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0631 Effect of sunflower seed or sunflower oil as diet supplement on milk production, milk composition, and milk fatty acid profile in lactating goats.

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Seeds are natural source of fats and proteins in dairy animal feed, which contains unsaturated fatty acids. Some of these seeds, especially sunflower seed contain about 40% oil and the oils are protected in the seeds as long as has not been crushed. Given the importance of some of these seeds and oils to improve the performance of the animals and his reproductive activity and also increase the percentage of unsaturated fatty acids in milk specialty conjugated linolenic acid (CLA) which is of great importance to human health. Therefore, in this study we try to investigate the effect of a diet supplemented with sunflower seed or sunflower oil on milk production and composition and also milk fatty acids profile in dairy goats. Fifteen lactating Damascus goats were used in this experiment, starting by the first week of lactation stage through a 90-d period. Goats divided into three aged groups and assigned at random to receive one of three dietary treatments, five animals each, using complete randomized block design. The treatments were 1) control, 2) control +50 g/head/day sunflower seed, and 3) control +20 mL/head/day sunflower oil. Control ration consisted of concentrate feed mixture (CFM):bersem clover (50:50 dry matter bases). Milk was sampled every 2 wk during the experimental period for chemical analysis. Results indicated that experimental additives, especially sunflower oil had significantly increased ($P < 0.05$) milk yield, fat, and lactose contents compared with the control; however, urea nitrogen milk was decreased ($P > 0.05$) by treatments compared to the control. The experimental additives were increased ($P < 0.05$) unsaturated fatty acids in milk specially [C18:2 *trans*-10, *cis*-12] and conjugated linoleic acids (CLA). Moreover all additives increased ($P > 0.05$) C18:3N3 and C18:3N6 (omega 3 and omega6) compared with control. In conclusion, adding either whole sunflower seed or sunflower oil to lactating goats ration had beneficial effects on milk yield and milk composition and so enhance healthy fatty acids (CLA and omega 3) contents in milk, without detrimental effects on animal performance.

Key Words: lactating goats, sunflower, milk composition

0632 The relationship between human daily requirements of CLA, the potential enrichment of milk through cow's nutrition, and daily human consumption.

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Interest in functional foods has increased in recent years, being the enrichment of milk with conjugated linoleic acid (CLA) one of the targeted products. The objectives of this research were: a) to identify the source of human daily recommendations (literature search), b) to determine the effect of feeding strategies on CLA concentration in milk (meta-analysis), and c) to determine current average human intake of CLA and the expected improvement if milk and milk products were consumed in a CLA enriched form (literature search). The most commonly reported intake recommendations for human are 0.8 g/d (from 0.6 to 3.0 g/d). All recommendations have been extrapolated from animal models and the few human studies reported contradictory results. We selected published papers ($n = 69$) where dairy cows were fed different fats and the milk fat content and fatty acid (FA) profile were reported. Treatments were categorized by source (vegetable oils, fish oils or the combination) and method of processing (raw, processed or extruded seeds, and oils). Data were analyzed using meta-analysis techniques. The combination of fish and vegetable oils resulted in the greatest increase (0.61 vs. 1.34 g CLA/100 g FA; $P = 0.01$), but milk fat content decreased (3.61 vs. 3.12%; $P = 0.01$). Linseed increased CLA proportion (0.61 vs. 0.90 g CLA/100 g FA; $P = 0.01$) without affecting milk fat content. The best processing methods to enriched milk with CLA were extruded seeds (0.57 vs. 1.11 g CLA/100 g FA; $P = 0.01$) and oils (0.57 vs. 1.10 g CLA/100 g FA; $P = 0.01$), but extruded seeds decreased milk yield (30.4 vs. 28.9 kg/d; $P = 0.01$) and oils decreased milk fat content (3.61 vs. 3.31%; $P = 0.01$). Considering the changes in CLA and milk fat content, supplementation with fish oils together with vegetable oils would be the best strategy (118% increase). The estimated current average human consumption in Europe, the United States, and Canada is 0.21 g/d, ranging from 0.06 g/d in Portugal to 0.40 g/d in Germany, well below the requirements. If we assume an increase content of 118% in CLA in milk and milk products, average human consumption would increase from 0.21 to 0.46 g/day. Although there is sufficient data on feeding strategies to increase CLA content in milk, human requirements have not been well-established and, based on current recommendations, they are unattainable even if all milk and milk products were consumed as CLA enriched products.

Key Words: conjugated linoleic acid (CLA), dairy products, human requirements

0633 Tolerance study of rumen protected conjugated linoleic acid on dairy cows during the transition and early lactation period. Z. H. Wei*[1], J. S. Shen[1], J. X. Liu[2], Y. J. Zhang[3], and Y. Jiang[3], [1]*Institute of Dairy Science, Zhejiang University, Hangzhou, China,* [2]*Zhejiang University, Hangzhou, China,* [3]*BASF (China) Company Ltd., Shanghai, China.*

The objective of the current study was to investigate the effects of dietary addition of rumen protected conjugated linoleic acids (CLA) on lactation performance and blood biochemical and hematological parameters of dairy cows during transition and early lactation period, and to evaluate the acute toxicity when it was added with the 10-fold of the recommended level. Twenty-seven perinatal Holstein cows were selected based on their parity and milk production of previous lactation and assigned to one of three treatments according to a randomized complete block design: 1) basic diet added with no extra CLA (control), 2) 50 g/d of CLA per head (recommended level), and 3) 500 g/d of CLA per head (10-fold of the recommended level). The CLA used in this trial contained 12.0% of cis-9, trans-11 and 11.9% of trans-10, cis-12 CLA isomer. The experiment started 3 wk before expected calving day and finished at 8 wk after calving. Milk yield was recorded, and milk samples were collected to analyze milk composition weekly. The blood samples were collected on d 21 and 10 prepartum and d 1 and week 1, 2, 4, and 8 postpartum to analyze the blood biochemical and redox parameters. An aliquot of blood samples collected on d 21 prepartum and 8 wk postpartum were used for hematological analysis. Addition of CLA did not exert significant effects on dry matter intake, milk yield, content and yield of milk protein and lactose, and somatic cell count ($P > 0.10$). Compared with control and recommended dose group, CLA addition at 500 g/d significantly reduced content and yield of milk fat, milk urine nitrogen, and total solids content ($P < 0.01$). No significant differences were observed in hematological parameters including red blood cell count, hematocrit, hemoglobin, white blood cell count, and its differential count and percentage, platelet count among groups ($P > 0.10$). Addition of CLA significantly decreased plasma levels of non-esterified fatty acids ($P < 0.05$), which is beneficial for alleviating negative energy balance status of dairy cows. The CLA also tended to improve the total antioxidant capacity ($P = 0.09$). There were no significant differences in plasma glucose, total protein, albumin, globulin-to-albumin ratio, creatinine, alanine transaminase, aspartate aminotransferase, and alkaline phosphatase among the three groups ($P > 0.10$). These results indicated that there is no adverse effects of CLA addition on dairy cows' health even at a 10-fold of recommended dose.

Key Words: conjugated linoleic acids, dairy cows, tolerance

0634 Effect of different dietary fat supplements on milk odd and branched chain fatty acids in dairy cows. E. Baumann*, P. Y. Chouinard, Y. Lebeuf, and R. Gervais, *Université Laval, Québec, Canada.*

The odd and branched chain fatty acid (OBCFA) profile of milk has emerged as an interesting, noninvasive option for evaluating rumen function. These fatty acids (FA) are synthesized by different ruminal microbe populations, absorbed in the intestine, and taken up by the mammary gland to be incorporated in milk fat. Lipid supplementation in lactating cows could affect different steps in these processes, as dietary FA have been reported to inhibit (step i) microbial growth, and (step ii) de novo microbial FA synthesis in the rumen, and to increase (step iii) the uptake preformed FA from dietary origin by mammary gland. Such phenomena could reduce synthesis and secretion of OBCFA, and thereby, when cows receive high fat diets, interfere with previously established relationships between these milk FA. To assess the influence of dietary lipids on milk OBCFA, eight Holstein cows (101 ± 11 DIM) were used in a double 4 × 4 Latin-square design with 14-d periods. Treatments were infusion of: CTL) fat-free emulsion in the rumen; SBR) 450 g emulsified unsaturated FA (soybean oil) in the rumen (putative effects on steps i, ii and iii); EBR) 450 g emulsified saturated FA (EnergyBooster) in the rumen (putative effects on steps ii and iii); and EBA) 450 g emulsified saturated FA in the abomasum (putative effects on step iii). Contrasts compared CTL to SBR, SBR to EBR, and EBR to EBA. The results indicate that dietary lipids do affect expression of various milk OBCFA; these effects would need to be considered in the development of models aiming to predict rumen parameters based on milk OBCFA.

Key Words: milk fat synthesis, odd and branched chain fatty acids, dietary lipids

Table 0634. Milk fat concentrations (mg/g) of individual OBCFA

					P-value		
Fatty acid	CTL	SBR	EBR	EBA	CTL vs. SBR	SBR vs. EBR	EBR vs. EBA
iso13:0	0.31	0.26	0.24	0.25	0.01	0.23	0.79
anteiso13:0	0.22	0.16	0.22	0.15	0.05	0.02	0.01
13:0	1.24	1.04	1.05	1.00	< 0.01	0.79	0.35
iso14:0	1.36	1.47	1.40	1.74	0.20	0.40	< 0.01
iso15:0	1.90	1.66	1.68	1.79	< 0.01	0.58	0.02
anteiso15:0	8.17	7.50	7.48	7.92	0.05	0.95	0.19
15:0	12.2	10.2	10.7	10.6	< 0.01	0.18	0.69
iso16:0	3.51	3.44	3.45	4.26	0.82	0.96	0.02
iso17:0	1.12	1.27	1.24	1.30	0.04	0.64	0.34
anteiso17:0	3.34	2.85	3.49	3.53	< 0.01	< 0.01	0.71
17:0	4.80	4.28	6.21	6.18	< 0.01	< 0.01	0.81
*c*9–17:1	1.46	1.32	1.71	1.74	0.01	< 0.01	0.46
iso18:0	0.17	0.17	0.24	0.16	0.74	< 0.01	< 0.01

0635 Feeding incremental levels of ground flaxseed increased n-3 fatty acids and conjugated linoleic acids in organically-managed jersey cows.

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We reported previously that feeding incremental levels of ground flaxseed (GFLAX) linearly reduced DMI, milk production, and contents and yields of milk components. Flaxseed is a high-energy oilseed rich in α-linolenic acid. It is well established the impact of flaxseed on changing milk fatty acids (FA) profile but there is limited research about the effects of GFLAX on milk FA composition, particularly in cows fed high-forage diets. In a recent needs assessment of research and educational needs of the organic dairy industry in the Northeast 84% of respondents indicated the development of value-added dairy products as one of the most pressing areas for dairy research (Pereira et al., 2013 JDS 96:7340–7348), thus justifying additional studies with flaxseed. Twenty organically managed Jersey cows (425 ± 37 kg of BW and 111 ± 62 DIM) in the beginning of the study were blocked by milk yield and parity and randomly assigned to treatment sequences in five replicated 4 × 4 Latin squares to investigate the effects of incremental levels of GFLAX (0, 5, 10, or 15% diet DM) on milk FA composition. All cows were fed TMR containing (% of diet DM): 55% alfalfa-grass baleage, 8% grass hay, and 37% concentrate; soybean meal (from 6 to 2% of diet DM) and corn meal (from 27 to 16% of diet DM) were replaced with GFLAX (from 0 to 15% of diet DM), while roasted soybean (2% of diet DM) was maintained constant across treatments. Diets were isonitrogenous (mean = 18.3% CP), but crude fat increased from 3.8 to 7.4% when replacing soybean meal and corn meal with GFLAX. Milk concentration (% of total milk FA) of total n-3 FA (0.74 to 1.42%), *t*C18:1 (1.35 to 2.63%), *c*9, *t*11 CLA (0.47 to 0.87%), total CLA (0.55 to 1.08%), total monounsaturated FA (21.9 to 34.3%), and total polyunsaturated FA (2.87 to 4.72%) increased linearly in response to increasing levels of GFLAX. Conversely, milk concentrations of n-6 FA (1.78 to 1.49%) and total saturated FA (72.7 to 58.1%), and the n-6 to n-3 ratio (2.42 to 1.06) declined linearly with increasing levels of GFLAX. Quadratic effects were observed for total n-3 FA, *t*C18:1, *c*9, *t*11 CLA, total CLA, and the n-6 to n-3 ratio. It can be concluded that GFLAX is an effective supplement to enrich milk with bioactive FA of potential health benefits for humans.

Key Words: flaxseed, organic dairy cows, milk fatty acids

0636 Lactational responses to palmitic acid supplementation when substituted for soyhulls or corn grain. C. L. Preseault, J. P. Boerman, and A. L. Lock*, *Michigan State University, East Lansing.*

Effects of a palmitic acid-enriched fat supplement (PA; 87% C16:0) when replacing soyhulls or corn grain on feed intake and metabolic and production responses of dairy cows were evaluated. Twenty-four Holstein cows (185 ± 70 DIM) were randomly assigned to treatment sequence in a 3 × 3 Latin square design. Treatments were a control diet (CON; no added PA), 1.5% added PA with soyhulls replaced (PA-SH), or 1.5% added PA with corn grain replaced (PA-CG). Treatment periods were 21 d, with the final 5 d used for sample and data collection. The study was conducted from June through August 2013 when temperature-humidity index in the barn averaged 70.5 ± 5.7°F. The corn silage and alfalfa silage-based diets contained 20.0% forage NDF and 16.8% CP. The statistical model included the random effect of cow and fixed effects of period and treatment; preplanned contrasts evaluated the effect of PA treatments (CON vs. 1/2[PA-SH+PA-CG]) and the effect of PA-SH vs. PA-CG. The PA treatments increased milk fat concentration (3.55, 3.65, and 3.71%; $P < 0.01$) and yield (1.38, 1.49, and 1.42 kg/d; $P < 0.05$) for CON, PA-SH, and PA-CG, respectively. Compared with CON, there was no effect of PA treatments on DMI, milk yield, milk protein yield, or ECM ($P > 0.18$). However, compared with PA-CG the PA-SH treatment increased DMI 1.35 kg/d, milk yield 2.38 kg/d, milk protein yield 0.08 kg/d, and ECM 2.26 kg/d ($P < 0.05$). The PA treatments increased feed efficiency (ECM/DMI), 1.46, 1.51, and 1.50 for CON, PA-SH, and PA-CG, respectively ($P < 0.05$). Compared with CON, PA treatments increased the yield of 16-carbon milk FA by 83 g/d ($P < 0.01$) but did not affect the yield of de novo ($P = 0.38$) or preformed ($P = 0.71$) milk FA. There was a trend for increased yield of de novo (21 g/d; $P = 0.07$) and preformed (27 g/d; $P = 0.10$) milk FA for PA-SH vs. PA-CG. The PA treatments did not alter BW ($P = 0.42$) or BCS ($P = 0.99$); however, PA-SH increased BW 9.5 kg vs. PA-CG ($P < 0.05$). There was no effect of PA treatments on plasma concentrations of glucose ($P = 0.92$) or insulin ($P = 0.57$), whereas PA treatments increased NEFA (99.5, 110, and 109 uEq/L for CON, PA-SH, and PA-CG, respectively; $P < 0.01$). Treatment had no effect on rectal temperature or respiration rate ($P > 0.46$). Results demonstrate that a PA-enriched fat supplement increased milk fat concentration and yield and feed efficiency. Responses were greater when PA replaced soyhulls rather than corn grain.

Key Words: fat supplementation, milk fat, palmitic acid

0637 Interaction between culture pH and corn oil concentration on NDF digestibility and biohydrogenation of unsaturated fatty acids in batch culture. Y. Sun*, M. S. Allen, and A. L. Lock*, Michigan State University, East Lansing.*

Effects of culture pH and corn oil (CO) concentration on NDF digestibility (NDFD) and biohydrogenation (BH) of unsaturated fatty acids (FA) in batch culture were evaluated in a 2 × 3 factorial design. Cultures (4/treatment/time point) included alfalfa hay plus increasing concentrations of CO (0, 1, 2% DM) incubated at culture pH 5.8 or 6.2 for 0, 6, 12, 18, and 24 h. Effects of culture pH, CO, time, and their interactions were determined. Increasing CO in cultures increased total FA concentration which averaged 2.19, 3.36, and 4.54% DM for 0, 1, 2% CO, respectively ($P < 0.001$). Culture pH did not affect total FA concentration ($P = 0.29$). Main effects of treatments (culture pH and CO concentration) across time were significant for the response variables of interest despite significant ($P < 0.10$) interactions (both two-way and three-way interactions) for these variables. Lower culture pH reduced NDFD across CO treatments and time (11.6 vs. 21.6%; $P < 0.001$), whereas increasing CO increased NDFD across pH treatments and time (14.2, 16.9, and 18.8%; $P < 0.001$); NDFD increased over time for all treatments ($P < 0.001$). Addition of CO increased the concentration of *cis*-9, *cis*-12 18:2 across pH treatments and time (7.88, 17.4, 23.0 g/100 g FA; $P < 0.001$) and higher culture pH reduced its concentration across CO treatments and time (13.8 vs. 18.4 g/100 g FA; $P < 0.001$). Lower culture pH reduced BH extent for *cis*-9, *cis*-12 18:2 (34.4 vs. 53.0%; $P < 0.001$), which increased with time ($P < 0.001$) and was affected to a lesser extent by increasing CO (43.0, 45.3, and 42.7%; $P < 0.001$ quadratic). Lower culture pH and increasing CO reduced the concentration of 18:0 (20.1 vs. 24.9 g/100 g FA and 28.7, 21.7, and 17.1 g/100 g FA, respectively; $P < 0.001$). Lower culture pH increased the concentration of *trans*-10 18:1 (1.04 vs. 0.73 g/100 g FA; $P < 0.001$) and reduced the concentration of *trans*-11 18:1 (4.73 vs. 6.11 g/100 g FA; $P < 0.001$) across CO treatments and time. Increasing CO increased the concentration of *trans*-10 18:1 (0.72, 0.92, and 1.03 g/100 g FA; $P < 0.001$) and *trans*-11 18:1 (3.46, 5.85, and 6.95 g/100 g FA; $P < 0.001$) across pH treatments and time. In conclusion, higher culture pH increased NDFD, BH of *cis*-9, *cis*-12 18:2, and formation of *trans*-11 18:1. Increasing the inclusion of CO increased the formation of BH intermediates as well as NDFD (unexpectedly). Treatments interacted with each other and with time for all variables of interest, particularly formation of *trans*-10 and *trans*-11 18:1.

Key Words: batch culture, biohydrogenation, digestibility

0638 Feed intake and production responses of lactating dairy cows when commercially available fat supplements are included in diets: a meta-analysis. J. P. Boerman* and A. L. Lock, *Michigan State University, East Lansing.*

This analysis was performed to evaluate the effects of commercially available fat supplements on DMI and production responses of lactating dairy cows. Available data were collected from 133 peer-reviewed publications; of which 88 met our selection criteria, comprising 159 treatment comparisons. Calcium-salts of palm fatty acid distillate (PFAD; $n = 73$), saturated prilled fats (PRILLS; $n = 37$), and tallow ($n = 49$) supplemented at $\leq$ 3% diet DM were compared to nonfat supplemented diets used as controls. Analysis was performed using Comprehensive Meta Analysis v2 software to calculate the effect size as the mean difference in least square means between control and fat supplemented treatments using a random effects model. Treatment comparisons were obtained from either randomized design ($n = 99$) or crossover/Latin square design experiments ($n = 60$). There were no differences in the overall effect of fat supplementation between randomized design and crossover/Latin square design experiments for any production parameter (all $P > 0.46$). Therefore, all types of experimental design were analyzed together. Fat supplementation reduced DMI compared to control (0.30 kg/d, $P < 0.01$). However, the response was dependent on fat type; PFAD and tallow reduced DMI (0.58 and 0.44 kg/d, $P < 0.01$ and $P = 0.06$, respectively), while PRILLS had no effect ($P = 0.71$). Fat supplementation increased milk yield by 1.05 kg/d ($P < 0.01$), with differences in the magnitude of response for PFAD (1.20 kg/d, $P < 0.01$), PRILLS (1.19 kg/d, $P < 0.01$), and tallow (0.70 kg/d, $P < 0.01$). Fat supplementation increased milk fat yield by 0.04 kg/d ($P < 0.01$) with increases of 0.05 and 0.06 kg/d for PFAD and PRILLS, respectively (both $P < 0.01$) with no effect of tallow ($P = 0.72$) compared to control. There was no overall effect of fat supplementation on milk fat concentration ($P = 0.84$), although compared with control, tallow reduced milk fat by 0.08% units ($P = 0.01$), PFAD had no effect ($P = 0.25$), and PRILLS increased milk fat by 0.08% units ($P = 0.05$). Milk protein yield was unaffected by PFAD and tallow (both $P > 0.31$) and increased by 0.03 kg/d by PRILLS ($P < 0.01$) resulting in an overall increase by fat supplementation of 0.01 kg/d ($P < 0.01$). Milk protein concentration was reduced by all fat supplements ($P < 0.01$ for PFAD and tallow; $P = 0.04$ for PRILLS) for an overall reduction in milk protein concentration of 0.05% units ($P < 0.01$). In conclusion, fat supplementation has the potential to reduce DMI and increase the yield of milk and milk components. However, consideration should be given to the type of fat, as production responses were highly variable across fat supplements.

Key Words: fat supplementation, meta-analysis, production response

0639 Effect of dietary fat source on milk production and milk composition in early lactation cows in a continuous trial design. G. Ma*[1], J. H. Harrison[2], E. Block[3], and L. VanWieringen[4], [1]*Washington State University, Pullman,* [2]*Washington State University, Puyallup,* [3]*Church and Dwight Animal Nutrition, Ewing, NJ,* [4]*Washington State University, Sunnyside.*

This study was designed to look at two dietary fat sources (Megalac and Palmit 80) when fed at amounts to deliver fatty acids at ~ 0.22 kg/d. Twenty-four multiparous dairy cows in early lactation (average DIM = 68) were used to compare the temporal relationship of DMI, milk production, milk composition, body weight, and BCS. Cows were fed individually via Calan headgates. Data from wk 1 to 2 was averaged and used as a covariate period, and cows were fed Megalac as the only source of supplemental fatty acids. During wk 3 to 12, 12 cows were fed the Megalac diet at 1.15% DM, and 12 cows were fed the Palmit 80 diet at 0.93% DM. Milk production was obtained 2x/d and 1x/wk an AM-PM composite of milk was obtained from each cow and analyzed for composition. Data were analyzed with PROC MIXED of SAS with repeated measurements using a model that included treatment, week, treatment x week. There was no treatment x week interaction ($P > 0.1$). The covariant played a significant role in the adjustment ($P < 0.05$). In this study, there was no significant difference between sources of supplemental fat on milk production, 39.2 vs. 40.0 kg; DMI, 29.2 vs. 29.1 kg; milk fat %, 4.3 vs. 4.3%; milk protein %, 2.91 vs. 2.98% ($P < 0.09$); milk fat yield, 1.65 vs. 1.74 kg; BCS, 2.81 vs. 2.80; BW, 668 vs. 677 kg; or BW change, 11.7 vs. 9.5 kg (Megalac vs. palmit 80, $P > 0.1$). Milk protein yield was greater 1.13 vs. 1.19 kg ($P = 0.002$) when cows consumed Palmit 80. A previously reported trial of similar design (J. Dairy Sci. 96 (Suppl.E):Abstr. W29) showed higher production by cows fed Megalac vs. Palmit 80. In that trial, cows were earlier in DIM at the start of the study. A hypothesis is that cows at different stages of lactation use individual fatty acids differently due to metabolic status.

Key Words: milk fat, dietary fat, fatty acids

0640 Farm survey: Milk fatty acid composition measured by mid-infrared. D. M. Barbano*[1,2], C. Melilli[1,2], and T. R. Overton[3], [1]*Cornell University, Ithaca, NY,* [2]*Northeast Dairy Foods Research Center, Ithaca, NY,* [3]*Cornell University, Dep. of Animal Science, Ithaca, NY.*

Our objectives were: 1) measure fatty acid (FA) composition of individual herd milks using new chemometric models for mid-infrared (IR) milk analysis and 2) determine if there were correlations between milk FA composition and bulk tank milk fat and protein tests. Bulk tank milks from 430 farms were tested multiple times per month for 14 mo by mid-IR (Lactoscope FTA, Delta Instruments) for fat, protein, and FA composition. The IR instrument could test about 100 samples per hour. Data were organized in two groups: Jersey and Holstein. A variety of individual FA and groups of FA were measured. Validation of IR FA results was done by GLC. The key FA parameter that was positively correlated with bulk milk fat and protein concentration was de novo FA (g/100 g milk). Structural parameters of FA chain length (carbon number) and total unsaturation (double bonds/FA) were negatively correlated with fat and protein (g/100 g milk). This was true for both Jersey and Holstein. When de novo FA (relative % of FA) were higher, fat test was higher for both Jersey and Holstein. As de novo FA (g/100 g milk) increased, fat (g/100 g milk) increased ($P < 0.001$) at a much faster rate (i.e., higher slope) than when preformed FA (g/100 g milk) increased (slope 2.28 vs. 1.29) for Jersey and (slope 2.16 vs. 1.22) for Holstein, for de novo vs. preformed, respectively. As the proportion of de novo increased (and fat percent increased), the measured FA chain length and double bonds per FA decreased ($P < 0.001$). True protein (g/100 g milk) increased as de novo FA (g/100 g milk) increased. We hypothesize that feeding and farm management practices influenced de novo FA production and milk fat and protein (g/100 g milk). A group of 20 Jersey and 20 Holstein farms of interest that had a wide range of de novo FA (g/100 g fat) were selected for a more in-depth field study, in the next year, to determine if there are cost effective feeding and management practices that can be used to increase fat and protein tests. During the 14-m period of our study, the 10 Holstein and 10 Jersey low de novo herds averaged 3.62 and 3.97% fat and 2.99 and 3.15% true protein, while the 10 high de novo Holstein and Jersey herds averaged 3.92 and 4.80% fat and 3.09 and 3.62% true protein, respectively.

Key Words: mid-infared milk analysis, de novo fatty acids, fat and protein concentration

0641 The effects of high rates protected fat in rations of high yielding dairy cows on production efficiency and digestibility. U. Moallem*[1], E. Frank[1,2], M. Zachut[1], L. Livshitz[1], and A. Arieli[2], [1]*Institute of Animal Science, Volcani Center, Bet Dagan, Israel,* [2]*Faculty of Agriculture, Hebrew University, Rehovot, Israel.*

Due to the rise in grain price, there is an increased use of fat in rations of dairy cows in Israel; however, the effects of high rates have never been examined in the Israeli rations. Therefore, the objectives were to determine the effects of increasing rate of calcium soap of fatty acids (CSFA) on yields, efficiency and digestibility. Forty-two multiparous dairy cows were divided into three treatment groups according to milk, parity and days in milk (DIM), and fed diets containing: (i) low fat (LF), 4.7% ether extracts (EE; 1.7% CSFA); (ii) moderate fat (MF), 5.8% EE (2.8% CSFA), and (iii) high fat (HF), 6.8% EE (3.9% CSFA). The diets were isonitrogenous (16.5%), but energy content was 1.8 in the HF compared to

1.78 Mcal/kg DM in the LF and MF diets. Rumen samples were taken three times in 1 d (2 h pre-feeding, at feeding, and 2 h post-feeding) for pH and rumen measurements. The data were analyzed using the PROC MIXED model of SAS and the model included parity, DIM, and related covariate data. No differences were observed in milk and FCM (4%) yields or fat and lactose percentages and yields among groups. A trend of decreased protein percentage in milk with increasing EE content in diet was observed ($P < 0.08$), and higher protein yields were observed in LF and MF than in HF. No differences were observed in dry matter intake (DMI) or energy intake among groups. Efficiency of converting DMI to milk was also similar, but conversion of DMI into FCM (4%) was higher in MF and HF than in LF. Rumen pH was higher in MF and HF than in LF, with no differences in rumen ammonia concentrations. Total VFA concentration in rumen was higher in LF than in MF and HF groups, and apparent digestibility of DM and organic matter (OM) was higher in the LF than in both other groups. In conclusion, although apparent digestibility of DM and OM was lower in MF and HF, no detrimental effects of high rate of CSFA supplementation (up to 3.9% of the diet) on milk yields and efficiency were observed.

Key Words: CSFA, digestibility, efficiency

0642 Long chain fatty acids alter expression of genes involved in lipid metabolism in goat mammary epithelial cells partly through PPARγ. W. Zhao[*1,2], M. Bionaz[3], J. Luo[1], A. Hosseini[4], P. Dovc[5], and J. J. Loor[2], [1]*Northwest A & F University, Yangling, China,* [2]*University of Illinois, Urbana,* [3]*Dep. of Animal and Rangeland Sciences, Oregon State University, Corvallis,* [4]*University of Bonn, Germany,* [5]*University of Ljubljana, Domzale, Slovenia.*

Data from dairy cows and goats indicate a prominent role of PPARγ in regulating milk fat synthesis (MFS). The PPARγ binds and is activated by long-chain fatty acids (LCFA), hence is amenable for fine-tuning MFS. Previous data in MacT cells indicated an agonistic capacity of saturated LCFA but also the potential of LCFA to act through alternative transcriptional regulators. To determine the specificity of LCFA in modulating PPARγ in goats, triplicate cultures of primary mammary cells from Saanen goats cultivated in lactogenic medium were cultured for 24 h with 50 μM of the specific PPARγ activator rosiglitazone (ROSI) or the specific PPARγ inhibitor GW9662 (GW), 100 μM of several LCFA (16:0, 18:0, t10,c12-CLA, DHA, and EPA), and a combination of GW with each of LCFA (for a total of 12 treatments excluding controls). Expression of 28 genes involved in MFS plus three internal control genes was measured using qPCR. Data were log-transformed and statistically analyzed using the GLM of SAS. The multiple comparisons were corrected using Tukey's test and significance set at $P < 0.05$. The cells treated with GW alone allowed uncovering that a minimum activation of PPARγ is essential for the expression of LPIN1, PPARG, LXRA, LPL, ACSL1, FABP3, and FABP4. The combination of the data from GW and ROSI treatments allowed identification of SCD, FADS1, NR1H3, SREBF1, INSIG1, LPL, FABP3, and FABP4 as strong PPARγ target genes. The 16:0 and 18:0 had the strongest effect on most of the measured genes and stronger than ROSI. Among the unsaturated LCFA, the CLA had the strongest effect in decreasing expression of FASN, FADS1, LPIN1, SREBF1, SREBF2, INSIG1, RXRA, NCOR1, and FABP3. The combination with GW diminished but did not completely eliminate the effect of saturated LCFA and interacted in a complex manner with the effect of unsaturated LCFA. The expression of AGPAT6, PLIN2, and CD36 increased in all treatments compared with control. The expression of NR1H3 solely responded to ROSI and GW but not to LCFA. Results allowed pinpointing true PPARγ target genes in goat mammary cells, and confirmed that saturated LCFA are potent PPARγ agonists in ruminants but that they act also through alternative transcriptional factors. Data established the lipid-depressing effect of unsaturated LCFA, particularly CLA. A complex mechanism for LCFA in regulating expression of lipid-related genes in goat mammary cells was uncovered.

Key Words: nuclear receptors, milk fat synthesis, nutrigenomics