design with 8 lactating dairy cows (109 ± 15.1 DIM). Oilseed meals were included at 12 to 13% of dietary DM. Fat and CP concentrations (% of DM) of the meals were: 3.1 and 43%, 16.1 and 32.8%, 13.7 and 45.2%, and 17.9 and 34.3%, respectively. Relative to the control, inclusion of high-oil seed meals in the diet lowered ($P = 0.006$) ruminal acetate concentration and decreased DMI (30.9 vs. 28.8 kg/d, respectively; $P = 0.001$). Milk yield was lower ($P = 0.047$) for Canola and Rape than the Control (44.9, 45.0, and 47.1 kg/d, respectively). Treatments had no effect on milk composition, other than an increase ($P < 0.001$) in MUN for HOLL. Urinary urea N losses and ammonia emission from manure were increased ($P = 0.03$) by HOLL. Replacing solvent-extracted canola meal with the high-oil meals decreased milk fat 12:0, 14:0, 16:0 and total saturated FA content and enhanced cis-9 18:1 and total monounsaturated FA concentrations ($P < 0.05$). Relative to the control, Canola increased ($P = 0.03$) total trans FA in milk, while inclusion of HOLL increased ($P =$ 0.009 and 0.003) trans-11 18:1 and cis-9,trans-11 CLA content. Rape increased milk fat cis-13 22:1 content from 0.07 to 2.33 g/100 g FA. In conclusion, high-oil canola or rapeseed meals, which are likely to come from small-scale biodiesel plants where oil is cold pressed without hexane extraction, fed at levels at or above 12 to 13% of dietary DM may decrease feed intake and milk production, but can be used to alter milk FA composition in lactating dairy cows.

**Key words:** canola meal, rapeseed meal, dairy cow

**129 Chain length of dietary saturated fatty acids affects meal patterns and plasma metabolite and hormone concentrations of cows varying in milk yield.** M. Hollmann*, M. S. Allen, and D. K. Beede, *Department of Animal Science, Michigan State University, East Lansing.*

Dietary saturated medium-chain fatty acids (FA; $\leq C_{12}$) in coconut oil (CO) often depress DMI of cows but the underlying mechanisms are not well understood. Eight cows were blocked by milk yield (HIGH: 53 to 59 kg/d; LOW: 24 to 35 kg/d) and assigned to treatment sequence in a crossover design experiment. Dietary treatments were 3.35% (dry basis) of CO or saturated long-chain FA (Energy Booster 100®, EB). Diets contained 58% forage (corn silage, and alfalfa hay and haylage), 26.3% NDF, and 14.5% CP (dry basis). Periods were 27 d, and cows were milked twice and fed once daily. Blood samples were collected before feeding and hourly post-feeding for 6 h on d 17 through 20. Feeding behavior was measured from d 21 through 24. CO reduced daily DMI by 18% ($P < 0.01$) regardless of production level (interaction: $P > 0.4$) and increased the size of the first meal following feeding (conditioned meal) as a proportion of daily DMI (33 vs. 22%; $P < 0.01$) and amount (tendency: 6.0 vs. 5.2 kg; $P < 0.13$). However, hunger ratio (meal size per preceding inter-meal interval) of the first spontaneous meal following the conditioned meal tended to be lower for cows fed CO than EB (1.7 vs. 2.6 kg/h; $P < 0.07$). CO increased plasma concentrations of insulin, NEFA, and BHBA ($P < 0.01$), but did not affect glucose and glucagon concentrations compared with EB. Concentrations of insulin and BHBA did not differ between treatments before feeding but CO increased concentrations after the first meal more rapidly than EB. The rapid elevation of BHBA following the conditioned meal is consistent with increased hepatic FA oxidation for CO compared with EB. Feeding behavior results are consistent with control of feed intake by hepatic oxidation of FA because the reduction in DMI by CO was only for spontaneous meals when plasma BHBA concentration was elevated.

**Key words:** feeding behavior, hepatic oxidation, DMI regulation

**130 Effects of different amounts of dietary protected and unprotected niacin on responses of blood metabolites to an epinephrine challenge in dairy cows.** F. C. Cardoso*[1], J. Garrett[2], and J. K. Drackley[1], *[1]University of Illinois, Urbana, [2]QualiTech, Chaska, MN.*

Niacin may modulate lipolytic responses in adipose tissue but is highly degradable in the rumen so that oral administration leads to unknown quantities absorbed. We determined responses to epinephrine (EPI) challenge as affected by 3 levels of protected niacin (PN) or unprotected niacin (UN) in the diet or infused abomasally. Six multiparous rumen–cannulated Holstein cows (BW = 656 kg; 128 ± 23 d in milk) were used in a completely randomized 6 × 6 Latin Square with an extra period to quantify carry-over effects. Periods consisted of 7 d for adaptation followed by 7 d for measurements. Cows were fed according to NRC (2001) recommendations. Treatments were: CON, no niacin; INF, abomasal infusion of 12 g UN; N12, 12 g UN; BN3, 3 g PN; BN6, 6 g PN; and BN12, 12 g PN. Treatments N12, BN3, BN6, and BN12 were top-dressed on the TMR twice daily. Treatment INF was divided in 5 equal portions and infused every 4 h. Cows receiving treatments other than INF were infused with the same volume of water at the same times. On d 12 cows received an i.v. infusion of EPI (1.4 µg/kg BW). Blood was sampled at −45, −30, −20, −10, and −5 min before EPI infusion and 2.5, 5, 10, 15, 20, 30, 45, 60, 90, and 120 min after. Total area under the curve (AUC) responses of NEFA and glucose concentrations in plasma were calculated. Statistical analysis was performed using the MIXED procedure of SAS. Least squares means were separated using the Tukey adjustment. A quadratic effect existed among treatments BN3, BN6, and BN12 ($P = 0.01$) for NEFA AUC. Time to peak NEFA concentration tended ($P = 0.08$) to be greater for N12 (22.1 ± 3.2 min) than for BN12 (14.8 ± 3 min). For glucose, INF resulted in greater AUC than N12 ($P = 0.04$) and BN12 tended to have greater AUC than N12 ($P = 0.07$). Glucose AUC displayed a quadratic response among treatments BN3, BN6, and BN12 ($P = 0.03$). Time to peak and peak concentration of glucose, as well as NEFA peak concentration, did not differ ($P > 0.1$). In conclusion, dietary PN unexpectedly resulted in greater lipid mobilization in response to EPI challenge compared with cows receiving equivalent dietary UN.

**Key words:** niacin, lipolysis, epinephrine

**131 Chain length of saturated fatty acids affects intake and ruminal turnover of NDF and chewing activity in lactating cows varying in milk yield.** M. Hollmann*, M. S. Allen, and D. K. Beede, *Department of Animal Science, Michigan State University, East Lansing.*

Coconut oil (CO), a source of dietary saturated (90%) medium-chain fatty acids (FA; 60% of FA ≤ $C_{12}$), reduces DMI and NDF digestibility. To test effects of CO compared with Energy Booster 100® (EB; 90% of FA $C_{16}$ and $C_{18}$; 90% saturated) on ruminal NDF turnover and pool size and chewing activity, 8 cows were blocked by milk yield (53 to 59 vs. 24 to 35 kg/d) and fed diets containing either 3.35% (dry basis) CO or EB in a crossover design. Diets contained 58% forage (55% corn silage, 45% alfalfa hay and haylage) and 26.3% NDF (86% from forage), dry basis. Periods were 27 d, and cows were fed once daily. Feeding behavior was monitored and feed ingredients, orts, and milk were sampled d 21 through 24. Rumens were evacuated and digesta sampled 4 h after feeding on d 25 and 2 h before feeding on d 27. Reported results differed at $P < 0.05$. Cows fed CO consumed 18% less DM and NDF daily compared with those fed EB and no interaction was detected between treatment and production level. However, the conditioned meal after feeding was numerically greater for CO compared with EB (6.0 kg vs. 5.2 kg; $P < 0.13$). CO decreased NDF turnover rate (3.7 vs. 4.6%/h) and increased NDF turnover time (29 vs. 23 h) compared with EB, but ruminal NDF pool size was similar between treatments. Digesta weight and volume did not differ but digesta density was greater for CO compared with EB. CO reduced molar concentration of ruminal acetate (66 vs. 80 mM) and acetate-to-propionate ratio (2.3 vs. 3.1), but not propionate (28 mM), and decreased ruminal pH post-feeding (5.3 vs. 5.7), but not pre-feeding (6.0) compared with EB. Cows fed CO spent more time ruminating (8.9 vs. 7.4 h/d) and chewing (13.2 vs. 12.1 h/d) than those fed EB. Increased turnover time may have been because CO decreased ruminal NDF digestibility and passage rate (not measured). Although CO reduced DMI while maintaining rumen pool size of digesta, lack of interaction of treatment by production level and the numerical increase in DMI for the conditioned meal do not support rumen distention as a mechanism for lower DMI for CO.

**Key words:** NDF digestion, saturated fatty acid, rumination

**132 Performance and milk fatty acid profile of Holstein dairy cows in response to dietary fat supplements and forage:concentrate ratio.** S. Kargar[1], M. Khorvash[1], G. R. Ghorbani*[1], M. Alikhani[1], and D. J. Schingoethe[2], *[1]Isfahan University of Technology, Isfahan, Iran, [2]South Dakota State University, Brookings.*

The objective of this experiment was to investigate the lactation performance of dairy cows fed hydrogenated palm oil and yellow grease. The experiment was conducted with alfalfa-based diets containing whole cotton seed, with different forage to concentrate (F:C) ratios being fed supplemented with hydrogenated palm oil or yellow grease. The experiment used 8 lactating Holstein cows in a replicated 4 × 4 Latin square with 3 wk periods. Treatments were: 1) no added fat and 34:66 F:C ratio (Control); 2) 2% hydrogenated palm oil and 34:66 F:C ratio (HPO); 3) 2% yellow grease and 34:66 F:C ratio (YG); or 4) 2% yellow grease and 45:55 F:C ratio (YGHF). All data were analyzed using the MIXED procedure of SAS. Preplanned statistical contrasts were used to test the effect of fat supplementation (Control vs. HPO + YG); the effect of source of fat supplement (HPO vs. YG); and the effect of forage to concentrate ratio within diets supplemented with yellow grease (YG vs. YGHF). Feeding fat and increasing F:C ratio had no effect on milk yield but fat source influenced milk yield ($P < 0.05$). Fat supplementation tended ($P < 0.06$) to increase milk fat content and yield but were not affected by increasing F:C ratio. Feeding fat and source of fat tended ($P < 0.07$) to increase and increased ($P < 0.01$) total milk fat conjugated linoleic acid without affecting desaturase indices, respectively. Fat supplementation decreased milk short-chain FA and increased long-chain FA (LCFA) with significant changes in C18:0 and cis-9 C18:1 concentration. Furthermore, YG decreased medium-chain FA and increased LCAF and total unsaturated FA of milk fat relative to HPO. Total tract digestibility of organic matter was greater ($P < 0.05$) in the YG diet than HPO, however, it was not affected by fat compared with control and also F:C ratio. Feeding yellow grease had no detrimental effects on nutrient digestibility but increased production responses and improved milk FA profile without inducing milk fat depression. Increasing F:C ratio did not affect production performance and increased saturated FAs of milk fat.

**Key words:** yellow grease, forage to concentrate ratio, CLA

**133 Effect of a high palmitic acid fat supplement on ruminal fermentation and milk production in high- and low-producing dairy cows.** D. E. Rico* and K. J. Harvatine, *The Pennsylvania State University, University Park.*

Two experiments tested the effect of fatty acid (FA) supplements on milk production and composition. In experiment 1, 24 Holstein dairy cows were blocked by production level (High > 40 kg/d and Low < 30 kg/d) and in a replicated 3x3 Latin Square design. Treatments were control (no supplemental fat), Ca-Salts of palm FA (Ca-FA; Megalac; 2.4% of DM), and free FA high in palmitic acid (PA; BergaFat F100; 2% of DM). The statistical model included the random effect of period, cow and sequence, and the fixed effect of treatment, block and the interaction of block and treatment. There was a treatment by block interaction ($P < 0.05$) for fat percent but not for milk yield or other milk components. In high producing cows, milk fat percent was not different between control and PA, but was lower for the Ca-FA compared with PA (2.87 and 3.21%, $P < 0.01$). In contrast, in low producing cows, treatment had no effect on the concentration or yield of milk fat. Treatment did not affect milk yield or DMI (42.1 ± 2.6 kg/d and 26.3 ± 1.36, respectively) in the high producing block; concentration and yield of milk components was also no affected. For low producing cows, DMI was higher in the control compared with the PA treatment (24.1 and 22.9 kg/d, $P < 0.05$), but was not different between PA and Ca-FA. In experiment 2, 16 high producing cows (>40 kg milk/d) were used in a crossover design with 14 d periods. Treatments were Ca-FA and PA fed as described above. The statistical model included the random effect of cow nested in sequence and period and the fixed effect of treatment. Milk yield was significantly higher in the PA compared with Ca-FA treatment (45.8 vs. 44.1 kg/d, $P < 0.01$). There was no effect of treatment on DMI. Yields of fat, protein, and lactose were higher ($P < 0.05$) in PA vs Ca-FA. Our results show that Ca-FA decreases milk fat content relative to PA in high producing cows but not in low producing cows. Under some circumstances, PA can increase yield of milk and of milk components.

**Key words:** dairy cows, palmitic acid

**134 Effect of extruded flaxseed or alfalfa protein concentrate in interaction with two levels of concentrate on milk fat production.** C. Hurtaud*[1], G. Chesneau[2], D. Coulmier[3], and J. L. Peyraud[1], [1]*INRA-Agrocampus Ouest UMR[1080] Production du Lait, Saint-Gilles, France,* [2]*Valorex, Combourtillé, France,* [3]*Desialis, Paris, France.*

Increasing milk omega-3 fatty acids (FA) content is desirable for human health. Our objective was to study the effect of 2 supplements rich in omega-3 in interaction with the proportion of concentrate in the diet on milk FA composition. The 2 sources of omega 3 were extruded flaxseed (FLAX, 1 $kg.d^{-1}$) and alfalfa protein concentrate (APC, 2 $kg.d^{-1}$) supplying respectively 115 and 49 $g.d^{-1}$ omega-3 per cow. The cows were fed a corn silage based diet with 30% (C0) or 65% (C+) cereal based concentrate. The trial was carried out according a nested reversed design using 24 dairy cows averaging 117 ± 14 DIM with 2 periods of 14 d. Data were analyzed according a split plot design using proc mixed procedure. There was no significant interaction between the level of concentrate and the form of omega-3. C+ largely decreased milk fat content (−1.15 %) and yield (−301 $g.d^{-1}$), the proportion of saturated FA (especially C16:0, C18:0, C4:0, C6:0 and C8:0) and increased trans C18:1, (especially t9, t10 and t12). Compared with FLAX, APC increased milk fat content (0.33 %), saturated FA (especially C4 to C12, C14:0 and C16:0) and decreased cis and all trans C18:1 isomers. Actually, FLAX induced high levels of cis and trans C18:1 isomers, c9t11CLA and C18:2 isomers. Transfer rate of C18:3 from feed to milk was much higher for APC (15.3 vs 4.7%) and increased with C+ when FLAX was fed. Decrease in milk fat content with C+ is classical and is due to the large amount of concentrate that had probably increased rumen propionic acid and t10 FA. It seems that these nutrients could have had a negative additive effect on milk fat content and yield. Especially, t10 FA could have inhibited FA synthesis in mammary gland. Decrease in milk fat content with FLAX is a consequence of heat seed treatment that increases oil release in the rumen, limiting ruminal biohydrogenation and inducing more trans FA. Positive effect of APC on transfer rate could be due to its manufacturing process inducing a lipid-proteic coagulum protecting FA. The effect of nature and protection of lipids on biohydrogenation depends on level of concentrates.

**Key words:** concentrate, lipids, milk fatty acids

**135 Abomasal infusion of butterfat during CLA induced milk fat depression in lactating dairy cows.** D. Vyas*[1], U. Moallem[2], B. B. Teter[1], P. Delmonte[3], and R. A. Erdman[1], [1]*Department of Animal and Avian Sciences, University of Maryland, College Park,* [2]*Agriculture Research Organization, Bet Dagan, Israel,* [3]*U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, College Park, MD.*

During diet induced milk fat depression (MFD), the short and medium chain fatty acids (SMCFA), which are synthesized de novo in the mammary gland, are reduced to a much greater extent than the long-chain fatty acids(LCFA) which originate from the diet. Our hypothesis was that increased availability of SMCFA might rescue conjugated linoleic acid (CLA) induced MFD in lactating dairy cows. To test that hypothesis, 4 rumen fistulated lactating Holstein cows (128 ± 23 DIM) were used in 4 × 4 Latin square design with 3 wk experimental periods. Treatments were applied in 2 × 2 factorial arrangement during the last 2 wk of each period and included abomasal infusion 3X daily of a total of: 1) 230 g/d of long chain FA (LCFA, blend of 59% cocoa butter, 36% olive oil and 5% palm oil); 2) 420 g/d butterfat (BF); 3) 230 g/d LCFA with 27 g/d CLA (LC-CLA) containing 10 g/d of t10, c12 CLA and 4) 420 g/d butterfat with 27 g/d CLA (BF-CLA). Data were analyzed using Mixed procedure in SAS using treatments as fixed whereas period and cows as random factors in the model. $P \leq 0.05$ was considered statistically significant. Butterfat provided 50% of C16:0 and similar amounts of C18 FA as found in LCFA such that the difference between the BF and LCFA treatments were 190g/d SMCFA. No effects were observed on DMI or milk yield. Milk fat content was significantly reduced ($P = 0.001$) by 41% with LCCLA and 32% with BF-CLA and milk fat yield was reduced ($P < 0.001$) by 41% and 38% with LCCLA and BF-CLA compared with their respective controls. Milk FA composition showed significant reduction of de-novo synthesized FA (DNFA) with CLA infusion. Milk fat percent and DNFA yields were greater for BF-CLA compared with the LC-CLA ($P = 0.09$). In conclusion, the increased availability of SMCFA from BF during CLA induced MFD was able to rescue 21% and 7% of milk fat content and yields, respectively but differences were not significant. Milk fat responses suggest potential limitation of SMCFA however increased availability of the respective FA might not completely rescue MFD.

**Table 1.**

| Item | BF | BF-CLA | LCFA | LC-CLA | SEM |
|---|---|---|---|---|---|
| DMI (kg/d) | 24.9 | 24.0 | 25.4 | 22.6 | 1.26 |
| Milk yield (kg/d) | 49.2 | 46.0 | 47.9 | 46.9 | 5.84 |
| Milk fat (%) | 3.38[a] | 2.30[b] | 3.36[a] | 1.99[b] | 0.21 |
| Milk fat yield (g/d) | 1640[a] | 1013[b] | 1600[a] | 937[b] | 169.7 |
| De-novo FA (%) | 43.27[a] | 38.64[b] | 42.57[a] | 36.07[b] | 1.52 |
| De-novo FA (g/d) | 710[a] | 396[b] | 686[a] | 344[b] | 82.5 |

**Key words:** milk fat, de novo synthesis, lactation

**136 The partial replacement of soya and rapeseed meal with urea or a slow release urea source (Optigen) and its effect on intake, performance and metabolism in dairy cows.** L. A. Sinclair*, P. Griffin, G. H. Jones, and C. W. Blake, *Harper Adams University College, Newport, Shropshire, UK.*

The objectives of the study were to determine the effect of partially replacing soya and rapeseed meal with urea or a slow release urea source (Optigen; Alltech UK) on the intake, performance and metabolism in dairy cows. Forty-two Holstein-Friesian dairy cows were allocated to one of 3 treatments in each of 3 periods of 5 wk duration in a Latin square design. The first 28 d of each period allowed adaptation to the dietary treatments with measurements during the final 7 d. Cows receiving the control treatment (C) received a mixed ration that included (DM basis) 38% corn silage, 18% grass silage, 29% concentrates and 15% of a 60:40 mix of soya and rapeseed meal. Cows on the Urea (U) or Optigen (O) treatments received the same basal ration but with the replacement of 1.1 kg/cow/d of the soya/rapeseed meal mix with either 100 g of feed grade urea or 110 g of Optigen respectively. There was no effect ($P > 0.05$) of treatment on dry matter intake or milk yield (mean values of 22.5 and 33.9 kg/d respectively). There was a trend ($P = 0.09$) for cows fed U or O to have a higher milk fat content (average of 40.1 g/kg for U and O vs. 38.9 g/kg for C). Milk true protein concentration and yield were not affected by treatment ($P > 0.05$) but milk urea content tended to be lower ($P = 0.07$) in cows fed C compared with U or O. Hourly plasma urea concentrations were higher ($P < 0.05$) in cows fed U and lowest in C, but there was no effect ($P > 0.05$) of treatment on plasma ammonia levels. Cows fed O had a higher ($P < 0.01$) efficiency of N use (kg milk N/kg N intake) and food conversion ratio (kg fat-corrected milk/kg DM intake) ($P < 0.001$) and tended ($P = 0.07$) to have a higher live weight gain than those fed C, with cows receiving U having intermediate values. In conclusion, the replacement of a mixture of soya and rapeseed meal with feed grade urea or Optigen can be achieved without affecting milk performance, with N and feed efficiency being higher and live weight gain tending to be higher in animals fed Optigen compared with a soya/rapeseed meal mixture.

**Key words:** dairy cow, slow release urea, performance

**137 Effect of added fat to diets for dairy cattle on production performance and dry matter intake.** A. R. Rabiee[1], K. Brienhild[1], W. Scott[1], H. M. Golder[1], E. Block[2], and I. J. Lean*[1], [1]*SBScibus, Camden, New South Wales, Australia,* [2]*Church & Dwight Co. Inc., Princeton, NJ.*

It was hypothesized that effects of different dietary fats on production performance of dairy cattle differ and are influenced by diet composition. Literature provided 39 studies containing 86 comparisons of control diets to diets with different fat sources. Only randomized controlled trials were included, if these provided: information on fat treatment and diet, data on outcomes of interest and a measure of variance. Fats were evaluated in 5 groups; tallow and greases; oilseeds (cotton, soy, sunflower), Ca salts of palm fatty acids (Capalm), other Ca salts (fish, linseed, flaxseed and others), and prilled fats. Statistical evaluation used a random effects analysis to estimate the effect size (ES) and 95% confidence interval (95% CI) for milk, fat and protein yields and DMI. The ES in milk production was increased 0.265 (95%CI = 0.101 to 0.429; $P = 0.002$) and the weighted mean difference (WMD) was 0.659 kg per day (95% CI = 0.115 to 1.203). Increase in ES for Capalm, oilseeds and other Ca-salts were significant ($P < 0.1$). Milk fat yield ES was 0.144 (95% CI = −0.010 to 0.298; $P = 0.07$) and the WMD was 0.03 kg per day (95% CI = 0.004 to 0.051). ES for fat yield was positive ($P < 0.05$) for CaPalm and Oilseeds, ES for milk protein yield was −0.004 (95% CI = −0.198 to 0.191; $P = 0.971$) and the WMD was −0.006 kg per day (95% CI = −0.022 to 0.010). The ES for DMI was −0.335 (95% CI = −0.467to −0.202, $P < 0.0001$). The WMD for DMI was −0.571 kg per day (95% CI = −0.851to 0.290). These results, were heterogenous ($P < 0.002$), indicating that responses were not consistent across trials. Responses among different fat sources varied. All fat sources negatively affected DMI. The largest effects on WMD were from Tallow and other Ca-salts at −0.8 and −1.7 kg/d, respectively. Univariate meta-regression analysis showed that the different fat sources were not sources of heterogeneity for milk yield ($P = 0.658$), and milk protein yield ($P = 0.681$), but were for milk fat yield ($P = 0.002$) and DMI ($P = 0.052$). This study provides good evidence that use of fats improves the efficiency of milk production performance, but results are influenced by types of fat used and other factors.

**Key words:** dietary fats, meta-analysis

**138 Effect of dietary fat blend and monensin supplementation on dairy cattle performance, milk fatty acid profiles and milk fat depression.** M. He[1], K. L. Perfield[2], H. B. Green[2], and L. E. Armentano*[1], [1]*Department of Dairy Science, University of Wisconsin-Madison, Madison,* [2]*Elanco Animal Health, Greenfield, IN.*

The effect of feeding increasing levels of $C_{18:1}$ and $C_{18:2}$ both independently and together, with or without monensin, was evaluated. Fifty-six Holsteins were blocked by parity. Pairs of cows (1 high and 1 low production) of the same parity were assigned to a single feeding station and cow pair was the experimental unit. Cow pairs were assigned to monensin (15.9 g/ton DM) or control as main plot. The 7 cow pairs in each of the Monensin/Parity groups were further assigned to a sequence of fat blend diets as split plot. Seven fat blend treatments in the split plot 7 × 7 Latin Square were no added fat (NoFAT), or diets with increasing levels of $C_{18:1}$ or $C_{18:2}$: 1.0% $C_{18:1}$, 1.5% $C_{18:2}$ (LOLL); 1.0% $C_{18:1}$, 2.7% $C_{18:2}$ (LOML); 1.0% $C_{18:1}$, 3.9% $C_{18:2}$ (LOHL); 2.1% $C_{18:1}$, 1.5% $C_{18:2}$ (MOLL); 2.2% $C_{18:1}$, 2.7% $C_{18:2}$ (MOML); 3.3% $C_{18:1}$, 1.5% $C_{18:2}$ (HOLL). Each period had 21 d with last 4 d for sample collection. Data reported were analyzed using the mixed model of SAS (Y = covariate + monensin + parity + monensin × parity + fat + fat × monensin + fat × parity + period + period × monensin + period × parity + production). Monensin feeding did not affect milk fat concentration and yield but decreased the proportion of $C_{<16}$ (21.0 vs. 22.9%), increased the proportion of total $C_{18}$ (49.7 vs. 47.7%), increased the proportion of t-10, c-12 CLA (0.07 vs. 0.05%), and increased the proportion and yield of t-10 $C_{18:1}$ (5.2 vs. 3.5% and 40.0 vs. 28.1 g/d, respectively) in milk FA. As either $C_{18:1}$ or $C_{18:2}$ increased beyond these 2 FA present in LOLL, milk fat concentration and yield and milk $C_{<16}$ yield decreased, and milk t-10 $C_{18:1}$ yield increased. When dietary total FA and FA other than $C_{18:1}$ and $C_{18:2}$ were similar,

$C_{18:2}$-rich diets decreased milk fat yield compared with $C_{18:1}$-rich diets (LOML vs. MOLL; LOHL vs. HOLL), indicating that $C_{18:2}$ is more potent than $C_{18:1}$ on milk fat depression. Increasing dietary FA content from NoFAT to LOLL, which increased primarily $C_{18:1}$ and $C_{18:2}$, reduced the yield of $C_{<16}$ while increasing total $C_{18}$ yield in milk. Few significant monensin × fat interactions were detected on milk composition parameters analyzed.

**Table 1.** Effect of fat blend on dairy cattle performance and milk FA profiles

| | NoFAT | LOLL | LOML | LOHL | MOLL | MOML | HOLL | SEM |
|---|---|---|---|---|---|---|---|---|
| DMI, kg/d | 23.8[ab] | 24.1[a] | 23.3[ab] | 22.6[b] | 23.9[ab] | 23.5[ab] | 23.5[ab] | 0.5 |
| Milk yield, kg/d | 33.7[abc] | 35.8[a] | 34.0[ab] | 30.6[c] | 35.2[ab] | 32.5[bc] | 33.6[abc] | 1.4 |
| Fat yield, kg/d | 1.17[a] | 1.13[a] | 0.84[cd] | 0.74[d] | 0.98[b] | 0.79[d] | 0.91[bc] | 0.04 |
| Fat % | 3.50[a] | 3.17[b] | 2.54[de] | 2.47[e] | 2.88[c] | 2.46[e] | 2.76[cd] | 0.08 |
| Milk FA yield, g/d | | | | | | | | |
| $C_{<16}$ | 364[a] | 289[b] | 164[d] | 116[e] | 216[c] | 135[de] | 172[d] | 15 |
| Total $C_{18}$ | 334[c] | 423[ab] | 416[ab] | 393[bc] | 460[a] | 424[ab] | 466[a] | 22 |
| t-10, c-12 CLA | 0.3[d] | 0.4[cd] | 0.5[bc] | 0.8[a] | 0.4[cd] | 0.6[ab] | 0.5[bcd] | 0.1 |

[a-e]$P < 0.05$.

**Key words:** oleic, linoleic, monensin