mid growth phase for the tip (38.4 ± 0.3 °C) to have a higher DITI than the base (37.9 ± 0.2 °C) of the antler. In contrast, during the late growth period, DITI was higher (P<0.001) at the base (36.8 ± 0.3 °C) than at the tip (35.7 ± 0.3 °C) of the antler. During the time of VA growth, SC was positively correlated with BW (R=0.70, P<0.001), and increased (P<0.001) from 15.9 ± 0.5 cm on d 0 to 20.5 ± 0.7 cm on d 112. In addition, BW increased (P<0.001) from 113.0 ± 5.4 kg on d 0 to 137.2 ± 6.9 kg on d 112. In conclusion, VA thermogenesis patterned VA growth with higher VA temperatures occurring during the early and mid growth periods, and lower VA temperatures occurring during the late growth period when VA growth began to cease. This suggests that DITI measurements may have value in determining the period of peak VA growth.

Key Words: Red Deer, Velvet antler, Digital infrared thermography

572 Relationship between placental characteristics, delivery parameters and placental retention. A. L. Riddle*[1], H. D. Tyler[1], and J. D. Quigley[2], [1]*Iowa State University, Ames, IA,* [2]*APC Company, Inc., Ames, IA.*

Retained placenta and dystocia are increasing problems within the dairy industry. Optimal delivery conditions can improve overall health status of the calf and dam, along with reducing the incidence of retained placenta. The objectives of this experiment were to determine placental factors that may be associated with dystocia and retained placenta. Calves (n=70) and placentae (n=44) were obtained from Holstein cattle following parturition. Delivery parameters include calving ease scores, duration of parturition, calf weight and parity. Placental characteristics evaluated after expulsion included color index (1-light to 5-dark) of cotyledons located at center and tips of placenta, cotyledon number, placental weight and length of umbilical stump. After delivery, calves were weighed, blood samples were collected to evaluate hematocrit, and the length and diameter of umbilical cords were measured. Multiple regression was used to identify explanatory variables associated with each response variable. Response variables included placental expulsion time, duration of calving, calf weight and calving ease scores (CES). The only factor that significantly affected placental expulsion time was umbilical cord break point (p<0.05). Factors that affected duration of calving included parity (p<0.01), diameter of umbilical stump (p<0.01), calf weight (p<0.0001), total length of umbilical cord (p<0.05) and calf umbilical cord efficiency (calf weight/diameter of umbilical stump) (p<0.0001). Factors affecting CES included color index in center of placenta (p<0.01), color index in tips of placenta (p<0.01), diameter of the umbilical stump (p<0.01), cotyledon number (p<0.05), and umbilical cord break point (p<0.01). Finally, the only factor that affected calf weight was weight of the placenta (p<0.05). The data strongly reflects the relationship between placental factors and delivery parameters.

Key Words: Retained placenta, Calf, Parturition

573 The effect of using of Ovsynch with supplemental GnRH on pregnancy rates of Holstein heifers in the tropics. R. W. Godfrey, R. E. Dodson*, A. J. Weis, and O. T. Isles, *University of the Virgin Islands, Agricultural Experiment Station, St. Croix.*

This study was conducted to evaluate the effect of GnRH given after artificial insemination (AI; day 0) on pregnancy rate (PR) of synchronized Holstein heifers at two times of the year. Heifers were synchronized using Ovsynch in April-May (Spring; n = 30; 16.4 ± 0.2 mo of age) or September-October (Fall; n = 20; 20.2 ± 0.3 mo of age) of 2002. Control heifers (n = 10 per season) received Ovsynch only. In the Spring 10 heifers received GnRH (750 iu, i.m.) on d 5. In the Fall and Spring 10 heifers received GnRH on d 5 and 11. Pregnancy was determined on d 45 by palpation. Rectal temperature (RT) of all heifers was measured for 10 d before and 30 d after AI. Ambient temperature, relative humidity (RH) and temperature humidity index (THI) were measured during this time using data loggers. Percentage of black hair coat (BHC) was determined using image analysis software (Sigma Scan 5.0). Heifers were categorized as dark (> 50% BHC) or light (< 50% BHC). Data were analyzed using GLM procedures of SAS. Ambient temperature and THI were lower (P < 0.05) in the Spring than in the Fall (26.9 ± 0.1 °C and 76.8 ± 0.1 vs 29.1 ± 0.1 °C and 80.1 0.1, respectively) but RH was not different (P > 0.10; 71.9 ± 0.4 vs 72.7 ± 0.4 %, respectively). There was no effect of GnRH treatment or season (P > 0.10) on PR. Heifers had higher RT (P < 0.0001) in the Fall than in the Spring (40.0 ± 0.05 vs 39.5 ± 0.05 °C, respectively). Dark heifers had a lower PR (P < 0.03) than light heifers (42.5 vs 80.0 %, respectively). In the Fall pregnant heifers had lower BHC (P < 0.02) than open heifers (58.8 ± 5.4 vs 77.6 ± 5.7 %, respectively) but there was no difference in the Spring. These results indicate that there is no beneficial effect of supplemental GnRH given post-AI on pregnancy rates of heifers synchronized using Ovsynch. Coat color of heifers had an effect on pregnancy with light colored heifers having a higher PR. Selecting of light colored dairy cattle may be a way of enhancing pregnancy rates under tropical conditions.

Key Words: Heifer, Coat color, Pregnancy

574 The effect of hair coat color on rectal and surface temperatures of Holstein heifers in the tropics. R. W. Godfrey, O. T. Isles*, A. J. Weis, and R. E. Dodson, *University of the Virgin Islands, Agricultural Experiment Station, St. Croix.*

This study was conducted to evaluate the impact of the environment and coat color on rectal and surface temperatures of Holstein heifers. Heifers were evaluated for 40 d during April-May (Spring; n = 30; 16.4 ± 0.2 mo of age) and September-October (Fall; n = 20; 20.2 ± 0.3 mo of age). Ambient temperature, relative humidity (RH) and temperature humidity index (THI) were measured at 10-min intervals using data loggers. Rectal temperature (RT) of heifers was measured every other day. Coat surface temperature (CST) of white and black coat of heifers was measured every other day only during the Fall using an infrared thermometer. Percentage of black hair coat (BHC) was determined using image analysis software (Sigma Scan 5.0). Heifers were categorized as dark (> 50% BHC) or light (< 50% BHC). Data were analyzed using GLM and correlation procedures of SAS. Ambient temperature and THI were lower (P < 0.05) in the Spring than in the Fall (26.9 ± 0.1 °C and 76.8 ± 0.1 vs 29.1 ± 0.1 °C and 80.1 ± 0.1, respectively) but RH was not different (P > 0.10) between Spring and Fall (71.9 ± 0.4 vs 72.7 ± 0.4 %, respectively). Mean and median BHC were 67.6 and 73.3 %, respectively. Heifers had higher (P < 0.0001) RT in the Fall than in the Spring (39.8 ± 0.06 vs 39.2 ± 0.03 °C, respectively). Dark heifers had higher RT (P < 0.0004) than light heifers (39.6 ± 0.03 vs 39.4 ± 0.06 °C, respectively). The CST of black coat was 4.1 ± 0.2 °C higher (P < 0.0001) than CST of white coat. The CST of black coat of dark heifers was higher (P = 0.05) than that of light heifers (43.5 ± 0.2 vs 42.4 ± 0.5 °C, respectively), but CST of white coat was not different (P = 0.08) between dark and light heifers (39.3 ± 0.2 vs 38.6 ± 0.3 °C, respectively). There was a low correlation (P < 0.01; r = 0.175) between RT and CST of white coat but not with CST of black coat (P > 0.10; r = 0.069). The higher RT of dark heifers suggests that selection for white coat color may be useful in mitigating effects of heat stress in dairy cattle in hot climates.

Key Words: Heifer, Coat color, Environment

Ruminant Nutrition: Fats and fatty acids

575 Conjugated linoleic acid (CLA) and milk production. M. A. McGuire*[1] and J. M. Griinari[2], [1]*University of Idaho, Moscow,* [2]*University of Helsinki, Finland.*

Dairy products are an important source of nutrients in the human diet. However, many scientists view dairy fat unfavorably due to the risk of coronary heart disease. A substantial body of literature now demonstrates that fatty acids in dairy fat possess important benefits to human health. Conjugated linoleic acid (CLA) and its precursor, trans-11 C18:1 or vaccenic acid, have been shown to be potent anticarcinogens in various cancer models, and dietary intake and plasma concentrations of these fatty acids are related to a reduced risk of breast cancer. Enhancing the concentrations of CLA in bovine milk would improve the healthful nature of milk fat as well as the perception by the consumer. Conjugated linoleic acid refers to a family of 18 carbon fatty acids with 2 double bonds separated by a single bond. Many isomers exist that arise from biohydrogenation of polyunsaturated fatty acids in the rumen. Desaturation of vaccenic acid within mammary tissue is the main source of cis-9, trans-11 CLA, the principal CLA in milk fat, shown to have anticarcinogenic effects. Another isomer is trans-10, cis-12 CLA produced

in the rumen under conditions that promote milk fat depression. The trans-10, cis-12 CLA potently inhibits lipogenesis as well as reduces tumor formation. Many studies have outlined potential nutritional methods, from altering forage to concentrate ratio to supplementation with various oils, to enrich milk fat with cis-9, trans-11 CLA. The feeding strategies that boost milk fat CLA also increase trans fatty acid content of milk. Although, the increase is attributable mostly to an increase in vaccenic acid, it is not clear how CLA-enriched milk products would be viewed by new food labeling rules. Additionally, feeding a rumen-protected CLA may soon be available. One could enrich milk fat with cis-9, trans-11 CLA to supply a healthy milk niche market, although other feeding methods may be more cost effective. Alternatively, one could provide trans-10, cis-12 CLA to cause milk fat depression. This strategic use may be a tool for management to control energy output or meet milk fat quotas. Vaccenic acid and CLA are minor fatty acids in milk fat important for human health.

Key Words: Milk fat, Conjugated linoleic acid, Vaccenic acid

576 The challenges of supplying omega fatty acids to body tissues of cattle to meet critical metabolic and physiologic functions. T. C. Jenkins* and A. AbuGhazaleh, *Clemson University, Clemson, SC 29634.*

The omega system of describing the double bond position in a fatty acid chain designates the number of carbons between the methyl end of the chain and the closest carbon having a double bond. Oleic acid (omega-9), linoleic acid (omega-6), and linolenic acid (omega-3) with one, two and three double bonds, respectively, are found in low concentrations (mg/g DM) in cereal grains and forages, but in high concentrations in vegetable oils. Fish oils contain high concentrations of two unique omega-3 fatty acids referred to as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) with five and six double bonds, respectively. Tissue desaturases can synthesize omega-9 fatty acids, but not all of the omega-3 or omega-6 acids. Because the omega-3 and omega-6 fatty acids are required for the synthesis of prostaglandins and other physiological regulators, but cannot be synthesized by body tissues, they must come from dietary sources and are considered essential. Even when omega fatty acids are fed to cattle in vegetable or fish oils, their intestinal absorption remains low because of biohydrogenation by ruminal microorganisms. Despite extensive biohydrogenation in the rumen, it is often accepted that cattle fed "normal" diets do not show signs of essential fatty acid deficiency. This assumption has been challenged in recent years based on results that show positive metabolic changes, such as improved reproductive performance, when cattle were fed fat sources high in omega-3 or omega-6 fatty acids. Aside from determining the type and amount of omega fatty acid needed for optimal tissue function, a major challenge is regulating ruminal biohydrogenation to deliver the desired quantity of omega fatty acid at the proper time. Information needed to meet this challenge includes describing in more detail the pathways of biohydrogenation including all intermediates and end products, how the pathways are influenced by environmental conditions in the rumen that accompany diet changes, determining how fatty acid structure can be altered chemically or physically to increase protection from biohydrogenation, and exploring the use of molecular techniques to establish microbial species with altered biohydrogenation activities.

Key Words: Omega fatty acids, Biohydrogenation, Ruminants

577 Increasing milk fat *cis*-9, *trans*-11 Conjugated Linoleic Acid content in pasture-fed cows. J. K. Kay*[1], J. R. Roche[1], N. A. Thomson[1], J. M. Griinari[2], and K. J. Shingfield[3], [1]*Dexcel, New Zealand,* [2]*University of Reading, UK,* [3]*University of Helsinki, Finland.*

More than 90% of *cis*-9, *trans*-11 conjugated linoleic acid (CLA) secreted in the milk of grazing cows is produced from endogenous conversion of *trans*-11 18:1 in the mammary gland. Attempts to manipulate milk fat CLA content in grazing cows have been relatively unsuccessful. This study examined the potential of feeding lipid supplements for 4 weeks to increase milk fat CLA content of cows at pasture. Twenty-eight multiparous Friesian cows in mid lactation were randomly allocated to 1 of 4 dietary treatments; pasture alone (P), or pasture supplemented with 150 g/d fish oil (FO), 350 g/d sunflower oil (SO) or 150 g/d fish oil and 350 g/d SO (FSO). Milk yield and milk protein output were not affected by lipid supplements. Milk protein and fat content and milk fat yield were decreased ($P<0.05$) by FO and SO supplements. Milk fat concentrations of *trans*-10 and -11 18:1 and *cis*-9, *trans*-11 CLA were all increased ($P<0.05$) in response to FO, SO and FSO treatments. The increase in *trans*-11 18:1 and decrease ($P<0.01$) in milk fat 18:0 content suggests that FO supplements inhibited the reduction of *trans* 18:1 fatty acids in the rumen. On the basis of milk fatty acids responses, it appears that *trans*-11 18:1 production in the rumen can be further enhanced when SO is used in combination with FO. In conclusion, fish oil alone or in combination with sunflower oil can be used as an effective supplement for increasing milk fat *cis*-9, *trans*-11 CLA content in grazing cows.

Treatment	P	FO	SO	FSO	SED	FO	SO	FOxSO
						———	*P*	———
Milk yield (kg/d)	26.2	27.3	27.6	27.8	0.81	0.10	0.27	0.47
Fat yield (kg/d)	1.13	1.09	0.99	0.87	0.043	<0.01	0.02	0.22
Protein yield (kg/d)	0.90	0.91	0.91	0.87	0.026	0.44	0.49	0.22
Fat %	4.35	3.95	3.63	3.15	0.149	<0.01	<0.01	0.71
Protein %	3.43	3.33	3.31	3.15	0.049	<0.01	<0.01	0.44
cis-9, *trans*-11 CLA[1]	1.34	3.28	1.55	4.66	0.170	<0.01	<0.01	<0.01
trans-11 18:1[1]	3.96	8.66	5.39	14.91	0.756	<0.01	<0.01	<0.01
trans-10 18:1[1]	0.21	0.54	0.47	1.78	0.275	0.02	0.01	0.10
18:0[1]	10.72	6.48	14.29	5.91	0.636	<0.01	0.04	<0.01

[1]g/100g total fatty acids

Key Words: Pasture, Fish oil, Conjugated linoleic acid

578 Dose response to supplementation with calcium salts of conjugated linoleic acid during the transition period and early lactation. E. Castaneda-Gutierrez*, T. R. Overton, and D. E. Bauman, *Cornell University, Ithaca N.Y.*.

The objective of this study was to evaluate the production response of dairy cows to supplementation with two doses of calcium salts of conjugated linoleic acid (CLA) during the transition period and early lactation. Multiparous Holstein cows (n = 48) were divided into three groups, receiving one of the following treatments: 1) control (271 g/d of calcium salts of palm oil; EnerGII®, Bioproducts Inc.), 2) CLA low dose (CLA-L; 147 g/d of calcium salts of CLA plus 136 g/day of calcium salts of palm oil), and 3) CLA high dose (CLA-H; 295 g/d of calcium salts of CLA). The calcium salts of CLA contained 4.7% *cis*-9, *trans*-11; 4.6% *trans*-8, *cis*-10; 6.2% *trans*-10, *cis*-12; and 6.1% *cis*-11, *trans*-13. Each treatment provided 230 g/d of fat, and was top dressed each day from 2 wk prior to predicted calving until 9 wk postpartum. Milk production and feed intake were recorded daily, milk components determined weekly, and body weight and body condition score were recorded weekly. Over the 9 wk treatment, supplementation with calcium salts of CLA resulted in decreased milk fat percentage *($P<0.05$)* (3.88%, 3.48%, and 3.17% for control, CLA-L and CLA-H, respectively). However, milk fat percent was similar among treatments during the first 3 wk of lactation. Milk fat yield was progressively decreased, averaging 1.65, 1.49 and 1.31 kg/d for control, CLA-L and CLA-H, respectively. This represented a 21% decrease between control and CLA-H *($P<0.001$)*. Milk production did not differ among treatments averaging 43.4, 43.6 and 43.0 kg/day for control, CLA-L and CLA-H, respectively. Secretion of milk protein and milk lactose, feed intake, body weight and body condition score were also unaffected. The supplementation with both doses of calcium salts of CLA induced reduction of milk fat in early lactation, with effects being readily apparent after 3 wk postpartum.

Key Words: CLA, Early lactation, Milk fat depression

579 Comparison of the effect of different rumen protected forms of CLA on milk fat synthesis. M. J. de Veth*[1], J. W. McFadden[1], J. M. Griinari[2], S. K. Gulati[3], N. D. Luchini[4], and D. E. Bauman[1], [1]*Cornell University, Ithaca, NY,* [2]*Clanet Ltd, Espoo, Finland,* [3]*University of Sydney, Rumentek (Pty) Ltd, Australia,* [4]*Bioproducts Inc., Fairlawn, OH.*

Abomasal infusion studies have shown *trans*-10, *cis*-12 conjugated linoleic acid (CLA) decreases milk fat synthesis. However, a delivery that bypasses the rumen will be required for commercial application of

CLA. Rumen protection methods would reduce CLA metabolism in the rumen and increase its supply to the small intestine. Our objective was to compare the efficacy of two forms of rumen-protected CLA at inducing milk fat depression. Three mid-late lactation Holstein cows fitted with a rumen fistula were used in a 3 × 3 Latin square design. Treatments were 1) control, 2) Ca salts of CLA (Ca-CLA), 3) formaldehyde-protected CLA (FP-CLA). Both Ca-CLA and FP-CLA were derived from the same CLA mixture (Natural, Norway) that contained 28% *cis*-9, *trans*-11 and 27% *trans*-10, *cis*-12 CLA (as proportion of lipid). Treatments were designed to deliver 10 g/d *trans*-10, *cis*-12 CLA and infused intraruminally once per day. Treatment periods were 7 d with an 8 d interval between periods. Milk fat yield was reduced ($P < 0.01$) for CLA treatments compared to control, as was FP-CLA compared to Ca-CLA ($P = 0.01$). Milk fat content showed the same pattern of response as observed for milk fat yield. Relative to control (0.77 kg/d), milk fat yield of Ca-CLA decreased by 34% and FP-CLA decreased by 44%. CLA treatment had no effect ($P > 0.28$) on DMI and milk protein yield, but a small decline in milk yield (8%) occurred. The decrease in milk fat yield for CLA treatments was due to reductions in both *de novo* fatty acid synthesis and preformed fatty acids utilisation because yield of all fatty acids was reduced ($P < 0.01$). Likewise the lower milk fat yield for FP-CLA relative to Ca-CLA involved reductions in fatty acids of most chain lengths. *Trans*-10, *cis*-12 CLA levels in milk fat increased ($P < 0.01$) from < 0.01% in controls to 0.07% for Ca-CLA and 0.18% for FP-CLA. Efficiency of transfer of abomasally infused *trans*-10, *cis*-12 CLA into milk fat was 3.2% and 7.0% for Ca-CLA and FP-CLA, respectively. These values are much lower than transfer efficiencies reported for abomasally infused CLA, suggesting much of the two CLA forms were metabolized in the rumen. Overall, results indicate formaldehyde encapsulation of CLA provides greater protection from rumen metabolism than formation of Ca salts.

Key Words: Conjugated linoleic acid, Milk fat depression, Rumen protection

580 Lactational response of cows to different levels of ruminally protected conjugated linoleic acids. R. Gervais*[1], R. Spratt[2], and P. Y. Chouinard[1], [1]*Universite Laval,* [2]*Agribrands Purina Canada.*

Dietary CLA supplements have been shown to reduce milk fat synthesis in dairy cows. This technology may be useful as a tool to produce low fat milk where it is economically feasible. A rumen-protected source of CLA is required for commercial feed applications. The conversion of dietary lipids to a calcium salt (Ca-CLA) is proposed as a method to protect dietary lipids from ruminal biohydrogenation, because Ca-CLA is thought to be insoluble in the rumen. Our objective was to determine whether feeding Ca-CLA under commercial conditions would affect milk production, milk composition and blood metabolic profile. In this multi-site trial, 248 dairy cows from 8 farms were blocked according to the calving date, and randomly assigned to four treatments, which consisted of four doses of Ca-CLA, providing 0, 8, 16 and 32 g/d of CLA. The predominant CLA isomers were *trans*-8, *cis*-10 (5%), *cis*-9, *trans*-11 (34%), *trans*-10, *cis*-12 (37%), and *cis*-11, *trans*-13 (12%). Experimental period was 42-d in length. Milk production was recorded and milk was sampled on days 0, 7, 14, 28 and 42 of the feeding period. Blood samples were taken on day 42 from early lactating cows (<157 DIM) to determine the metabolic profile. Milk fat yield was decreased 11, 16 and 34%, and milk fat concentration was reduced linearly 16, 21 and 29% (linear; $P<0.01$) when cows received 8, 16 and 32 g/d of CLA, respectively. Milk yield and milk protein content and yield were not affected by treatments. The addition of Ca-CLA decreased the milk fat content of short- and medium-chain fatty acids, and increased the proportions of long-chain fatty acids (linear; $P<0.01$). The concentration of *trans*-10, *cis*-12 CLA increased in milk fat ($P<0.01$), and there was no change in *cis*-9, *trans*-11 CLA. Blood parameters (glucose, urea, total protein, albumin, globulin, Ca, P, Mg, creatinine, total bilirubin, aspartate amino transferase, creatine kinase, alkaline phosphatase, alanine transaminase) were not affected. Ca-CLA can be used as an effective tool to manipulate milk fat content on commercial dairy farms.

Key Words: Conjugated linoleic acid, Milk fat, Rumen protection

581 Synthesis of Trans fatty acids and isomers of Conjugated Linoleic Acid in the rumen of cows fed grass silage based diets supplemented with rapeseed, soybean and linseed oil. K. J. Shingfield*[1], S. Ahvenjärvi[2], V. Toivonen[2], P. Huhtanen[2], and J. M. Griinari[3], [1]*School of Food Biosciences, The University of Reading, UK,* [2]*Animal Production Research, MTT Agrifood Research Finland, Jokioinen, Finland,* [3]*Department of Animal Science, University of Helsinki, Finland.*

Based on in vitro incubations and measurements of fatty acids in digesta, it is increasing evident that biohydrogenation of unsaturated fatty acids in the rumen results in the formation of a wide range of trans C18:1 fatty acids and isomers of conjugated linoleic acid (CLA). This study attempted to identify the origin of biohydrogenation intermediates produced in the rumen using supplements of rapeseed (R), soybean (S) and linseed (L) oil as a source of cis-9 C18:1, C18:2 (n-6) and C18:3 (n-3), respectively. Four lactating cows fitted with rumen cannula were used in a 4 x 4 Latin square with 14 d experimental periods. Cows were offered 18 kg DM/d of a basal (B) diet consisting of grass silage and a cereal based-concentrate (60:40; forage:concentrate ratio, on a DM basis) alone or supplemented with 500 g of R, S or L. The flow of fatty acids leaving the rumen was assessed using the omasal sampling technique and a triple indigestible marker method. Oil supplements had no effect on DM intake, but shifted rumen fermentation towards propionate and butyrate at the expense of acetate, and increased the flow of C18:0 (280, 632, 634 and 581 g/d for B, R, S and L, respectively), trans C18:1 (42, 112, 133 and 151) and CLA (4.5, 5.7, 7.9, 7.4) entering the omasal canal. Quantitatively, trans-11 was the most important isomer accounting for proportionately 0.44, 0.33, 0.38 and 0.37 of total trans C18:1 flow, for B, R, S and L, respectively. Similarly, cis-9, trans-11 was the most abundant CLA isomer (0.66, 0.66, 0.73 and 0.47). Ruminal synthesis of trans-4, 5 and 6-8 C18:1 was increased by higher cis-9 and cis-11 C18:1 intakes. Formation of trans-10 and cis-12 C18:1, trans-10, trans-12; trans-9, trans-11; trans-8, trans-10; trans-10, cis-12 and cis-9, trans-11 CLA was increased in response to dietary C18:2 (n-6), while C18:3 (n-3) stimulated the formation of trans-13-14, -15 and -16 C18:1, trans-12, trans-14; trans-11, trans-13 and cis-12, trans-14 CLA biohydrogenation intermediates.

Key Words: Trans fatty acids, Conjugated linoleic acid, Biohydrogenation

582 WITHDRAWN. , .

583 Effect of alfalfa forage preservation method and particle length on performance of dairy cows fed corn silage-based diets and tallow. S. G. Onetti, S. M. Reynal, and R. R. Grummer*, *UW - Madison.*

A study was conducted to evaluate the effect of including alfalfa preserved either as silage or long-stem or chopped hay on DMI and milk fat production of dairy cows fed corn silage-based diets with supplemental tallow (T). Fifteen Holstein cows that averaged 117 DIM were used in a replicated 5 x 5 Latin square design with 21 d periods. Treatments (DM basis) were: 1) 50% corn silage: 50% concentrate without T (CS); 2) 50% corn silage: 50% concentrate with 2% T (CST); 3) 25% corn silage: 25% short alfalfa hay: 50% concentrate with 2% T (SAHT); 4) 25% corn silage: 25% long alfalfa hay: 50% concentrate with 2% T (LAHT); 5) 25% corn silage: 25% alfalfa silage: 50% concentrate with 2% T (AST). Diets averaged 16.4% CP and 30.3% NDF. Mean particle size of SAHT and AST was 3.4 and 3.6 mm, respectively. Including 2% T in diets with corn silage as the sole forage source decreased DMI and milk fat % and yield. Replacing part of corn silage with alfalfa in diets with 2% T increased milk fat % and yield. Milk fat of cows fed CST was higher in *trans*-10 C18:1 than that of cows fed diets with alfalfa. No effect of alfalfa preservation method or hay particle length was observed on DMI and milk production. Milk fat % and yield were lower, and proportion of *trans*-10 C18:1 in milk fat was higher for cows fed LAHT than for cows fed SAHT. Alfalfa preservation method had no effect on milk fat yield. Replacing corn silage with alfalfa increased rumen pH. Rumen pH was higher for cows fed LAHT than SAHT. Feeding alfalfa silage or chopped hay appears to be more beneficial than long hay in sustaining milk fat production when 2% T is fed with diets high in corn silage.

	CS	CST	Diet SAHT	LAHT	AST	Statistical contrast ($P <$) A	B	C	D
DMI, kg/d	27.3	26.1	26.7	26.6	26.5	0.08	NS	NS	NS
Rumen pH	6.23	6.26	6.32	6.40	6.31	NS	0.02	0.03	NS
Milk, kg/d	44.9	44.3	44.8	44.3	43.6	NS	NS	NS	NS
Fat, kg/d	1.4	1.2	1.4	1.3	1.5	0.01	0.01	0.10	NS
Fat, %	3.1	2.7	3.2	3.0	3.3	0.01	0.01	0.03	0.10
trans-10 C18:1, %	0.8	2.2	1.0	1.7	0.8	0.01	0.01	0.01	NS

[1]A = CS vs. CST; B = CST vs. SAHT + LAHT + AST; C = SAHT vs. LAHT; D = SAHT vs. AST.

Key Words: Tallow, Milk fat, Alfalfa and particle length

584 Effects of feeding raw, micronized and extruded flaxseed on rumen fermentation parameters and nutrient utilization by lactating dairy cows. C. Gonthier*[1], A. F. Mustafa[1], D. R. Ouellet[2], R. Berthiaume[2], and H. V. Petit[2], [1]*Macdonald Campus of McGill University,* [2]*Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada.*

Four ruminally and duodenally cannulated multiparous lactating Holstein cows (average BW 595 ± 70 kg, average DIM 225 ± 35) were used in a 4 x 4 Latin square experiment to investigate the effects of feeding unheated, micronized and extruded flaxseed on nutrient utilization and ruminal fermentation parameters of dairy cows. Four diets were formulated; a control diet with no flaxseed (NF), an unheated flaxseed diet (RF), a micronized flaxseed diet (MF) and an extruded flaxseed diet (EF). The flaxseed diets contained 6% fatty acids while NF contained 3% fatty acids (DM basis). All diets were formulated to be isonitrogenous. Results showed that feeding flaxseed had no effect on DMI, ruminal pH or NH_3-N concentration. Duodenal flow of DM was lower ($P < 0.05$) for cows fed EF compared with the other dietary treatments. Cows fed EF had a higher ($P < 0.05$) ruminal degradability of DM, OM and gross energy and a lower ($P < 0.05$) ruminal degradability of fatty acid compare with those fed MF. Ruminal CP degradability was higher ($P < 0.05$) for cows fed EF than for those fed the other dietary treatments. Intestinal digestibility of DM and CP were higher ($P < 0.05$) for cows fed MF than for cows fed NF or EF. Feeding RF also increased ($P < 0.05$) intestinal digestibility of CP relative to feeding NF or EF. Whole tract DM, OM, CP and NDF digestibilities were all higher ($P < 0.05$) for cows fed flaxseed diets than for cows fed NF. No differenced in whole tract nutrient digestibilities were found between cows fed EF and those fed MF. We concluded that inclusion of flaxseed in dairy cow diets up to 2 kg of the diet DM increased whole tract nutrient utilization by dairy cows with no negative effects of ruminal fermentation. Micronization can be used to increase ruminal undegraded protein content in flaxseed while extrusion can be used to increased nutrient availability in the rumen.

Key Words: Flaxseed, Heat treatment, Nutreint utilization

585 Effects of rumen-inert fat saturation on feed intake, milk production, and plasma metabolites in lactating dairy cows. K. J. Harvatine* and M. S. Allen, *Michigan State University, East Lansing.*

Saturated (SAT) and unsaturated (UNSAT) rumen-inert fat sources were evaluated for effects on feed intake, milk yield, and plasma metabolites. Eight ruminally and duodenally cannulated multiparous Holstein cows (77± 12 DIM) were used in a duplicated 4x4 Latin square design with 21 d periods. Treatments were control (CON) and a linear titration of 2.5% added rumen-inert fatty acids (FA) varying in unsaturation; SAT (prilled FA, Energy Booster 100®), 50:50 ratio of SAT and UNSAT (calcium soaps of long chain FA, Megalac R®), and UNSAT. Experimental diets were 40% forage and contained 27.5% NDF, 30% starch and 2.5% FA from supplemental vegetable fat (14% cottonseed). Fat treatments increased gross energy (GE) of the diet 8.2%. Increasing fat saturation increased milk yield 2.9 kg/d, however there were no treatment effects of concentration or type of fat on 3.5% FCM, SCM or energy corrected milk. Yield of milk components and milk composition were not affected by treatment. Negative effects of fat supplementation on DMI increased linearly as UNSAT increased (25.8, 24.5, 24.1, 23.0 kg/d for CON, SAT, 50:50, and UNSAT, respectively). Dry matter intake for SAT was not different from control while UNSAT decreased DMI relative to control ($P < 0.05$). UNSAT linearly decreased DMI up to 1.5 kg/d ($P < 0.05$) and tended to decrease GE intake up to 3.94 Mcal/d ($P <0.10$) compared to SAT. Wet weight of rumen contents tended to decrease 8.9% with rumen inert fat treatments compared to CON ($P < 0.1$) and decreased linearly by UNSAT compared to SAT ($P < 0.05$). Plasma NEFA, BHBA and glucose also were not affected by level or type of fat. UNSAT linearly increased empty body weight gain up to 0.84 kg/d ($P = 0.01$) and NE_L gain 3.9 Mcal/d calculated from empty body weight ($P = 0.02$) compared to SAT. Fat supplementation with rumen-inert fat sources had no effect on milk yield or composition but type of fat affected DMI and tissue energy gain.

Key Words: Rumen-inert fat, Saturation, Hypophagic effects

586 Interrelationships of hepatic palmitate and propionate metabolism, liver composition, blood metabolites, and cow performance. M. S. Piepenbrink* and T. R. Overton, *Cornell University, Ithaca, NY.*

Measurements (n=27) from 95 cows in previous experiments conducted in our laboratory were used to evaluate the potential relationships between liver triglyceride content (TG), liver metabolism, blood metabolites, and cow performance. Initially, data was subjected to Pearson correlation analysis. Those variables that were significantly ($P < 0.05$) correlated with TG on d1 and 21 postpartum were used to develop equations for predicting liver TG content. Variables were removed from multiple regression analysis in a stepwise, backward fashion until all variables had a probability of a greater $F < 0.05$. For TG on d1 postpartum, the TG 21d prepartum, the capacity of liver to store [1-^{14}C]palmitate intracellularly (SEP) 21d prepartum, the capacity of [1-^{14}C]propionate conversion to CO_2 (POx) on d1 postpartum, the area under the curve for concentration of NEFA in plasma from d7 prepartum to d21 postpartum (NAUC), and the area under the curve for βHBA from d7 prepartum to d21 postpartum (BAUC) remained significant resulting in the equation TG_1 ($r^2 = 0.61$). For TG on d21 postpartum, TG on d21 prepartum and d1 postpartum, capacity of liver to convert [1-^{14}C]propionate to glucose 21d postpartum (GNG), calving body condition score (BCS_c), and NAUC were significant resulting in the development of the equation TG_{21} ($r^2 = 0.51$). Other correlations suggested relationships between TG and GNG (r = -0.39 and #0.48 for d1 and d21), cumulative DMI from d-7 to +21 (r= -0.37 and #0.35 for d1 and d21), BCS_c (r = 0.29 and 0.36 for d1 and d21) and BW change from calving to 3 wk postpartum (r = -0.33 and #0.34 for d1 and d21). These findings reemphasize the importance for optimal BCS for cows at calving to reduce the severity of fatty liver and confirm the negative relationship between liver TG accumulation and gluconeogenic capacity.

$TG_1 = -8.6245 + (1.8047 \times TG\text{-}21) + (0.0284 \times SEP) - (0.0006 \times POx) + (0.0002 \times NAUC) + (0.0041 \times BAUC)$

$TG_{21} = -26.4965 + (2.1958 \times TG\text{-}21) + (0.4472 \times TG1) + (0.0014 \times GNG) + (6.6574 \times BCS_c) + (0.0005 \times NAUC)$

Key Words: Periparturient cow, Liver

Ruminant Nutrition: Additives, enzymes and feedstuff analysis

587 Effects of cinnamaldehyde, garlic and monensin on nitrogen metabolism and fermentation profile in continuous culture. M. Busquet[1], S. Calsamiglia*[1], A. Ferret[1], and C Kamel[2], [1]*Universidad Autonoma de Barcelona, Spain,* [2]*University of Leeds, UK.*

Eight 1.3-L dual flow continuous culture fermenters were used in three periods (10 d) to study the effects of natural plant extracts on N metabolism and fermentation profile. Fermenters were fed 95 g/d of a 50-50 forage-to-concentrate diet. Treatments were: no additive (Negative Control, NC), Monensin (4 or 40 mg/d per fermenter, M and M10), Cinnamaldehyde (100 or 1000 mg/d per fermenter, CI and CI10) and Garlic (100 or 1000 mg/d per fermenter, G and G10). Fermenters were maintained at constant temperature (39 C), pH (6.4) and solid (5%/h) and liquid (10%/h) dilution rates. Each day, a sample was taken 2 h after the morning feeding for the determination of peptide N (Pep-N), aminoacid N (AA-N), ammonia N (NH3-N) and volatile fatty acids (VFA). During the last 3 days, samples were taken at 0, 2, 4 and 6 h