The objective of this research was to compare linear regression methods with non-linear techniques and to develop a model with universal application across the full range of intake. Data from 11 trials (n = 159) conducted at the Centre for Dairy Research (CEDAR) UK, were used to develop the models. The backward elimination procedure for multiple regression in SAS was used to produce the linear models and the criteria for selecting the best-fit model were as described by Oldick et al. (1999). The main effects were analysed using Proc Mixed procedure of SAS (2000). The best fit model was as follows: CH_4 (MJ/d) = 5.93(SE 1.60) + 0.92(SE 0.08) × DMI (kg/d) (r^2=0.60; RMSE = 1.82). The Mitscherlich model was also chosen to represent methane production and parameterized according to the CEDAR data as follows: CH_4 (MJ/d) = CH_4max # (CH_4max + CH_4min)$e^{(-axMEI)}$ (r^2 = 0.66; RMSE =1.8). Where CH_4max (MJ/d) = 39.9, a = 0.0039 and CH_4min (MJ/d) = 0 The Mitscherlich model was evaluated alongside the linear model using an independent dataset comprising trials conducted at the Agricultural Research Institute of Northern Ireland (ARINI) (n = 62) and the Grassland Research Institute, Hurley, UK (n = 44). These data were from Holstein cows fed typical grass or grass silage based diets. The Mitscherlich model improved methane prediction in comparison to the linear model (r^2 = 0.81 vs 0.78). The root mean square prediction error as a % of the observed mean (rootMSPE%) was lowest for the Mitscherlich model (12.2 vs 14.9) and this was combined with the lowest proportion of MSPE due to bias (0.10 vs 0.24) and regression (0.10 vs 0.14). In contrast to linear models, the Mitscherlich model was able to predict methane over the full range of intake whilst applying parameters with a biological basis.

Key Words: Methane, Dairy cow, Modeling

1245 Physiological variations of milk components in relation to seasonal changes over two years. F. Brulisauer[1], J. Moll[2], and R. Eicher*[3], [1]*Swiss Federal Veterinary Office, Berne, Switzerland,* [2]*Swiss Braunvieh Cattle Association, Zug Switzerland,* [3]*Univerity of Berne, Switzerland.*

Nutritional and metabolic imbalances can be diagnosed by analysing milk components (fat, protein, urea) on a herd base. However, physiologic changes and non-nutritional factors have to be taken into account for a precise evaluation. The goals of this study were to investigate physiological variation of milk components according to non-nutritional factors like individual and herd level of production, somatic cells counts, climate zone, and seasonal effects. Study data included more than 33'000 lactations of Swiss Braunvieh cows from totally 1000 farms. Samples were taken monthly over 2 years, divided in 2 time periods each (green forages/pasture vs. conserved forages). The dairy farms were randomly chosen from 3 different land registers based mainly on altitude (500 farms in the valley zone, 250 farms in the mountain 1 zone, and 250 farms in the mountain 2-4 zones). Data analysis was mainly descriptive: median and interquartile range were calculated for the different levels. Special focus was set on seasonal variations. Results did not differ a lot between corresponding periods of the 2 years, although statistics of forage analyses were quite better in the second year. This can be mainly explained by a higher volume of sales of concentrates in the first winter. In valley zone the percentage for milk fat stayed relatively constant during summer (3.8-4.1%), during winter feeding there was a tendency of decrease, but on a higher level (4.4-3.9%). Fat values tended to be lower in mountain zones 2-4 (3.8-4.1%) in winter. Herds with high annual milk yield generated similar, in winter even slightly higher percentages of milk fat than herds with lower milk yields. Milk protein increased in the end of summer and decreased during winter. Valley farms had higher protein than mountain farms. Herds with high annual milk yield generated equal or higher protein values. Milk urea increased markedly during summer and was relatively stable in winter. Urea level in summer milk didn't vary in the different yield categories. In winter high yield cows produced higher urea values than cows with low yields.

Ruminant Nutrition
Fat and Intake

1246 Partial replacement of corn grain by calcium salts of unsaturated fatty acids in grazing dairy cows : 1- Dry matter intake, milk production and composition. L.I. Vidaurreta[1], G.A. Gagliostro[2], G.F. Schroeder*[1−3], and G. Eyherarbide[2], [1]*Fac. Cs. Agrarias. UNMdP,* [2]*INTA EEA Balcarce,* [3]*CONICET, Argentina.*

The effect of replacing fermentable energy (corn grain) by calcium salts of unsaturated fatty acids (UFA-Ca) on DM intake, milk yield and milk composition was studied in grazing dairy cows in midlactation (116 DIM). Two groups of seven multiparous Holstein cows (588 62 kg BW) were assigned to one of two treatments in a cross-over design. The cows grazed a fresh winter oat pasture (DM= 20.5%, NDF= 33.3%, CP= 19.4%, IVDMD= 73.2%) with an herbage mass averaging 1535 kg/DM/ha. Treatments consisted in two isoenergetic concentrates composed by 7 kg/d of ground corn grain and 0.4 kg/d of fish meal (T0) or 4.8 kg/d of corn grain, 0.4 kg/d of fish meal and 0.9 kg/d of UFA-Ca (T1). Fat energy represented about 13% of total metabolizable energy requirement of the cows. Neither pasture, DMI nor energy total intake were affected by fat supplementation. Yields of milk and milk protein were increased by feeding UFA-Ca. Milk fat yield was not increased and milk fat concentration was reduced. Milk protein content tended to be lower when UFA-Ca were fed. Changes in BW and BCS did not differ between treatments. Concentrations of plasma NEFA, glucose, triacilglycerides, total cholesterol and urea were not affected. Replacing rumen fermentable energy by UFA-Ca slightly increased milk and milk protein yields but decreased milk fat content in midlactation dairy cows in grazing conditions.

	T0	T1	SEM	P≤
Intake (kg DM/d)				
Pasture intake	19.1	18.9	0.77	0.92
Total DMI	23.6	22.4	0.80	0.39
Milk yield, kg/d	20.4	21.7	0.18	0.01
Milk Fat				
kg/d	0.61	0.60	0.01	0.22
%	3.08	2.72	0.07	0.01
Milk Protein				
kg/d	0.70	0.74	0.01	0.01
%	3.52	3.45	0.02	0.06

Key Words: milk production, fat supplementation, grazing

1247 Partial replacement of corn grain by calcium salts of unsaturated fatty acids in grazing dairy cows: 2- Milk fatty acid composition. L.I. Vidaurreta[1], G.A. Gagliostro[2], G.F. Schroeder*[1−3], A. Rodriguez[4], and P. Gatti[4], [1]*Fac. Cs. Agrarias. UNMdP,* [2]*INTA EEA Balcarce,* [3]*CONICET,* [4]*INTI CITIL PTM, Argentina.*

The aim of the study was to determine the effect of partial replacement of corn grain by calcium salts of unsaturated fatty acids (UFA-Ca) on milk fatty acid composition in grazing dairy cows in midlactation (116 DIM). Fourteen multiparous Holstein cows (588 62 kg BW) were assigned to one of two treatments in a cross-over design. All cows grazed an oat (Avena sativa, L) pasture (DM= 20.5%, NDF= 33.3%; CP= 19.4%; IVDMD= 73.2%, availability = 1535 kg/DM/ha) and were supplemented with two isoenergetic concentrates composed by 7 kg/d of ground corn and 0.4 kg/d of fish meal (T0) or 4.8 kg/d of corn grain, 0.4 kg/d of fish meal and 0.9 kg/d of UFA-Ca (T1). Fatty acid composition of the UFA-Ca used was: C14:0 (1.6%), C16:0 (16%), C16:1 (1.6%), C18:0 (13.5%), C18:1 (32%), C18:2 (30%), C18:3 (0.8%) and C20:0 (0.3%). Milk concentration of long-chain FA resulted higher,

whereas concentration of short-chain (C6 to C10) and medium chain FA (C12 to C16) were lower in cows that received UFA-Ca. Milk content of conjugated linoleic acid (CLA) was increased (58%) by UFA-Ca. Overall secretion of short and medium FA resulted lower in T1 cows whereas long-chain FA yield was increased by UFA-Ca feeding. Yields of C18:2 (T0= 12.1 and T1= 25.2 g/d) and CLA (T0= 7.3 and T1= 11.5 g/d) were increased by feeding UFA-Ca. In grazing dairy cows, partial replacing of rumen fermentable energy (corn grain) by UFA-Ca (30% of C18:2) seemed to be an effective way to increase the content and secretion of FA that may have positive effects on human health.

	T0	T1	SEM	P≤
Milk Fatty Acids, %				
C4:0	2.11	1.96	0.12	0.20
C6:0	1.98	1.45	0.04	0.01
C8:0	1.38	0.93	0.02	0.01
C10:0	3.21	2.08	0.04	0.01
C12:0	3.69	2.42	0.06	0.01
C14:0	10.8	8.11	0.13	0.01
C16:0	24.2	20.2	0.28	0.01
C16:1	1.43	1.43	0.08	0.96
C18:0	10.4	11.5	0.23	0.01
C18:1	21.9	25.0	0.24	0.01
C18:2	2.01	4.30	0.01	0.01
C18:3	0.61	0.75	0.02	0.01
CLA (cis-9. trans-11)	1.25	1.97	0.06	0.01

Key Words: Fat supplementation, Milk fatty acids, Grazing

1248 Ruminal environment and pasture digestion in grazing dairy cows supplemented with calcium salts of unsaturated fatty acids. L.I. Vidaurreta[1], G.F. Schroeder*[1−2], and G.A. Gagliostro[3], [1]*Fac. Cs. Agrarias. UNMdP,* [2]*CONICET,* [3]*INTA EEA Balcarce, Argentina.*

The effect of partial replacement of ground corn by calcium salts of unsaturated fatty acids (UFA-Ca) on ruminal environment and forage NDF and CP digestion was studied in grazing dairy cows. Four Holstein cows fitted with ruminal cannulas were used in a two treatments two periods cross-over design. Cows grazed a fresh oat pasture (DM= 20.5%, NDF= 33.3%; CP= 19.4%; IVDMD= 73.2%) with an average herbage mass of 1535 kg/DM/ha. Treatments were : T0= 7 kg/d of ground corn and 0.4 kg/d of fish meal; T1= 4.8 kg/d of ground corn and 0.9 kg/d of UFA-Ca. Fatty acid composition of UFA-Ca was: C14:0 (1.6%), C16:0 (16%), C16:1 (1.6%), C18:0 (13.5%), C18:1 (32%), C18:2 (30%), C18:3 (0.8%) and C20:0 (0,3%). Nylon bags containing fresh forage (5 g DM/bag) were incubated in the rumen and removed at 0, 3, 6, 9, 12, 16, 20, 28, 48, and 72 h to estimate the in situ disappearance of NDF and CP. Ruminal pH, NH3-N and total VFA concentrations did not differ. Parameters of in situ disappearance of forage NDF and CP were not affected by UFA-Ca. Calcium salts of UFA did not alter rumen fermentation or parameters associated to forage digestion when dairy cows grazed a high quality pasture even when low values of ruminal pH were recorded.

	T0	T1	SEM	P≤
pH	5.55	5.72	0.02	0.22
NH3-N (mg/dl)	11.1	12.2	0.47	0.26
Total VFA (mmol/L)	126.1	127.3	5.72	0.89
Acetate: Propionate ratio	2.64	2.80	0.09	0.33
Pasture NDF Fractions				
Soluble, %	1.00	4.19	1.39	0.25
Degradable, %	83.3	78.1	4.75	0.52
Rate of digestion (%/h)	0.13	0.11	0.02	0.67
Effective degradability, % 1	33.2	39.6	4.62	0.43
Pasture CP Fractions				
Soluble, %	59.4	60.8	1.73	0.62
Degradable, %	90.9	90.8	0.88	0.97
Rate of digestion (%/h)	0.13	0.11	0.02	0.67
Effective degradability, % 1	76.9	78.1	2.24	0.74

1-Rate of passage assumed: 7%/h

Key Words: Fat supplementation, Ruminal digestion, Grazing

1249 Reproduction of dairy cows fed flaxseed, Megalac or micronized soybeans. H. V. Petit*[1] and H. Twagiramungu[2], [1]*Agriculture and Agri-Food Canada,* [2]*L'Alliance Boviteq.*

One-hundred fourty-one Holstein cows were allotted at calving to 47 groups of three cows each to determine the effects of fat source on reproduction of the dairy cow. Cows within groups were allotted to one of three isonitrogenous, isoenergetic, and isolipidic supplements based on either whole flaxseed (FLA), Megalac (MEG) or micronized soybeans (SOY). Diets were fed as total mixed diets for ad libitum intake from calving up to d 50 of gestation. Body weight of cows was determined weekly. Cows were bred after the onset of estrus and pregnancy diagnosis was performed at 30 and 50 d by rectal palpation. Embryo mortality was calculated as the difference between the number of cows pregnant on d 30 and those not pregnant on d 50. The number and percentage of cows pregnant were tested using a chi-square test. Fisher's exact test of PROC FREQ was used to compare on a 2 x 2 basis the effects of treatment on gestation rate, embryo mortality, and pregnancy rate when the Fisher's exact test was significant at $P < 0.05$. Interval between calving and the first breeding and interval between the first and second breeding were similar ($P > 0.05$) among treatments. Cows fed FLA had a greater ($P = 0.06$) number of follicles equal or greater than 10 mm compared to those fed MEG (1.7 vs 1.0). Cows fed SOY had a similar number of follicles equal or greater than10 mm (1.2) to those fed either FLA or MEG. The corpus luteum diameter was significantly greater ($P < 0.05$) for cows fed FLA compared to those fed SOY (19.7 vs 16.9 mm) and there was no difference ($P > 0.05$) between cows fed MEG (17.5 mm) and those fed either FLA or SOY. Diets tended ($P = 0.11$) to have an effect on embryo mortality with FLA resulting in lower value (0%) than either MEG (15.4%) or SOY (13.6%). These results suggest that the decrease in embryo mortality that was observed when feeding greater levels of alpha-linolenic acid in the present experiment may partly result from lower levels of production of the dienoic prostaglandin PGF_2, alteration in corpus luteum regression, and increase progesterone concentration as observed in earlier work.

Key Words: Dairy cattle, Flaxseed, Soybeans

1250 The effect of different types of dietary fat on rumen fermentation and total tract digestion of sheep. H. Febel*[1], E. Andrasofszky[2], and Sz. Huszar[1], [1]*Research Institute of Animal Breeding and Nutrition, Herceghalom,* [2]*Szent Istvan University, Faculty of Veterinary Science, Budapest, Hungary.*

Dietary fat is used to increase the energy value of dairy diets, but its use may cause digestive problems. The effects of different fat sources were evaluated in a 5 x 5 Latin square with 21 d periods using five rumen cannulated wethers. Treatments were: C) control diet (no added fat), CS) C + calcium salts of palm oil fatty acids, SO) C + soybean oil, HA) C + hydroxyethylsoyamide, and BA) C + butylsoyamide. Fat content in DM was 2.3% for diet C, 5.7% for supplemented diets. The basal diet consisted of a 50:50 mixture of meadow hay and concentrate fed in equal amounts daily, at 080 and 2000h. Ruminal pH and total VFA concentration were not different among treatments (P>.05). However, the proportion of propionate was higher with fat supplementation (P<.01). The acetate:propionate ratio was highest for C, intermediate for CS, BA and HA, and lowest for the SO diets (4.29, 3.97, 3.65, 3.44 and 3.21, respectively). Rumen ammonia N concentration decreased due to fat supplementation (P<.05). Total tract digestibilities of DM and OM were reduced by SO and HA (P<.05). Higher total N digestion was observed in sheep fed the CS and HA diets (P<.05). Digestibility of ether extract (EE) was similar for the C and BA diets. However, the addition of CS, SO and HA significantly increased (P<0.001) total tract EE digestibility. Fat sources appeared to have no negative effect on apparent digestion of NDF (P>.05). The diet containing HA resulted in the lowest total tract ADF digestibility (P<.05). The results indicate that CS was the most inert fat source. The negative effect of HA on ruminal VFA and fiber digestion could be explained by the microbial breakdown of the amide with release of antimicrobial fatty acids. It is presumed that the ruminal breakdown of BA was avoided because this amide had fewer detrimental effect on ruminal fermentation than HA. Project was supported by Hungarian Scientific Research Fund (T 029043).

Key Words: Digestibility, Oleamide, Sheep

1251 Conjugated linoleic acid (CLA) content of milk from cows on different ryegrass cultivars. V. R. Loyola*[1,4], J. J. Murphy[2], M. O'Donovan[2], R. Devery[3], M. D. S. Oliveira[4], and C. Stanton[1], [1]*Teagasc, Dairy Products Research Centre, Moorepark, Fermoy, Ireland,* [2]*Teagasc, Dairy Production Research Centre, Moorepark, Fermoy, Ireland,* [3]*Dublin City University, Ireland,* [4]*Universidade Estadual Paulista, UNESP, Jaboticabal, Brasil.*

Milk fat CLA arises from microbial biohydrogenation of dietary linoleic acid in the rumen and also by endogenous synthesis in mammary tissue by Δ9 desaturase activity on vaccenic acid. CLA has exhibited a number of health benefits /italicizein vitro and /italicizein vivo, including anticarcinogenic activity. Therefore, strategies for optimising the CLA and vaccenic acid content of milk fat may provide means of enhancing its nutritional and health promoting properties. In this study, the effects of ingestion of four ryegrass cultivars, consisting of two diploid, Spelga (S) and Portstewart (P), and two tetraploid, Napoleon (N) and Millennium (M), with different heading dates (intermediate and late) on milk fat CLA concentrations were investigated. Four herds of 20 cows each were blocked onto the four ryegrass cultivars in March and throughout the season were rotationally grazed /italicizead libitum at a stocking density of 4.2 cows per hectare. Milk fatty acid composition was analyzed at 2 times during the grazing season (July and September). The linoleic and α-linolenic acid content of the ryegrass varieties were similar. The /italicizecis-9, /italicize trans-11 CLA content of the milk fat averaged for the 2 sampling times was significantly lower (P<0.01) from cows grazing N (1.35 g/100g FAME) than from cows grazing either M (1.72) or P (1.71), while CLA from S (1.54 g/100g FAME) did not differ from any other cultivar. Vaccenic acid content was also lower on this cultivar (P<0.05). There was no difference in milk fat CLA between the two sampling times. The heading date effect was significant (P<0.05), with late heading cultivars resulting in higher CLA. There was no significant difference in the milk fat CLA between diploid and tetraploid cultivars. These data suggest that ryegrass variety may influence the CLA and vaccenic content of milk fat in a similar manner.

Key Words: CLA, Ryegrass Cultivars, Bovine Milk Fat

1252 *In vitro* ruminal biohydrogenation of n-3 fatty acid from two fish oils as influenced by inclusion levels. F. Dohme*[1], V. I. Fievez[2], K. Raes[2], and D. I. Demeyer[2], [1]*Swiss Federal Research Station for Animal Production,* [2]*Ghent University, Belgium.*

One major limitation in the incorporation rate of n-3 fatty acids into milk and body fat is their biohydrogenation by rumen micro-organisms. The aim of the study was to determine whether release rate from triacylglycerols (TG) and biohydrogenation of eicosapentaenoic (EPA) and docosahexaenoic acids (DHA) varied between two fish oils (FOa; FOb) differing in their levels of EPA and DHA (FOa: 18.7% EPA, 11.7% DHA; FOb: 5.8% EPA, 7.6% DHA) and supplied at six levels (12.5, 25, 50, 75, 100, 125 mg). Using the batch cultures technique, FOa and FOb were incubated for 24 or 48 h in 25 mL buffer-rumen fluid-mixture and 0.4 g of ground hay. TG and free fatty acids were separated by TLC and the fatty acid composition was determined by GLC. Release rate and biohydrogenation of EPA and DHA were expressed as the ratio of the incubated and unincubated samples. Linoleic acid (LA) from soy oil has shown to be highly biohydrogenated and therefore was used as a reference. Although EPA and DHA concentration was markedly higher in FOa, release rate from the oils did not differ. Regardless of the oils supplied, EPA and DHA release rate decreased with increasing level ($P < 0.001$) and increased with extended incubation time ($P < 0.001$). The rate of free LA was on average 90% and was not affected neither by incubation time nor by inclusion level. EPA and DHA from FOb were biohydrogenated at a greater extent than those of FOa ($P < 0.001$). Increasing oil supplementation caused a decreased biohydrogenation rate of EPA and DHA ($P < 0.001$). Compared to 24 h, incubation during 48 h enhanced the amount of EPA and DHA being biohydrogenated ($P < 0.001$). Biohydrogenation rate of LA was nearly complete and numerically higher than that observed for EPA and DHA from the fish oils. In conclusion, the release from TG of EPA and DHA and their biohydrogenation depended on the inclusion level. Furthermore, biohydrogenation rate was affected by the fatty acid composition of the supplied fish oils.

Key Words: Fish oil, n-3 fatty acids, Biohydrogenation

1253 Effects of DMI, addition of buffer, and source of fat on duodenal flow and milk concentration of conjugated linoleic acid and *trans*-$C_{18:1}$ in dairy cows. X. Qiu*[1], M. L. Eastridge[1], J. L. Firkins[1], K. E. Griswold[2], and G. A. Apgar[2], [1]*The Ohio State University, Columbus,* [2]*Southern Illinois University, Carbondale.*

Four ruminally and duodenally cannulated multiparous Holstein cows averaging 106 ± 17 DIM were used in a 4 x 4 Latin Square with the treatments as follows: control (CON) = diet with 2% fish oil (FO) and fed ad libitum; buffer addition (BUFF) = CON with 0.8% of DM as $NaHCO_3$; low DMI (LDMI) = dietary concentration of nutrients and FO increased from the CON and DMI was restricted to 80% of the CON; and soybean oil (SBO) = CON with 2% SBO instead of FO. The diet was a 36.3: 63.7 forage: concentrate ratio TMR with 32.1% NDF and 3.3% fatty acids. Periods were 18 d with the last 7 d for data collection and the first 4 d for determining the appropriate feed offered for the LDMI treatment. Duodenal conjugated linoleic acid (CLA) flows were 6.04, 3.73, 4.27, and 0.89 g/d, for CON, BUFF, LDMI, and SBO, respectively. *Trans*-$C_{18:1}$ flows were 147.7, 142.3, 76.0, and 27.8 g/d, respectively. In milk, CLA concentrations were 24.5, 17.9, 18.5, and 10.1 mg/g of FA, respectively; and *trans*-$C_{18:1}$ FA concentrations were 95.6, 99.5, 70.7, and 35.8 mg/g of FA, respectively. Feeding buffer at 0.8% of DM neither significantly increased ruminal pH nor decreased duodenal flows of *trans*-$C_{18:1}$ and CLA, although the duodenal fows were numerically lower than CON. Restriction of DMI decreased duodenal flow of *trans*-$C_{18:1}$ but did not significantly decrease duodenal flow of CLA from CON. However, both BUFF and LDMI tended to result in lower CLA concentration in milk fat than CON. Compared to SBO, FO was more effective in increasing duodenal flows of CLA and *trans*-$C_{18:1}$ and, thus, concentration of CLA in milk. Cows fed FO had higher duodenal flow and milk concentration of n-3 polyunsaturated fatty acids than the cows fed SBO. Estimated by subtracting duodenal CLA flow from milk CLA production and then dividing by milk CLA production, endogenous synthesis of CLA by Δ^9 desaturase activity, averaging across the treatments, accounted for at least 72.1% of the CLA secreted in milk. The contribution of endogenous CLA varied as the source of dietary fat changed, with SBO (86.4%) being much higher than the other treatments (averaging 67.3%).

Key Words: conjugated linoleic acid, *trans* fatty acid, milk fat

1254 Performance of lactating holstein cows fed catfish oil in summer. A.K.Amorocho* and C.R. Staples. Department of Animal Sciences, University of Florida, Gainesville. A . K . Amorocho* and C. R. Staples, *University of Florida, Gainesville, Florida.*

The objective was to evaluate the effect of dietary catfish oil on milk production and composition, dry matter intake, plasma glucose and urea, and pH of rumen fluid, urine, and feces of 12 multiparous Holstein cows (six ruminally fistulated and six nonfistulated) (average of 195 days in milk). The fatty acid profile of catfish oil was 19% palmitic, 47% oleic, and 14% linoleic. Catfish oil (0, 1.5, and 3% of dietary DM) was suspended in liquid molasses, mixed with grain, and fed as a TMR containing corn silage and alfalfa hay. Treatments were arranged in a 3 x 3 Latin square design replicated four times. Each period lasted 27 days, 14 days for adaptation to a new diet and 13 days for data collection. Milk production and dry matter intake was measure daily. Blood was collected on days 12 and 13. Urine and fecal samples were collected and measured for pH on days 8 and 9. Rumen fluid was collected hourly for 8 hours on day 1. Intake of dry matter increased linearly ($P < 0.05$) as intake of catfish oil increased (23.0, 24.4, and 25.4 kg/d). Production of milk was unchanged by the feeding of catfish oil (28.9, 28.9, and 29.4 kg/d). Concentrations of milk fat (3.57, 3.60, and 3.48%) and protein (3.21, 3.18, and 3.23%) were similar across the catfish oil diets. Concentrations of plasma glucose (57.2, 55.1, and 56.0 mg/100 ml) and urea nitrogen (11.6, 11.0, and 12.0 mg/100 ml) were not affected by dietary treatments. The pH of urine (8.05, 8.05, and 8.06) and feces (6.73, 6.67, and 6.67) were unchanged by feeding of increasing amounts of catfish oil. Average ruminal fluid pH decreased linearly ($P < 0.0001$) as intake of catfish oil increased (6.40, 6.20, and 6.15). The treatment by square interactions were not significant. Catfish oil was successfully mixed with liquid molasses and fed to lactating Holstein cows at up to 3% of dietary dry matter, stimulating dry matter intake.

Key Words: lipids, dairy cows, rumen fluid

1255 Patterns of biohydrogenation and duodenal flow of *trans* fatty acids and conjugated linoleic acids (CLA) are altered by dietary fiber level and linseed oil in dairy cows. J. Loor*, K. Ueda, A. Ferlay, Y. Chilliard, and M. Doreau, *INRA, Unite de Recherche sur les Herbivores, 63122 St.-Genes Champanelle, France*.

Duodenal flows of hydrogenation intermediates in response to altered rumen fermentation and 18:3*n*-3 availability were evaluated using four lactating Holstein cows fed a high (65:35 forage to grain; HF) or low (35:65; LF) fiber [derived from grass hay] diet without (HFN, LFN) added oil or with linseed oil (HFO, LFO) at 3% of DM. A 4 × 4 Latin square design was implemented for 4 wk. Total fatty acid content in the DMI (20 ± 1 kg/d) ranked by treatment was HFO and LFO (4.6, 5.1%) > LFN and HFN (1.9, 1.6%). Feeding LFN increased intake of 18:2*n*-6 (142 vs. 97 g/d) but reduced 18:3*n*-3 (55 vs. 82 g/d) compared with HFN. Intakes of 18:2*n*-6 and 18:3*n*-3 increased further when HFO (361, 154 g/d) or LFO (404, 115 g/d) were fed. Greater hydrogenation of 18:2n-6 (77 vs. 74%) and 18:3*n*-3 (89 vs. 84%) was observed in response to HFN compared with LFN. Whereas hydrogenation of 18:2*n*-6 increased (92%) due to HFO or LFO, 18:3*n*-3 hydrogenation decreased (73%) but only in response to LFO. Duodenal flow of total CLA averaged 1.8 g/d due to feeding HFN or LFN and increased to 3.1 g/d in response to HFO or LFO. *C*9,*c*11- plus *t*,*t*-CLA were 75 or 55% of total CLA flow for HFN or LFN. *C*9,*t*11- was 5% of total CLA when HFN or LFN were fed compared with 16% due to HFO or LFO. Feeding LFN or LFO doubled flow of *t*10,*c*12-CLA (0.06 g/d). Flow of *t*11,*c*15-18:2 was 1.3 g/d in cows fed HFN or LFN compared with 9.6 or 65 g/d for HFO or LFO. Total *t*-18:1 flow was 40 g/d in cows fed HFN, increased to 77 and 135 g/d in response to LFN and HFO, and peaked at 290 g/d due to feeding LFO. Flows of *t*10- and *t*11-18:1 were lower for HFN (3.0, 22 g/d) compared with LFN (20, 26 g/d). Feeding HFO (6.7, 63 g/d) and LFO (68, 122 g/d) further increased their flows. Data show, low-fiber diets enhanced rumen production of *t*10-18:1 and to a lower extent *t*10,*c*12-CLA. Supplemental 18:3*n*-3, however, was hydrogenated to *t*11,*c*15-18:2 and *t*11-18:1, primarily, but led to minor increases in *c*9,*t*11-CLA.

Key Words: hydrogenation, *trans* FA, linseed oil

1256 Effect of linseed oil supplementation to different forage/concentrate ratio diets on ruminal digestion in dairy cows. K. Ueda, A. Ferlay, J. Loor*, Y. Chilliard, and M. Doreau, *INRA, Unite de Recherche sur les Herbivores, 63122 St.-Genes Champanelle, France*.

The effect of linseed oil supplementation on digestibility and rumen characteristics was investigated in dairy cows, when offered diets with different forage to concentrate ratios (F/C). The experiment was conducted in a 4 x 4 Latin square design with four lactating Holstein cows. Cows received diets: F(F/C=65/35), FO(F/C=65/32, 3% linseed oil), C(F/C=35/65), and CO(F/C=35/62, 3% linseed oil). Diets contained natural grassland hay, a grain mixture and soybean meal to meet energy and protein requirements. Total feces excretion and duodenal digesta flow were measured to obtain the digestibility in the total tract and the rumen for OM, NDF and starch. In situ DM degradation parameters were measured for hay, and the effective degradability was calculated assuming kp=0.04. Rumen fluid pH, VFA and protozoa concentration were also measured. Daily DM intake was not different among diets (F: 20.4, FO: 19.6, C: 20.5, CO: 20.4 kg). Total tract digestibility of OM (68.5, 70.0, 70.0, 73.3 %) and NDF (61.4, 63.3, 51.0, 54.0 %) were significantly higher (P<0.01) with oil supplementation for both F/C ratios. There was a tendency of interaction between oil supplementation and F/C for the ruminal digestibilities of OM (P=0.06; 52.3, 59.8, 60.7, 54.1 %) and NDF (P=0.06; 37.8, 55.7, 42.9, 31.0 %). Ruminal starch digestion was almost complete for all diets and the digestibility was not affected by oil supplementation (89.0, 87.7, 91.6, 94.3 %). Oil supplementation did not affect ruminal pH and VFA concentration. Total protozoa concentration for CO was numerically lower than for other diets (89, 95, 83, 14 x 10^3/mL). The difference among treatments in the effective degradability of hay DM was similar to those of ruminal OM and NDF digestibility (48.0, 54.0, 46.9, 46.8 %). In conclusion, linseed oil supplementation had no negative effects on total tract digestion in dairy cow. However, ruminal OM and NDF digestion tended to be reduced when cows were offered concentrate-rich diets.

Key Words: Linseed oil, Forage ratio, Ruminal digestion

1257 Milk fatty acid composition from cows fed a total mixed ration or grazing different pasture species. C. Benchaar*[1], T. D. Whyte[2], R. Berthiaume[1], T. Astatkie[2], G. F. Tremblay[3], A. H. Fredeen[2], R. C. Martin[2], and P. Y. Chouinard[4], [1]*Agriculture and Agri-Food Canada, Lennoxville, QC,* [2]*Nova Scotia Agriculutral College,Truro, NS,* [3]*Agriculture and Agri-Food Canada, Ste-Foy, QC,* [4]*Universite Laval, QC*.

The objective of this study was to evaluate the potential use of different pasture species to manipulate milk fatty acid (FA) composition. Thirty-two lactating Holstein cows were randomly assigned to one of four treatments: 1) total mixed ration (TMR), 2) permanent pasture (PP) containing a mixture of grasses and legume species, 3) pasture consisting of red clover (RC), and 4) PP during the day and annual ryegrass at night (PP/ARG). All cows received a supplement mix of similar composition. From the last week of June to the end of August, milk samples were collected from four consecutive milkings at wk 0 (covariate), 2, 4, 6, and 8 of the experiment. Data were analysed as repeated measures using Proc Mixed of SAS. Effects of treatments were determined by orthogonal contrasts: TMR vs all pastures, PP vs (RC+PP/ARG), and RC vs ARG/PP. Milk from cows on pasture was lower in C16:0 (27.9 vs 34.1%, $P<0.01$) and higher in C18:0 (13.5 vs 10.5%, $P<0.01$) than milk from cows fed TMR. Pasture-fed cows produced milk with higher contents of CLA (1.1 vs 0.4%) and *trans*-C18:1 (2.7 vs 1.2%) than cows fed TMR ($P<0.01$). Concentrations of these FA increased linearly over the grazing season. The proportion of *cis*-C18:1 was higher (25.4 vs 19.3%, $P<0.01$) for grazing cows than for confined cows, and the proportion of this FA decreased linearly over time for both groups. Milk fat content of C18:2 was increased in cows grazing pasture at wk 2 (2.8 vs 2.6%, $P=0.05$) and at wk 8 (2.8 vs 2.5%, $P=0.05$). The proportion of C18:3 was enhanced ($P<0.01$) by pasture treatments at wk 2, 4, and 8 of the trial. Milk FA profile was relatively similar between cows grazing PP and those grazing (RC+PP/ARG). Only CLA and C18:3 were slightly increased ($P=0.08$ and 0.03, respectively) in cows grazing RC or PP/ARG at wk 6 (1.3 vs 1.1%, CLA) and wk 8 (0.6 vs 0.5%, C18:3). Cows grazing RC had higher CLA (wk 6, $P=0.03$), C18:3 (wk 2, 4 and 8, $P<0.05$) and *trans*-C18:1(wk 2 and 4, $P<0.01$) than cows consuming ARG/PP. This study showed important differences in milk FA composition between cows fed TMR and cows grazing different pasture species.

Key Words: Milk fatty acids, TMR, Pasture

1258 Effect of linoleic or oleic acid-rich oils on conjugated linoleic acid (CLA) content of adipose and muscle of finishing cattle. M.A. McGuire*, A.N. Hristov, L.R. Falen, L. Kennington, C.W. Hunt, and J.K. Ropp, *University of Idaho, Moscow*.

Enhancing the CLA content of beef may be beneficial to human health. Impacts of biohydrogenation in the rumen could affect CLA content since CLA is formed as an intermediate in the biohydrogenation of linoleic acid. We examined whether linoleic (LIN) or oleic (OLE) acid-rich oils altered the CLA profile of muscle and adipose tissues of finishing cattle. Two groups of 8 Angus cattle (423 ± 7.4 kg initial BW) blocked by sex and BW were randomly allocated to two dietary treatments: LIN (76.5% linoleic acid safflower oil) or OLE (76.5% oleic acid safflower oil) fed at 5% of dietary DM. The remainder of the diets was 78% rolled barley grain, 15% wheat silage and alfalfa hay, and 2% minerals and vitamins (DM basis). Cattle were gradually adapted to the diet and fed individually for 116 days. Oils were fed during the last 86 days of the trial. Tissues were collected 24 h post slaughter and included kidney-pelvic fat (KP), subcutaneous fat (SQ) over the 12th rib, longisimus dorsi (LD), semitendinosus (ST), and semimembranosus (SM) muscle. Lipids were extracted by a modified Folch procedure and methyl esters formed using Na methoxide. Gas chromatography of the methyl esters was performed. Concentrations of the major CLA isomer (*cis*-9, *trans*-11) were greater ($P<0.005$) in KP (0.25 *vs* 0.15% total fatty acids), SQ (0.42 *vs* 0.23%) and LD (0.34 *vs* 0.21%) but not ($P>0.1$)in ST (0.31 *vs* 0.27%) or SM (0.37 *vs* 0.25%) from cattle fed LIN compared to OLE. The second most abundant CLA isomer was *trans*-7, *cis*-9 CLA. Treatment did not ($P>0.1$) alter *trans*-7, *cis*-9 CLA content averaging 0.19, 0.27, 0.14, 0.13 and 0.21% in KP, SQ, ST, SM and LD, respectively, for both treatments. The *trans*-10, *cis*-12 CLA isomer was greater ($P<0.05$) with LIN compared to OLE only in KP (0.05 *vs* 0.03%) and SQ (0.05 *vs*

0.02%). In conclusion, linoleic acid-rich safflower oil added to a barley-based diet enhanced the concentration of CLA isomers in most tissues of finishing cattle.

Key Words: Dietary oil, CLA, Cattle

1259 Effect of fat sources differing in fatty acid profile on lactational and reproductive performance of Holstein cows. S.O. Juchem*[1], J.E.P. Santos[1], R. Chebel[1], R.L.A. Cerri[1], E.J. DePeters[1], K.N. Galvao[1], S.J. Taylor[1], W.W. Thatcher[2], and D. Luchini[3], [1]*University of California Davis,* [2]*University of Florida,* [3]*Bioproducts Inc.*.

Five hundred multiparous Holstein cows were randomly assigned to one of the two treatments at calving after blocking according to parity and previous lactation milk yield. Treatments consisted of a diet containing either tallow (TA; 1.3% DM) or a Ca salt of palm and fish oils (CaS; 1.6% DM), to provide equal amounts of fatty acids (FA). The Ca salt supplement provided 20 g/d of eicosapentaenoic (EPA) and docosahexaenoic (DHA) FA combined. Cows were milked 3-x daily and production of milk and milk components were measured monthly for the first 130 DIM. All cows were timed artificially inseminated after the Presynch/Ovsynch protocol at 703 DIM. Pregnancy was diagnosed at 28 d after AI by ultrasonography and reconfirmed at 39 and 65 d after AI by rectal palpation. Milk and blood samples were collected for determination of FA profile. Coccygeal blood was also collected for measurements of plasma progesterone, glucose, and nonesterified FA. On day 15 of a synchronized estrous cycle, 20 cows were challenged with estradiol and oxytocin, and blood was collected sequentially for determination of plasma PGF2a metabolite. Individual cow DM intake and diet digestibility were determined twice in a subset of 30 cows (15/trt) using Alkane as a marker. Continuous data were analyzed by the PROC MIXED procedure of SAS, and binomial variables by logistic regression. Preliminary data are presented from 120 cows. Yields (kg/d) of milk, 3.5% fat-corrected milk, milk fat and true protein did not differ ($P > 0.15$) and were, respectively, 49.4, 52.6, 1.93, 1.38 for cows fed CaS, and 48.2, 52.0, 1.93, 1.38 for cows fed TA. Plasma glucose tended to be higher for cows fed CaS (60.0 vs 57.4 mg/dl; $P < 0.10$). Concentrations of n-3 FA in milk tended to increase for cows fed CaS (0.46 vs 0.42%; $P < 0.10$), but milk EPA (0.043 vs 0.037%), DHA (0.024 vs 0.014%) and CLA (0.76 vs 0.53%) were higher for CaS compared with TA ($P < 0.01$). Conception rate at d 28 after AI was similar for cows fed CaS and TA (42.6 vs 40.7; $P < 0.83$), but pregnancy loss from d 28 to 39 after AI was reduced for CaS compared with TA (0 vs 15%; $P < 0.10$).

Key Words: Fatty acid, Reproduction, Cows

1260 Breed of dairy cows has influence on conjugated linoleic acid (CLA) content of milk. T. R. Dhiman*[1], M. S. Zaman[1], L. Kilmer[2], and D. Gilbert[3], [1]*Utah State University,* [2]*Iowa State University,* [3]*New Generation Genetics, Inc., Wisconsin.*

Two experiments were conducted to determine the conjugated linoleic acid (CLA) content of milk from different breeds of dairy cows. In experiment-1, five cows each of Brown Swiss, Holstein-Friesian and Jersey breed were grazed on pasture and fed 8.6 kg of supplemental grain and 4.5 kg of alfalfa hay daily. The pasture contained predominantly perennial ryegrass, white clover and fescue. Grain supplement contained corn, barley and soybean meal. The duration of the experiment was 10 weeks. First 6 weeks were for adaptation to the diets and milk samples were collected during the last 4 weeks of the experiment from two consecutive a.m. and p.m. milkings. Weighted composite milk samples were analyzed for fat, protein, lactose and CLA content. In experiment 2, twenty lactating cows (five each of Ayrshire, Guernsey, Holstein-Friesian and Jersey breeds) were fed total mixed ration containing 34% conserved forage and 66% grain and by-product feeds (DM basis) for 7 weeks. First 3 weeks were considered for adaptation to the diets and milk samples were collected during the last 4 weeks of the experiment from consecutive a.m. and p.m. milkings for fat, protein, lactose and CLA analysis. In experiment 1 the CLA contents were 1.22^a, 0.86^b and 0.77^b g per 100 g of fat in milk from cows in Brown Swiss, Holstein-Friesian and Jersey breeds, respectively ($P < 0.05$). In experiment 2, milk from Ayrshire, Guernsey, Holstein-Friesian and Jersey had 0.57^b, 0.36^c, 0.78^a and 0.33^c g per 100 g of fat, respectively ($P < 0.05$). The Brown Swiss cows grazing on pasture and fed supplemental grain had higher levels of CLA in milk fat than Holstein-Friesians and Jerseys fed similar diets. The CLA content of milk from Holstein-Friesians and Jersey cows was not different in experiment 1. Experiment 2, milk from Ayrshire and Holstein-Friesian cows fed conserved forage and grain had higher level of CLA compared with cows in Guernsey and Jersey breeds fed similar diets. The CLA content of milk from Guernsey and Jersey cows fed conserved forage was not different. Results suggest that breed can influence CLA content of milk from cows fed similar diets.

Key Words: CLA, Milk, Breed

1261 Effect of tallow and Ca-salts of fatty acids on milk production and nutrients digestibility in lactating Holstein cows. Eeman Nooraee*, Abbasali Naserian, and Reza Valizadeh, *Ferdowsi University Of Mashhad, Mashhad, Khorasan,Iran.*

Nine multiparous cows in midlactation were utilized in 3×3 change over design with 21-day periods to study the effects of two supplemental fat sources (tallow and Ca-salts of fatty acids)on production and nutrients digestibility. Treatments were : 1) no added fat (control), 2) 4% tallow (DM basis), 3) 4% Ca-salts of fatty acids (DM basis). Cows were fed as TMR. Although Milk yield was increased about 4% by fat supplementation but differences among treatments were not significant ($P \leq 0.05$).4%FCM,milk fat percentage, fat yield, dry matter intake and apparent digestibilities of DM, OM and CP did not differ among treatments. Protein, SNF and casein percentages were reduced in fat included treatments significantly ($P \leq 0.05$), but yields of milk protein, SNF and casein did not differ among treatments. Digestibilities of EE, NDF, ADF and Ca were affected by treatments ($P \leq 0.05$).Digestibility of ether extract in fat included treatments were higher than control treatment. Concentrations of glucose, triglyceride and BUN in plasma were not affected by treatments, but concentrations of colesterol were elevated by fat supplementation significantly ($P \leq 0.05$). Thermal and humidity index had significant effect on percentages of milk fat, SNF, Casein, ($p \leq 0.05$) and milk yield, 4%FCM, DMI and ADF, NDF, EE intakes ($p \leq 0.01$).

Key Words: Dairy cows, Fat supplementation, Heat stress

1262 Modifications in the percentages of the C18 milk fatty acids due to the unsaturation level of dietary fats fed to dairy goats at the onset of lactation (linseed vs rapeseed). S. Giger-Reverdin[1], C. Duvaux-Ponter[1], P. Morand-Fehr[1], P. Weill[2], and D. Sauvant*[1], [1]*UMR INRA - INAPG Physiologie de la Nutrition et Alimentation,* [2]*Valorex-Prodex.*

Today, consumers are fond of dietary products rich in unsaturated fatty acids, because these types of products might decrease the cardio-vascular risks. Dietary fat from animal products is generally rich in saturated or monounsaturated fatty acids, especially with 18 atoms of carbon. As dietary composition of feeds allowed to the animals influences the composition of animal products, it was of interest to test the influence of the replacement of rapeseed grains (rich in C18:1) by linseed ones (rich in C18:3) for dairy goats in early lactation. Two groups of 13 dairy goats were fed with complete diets containing 50 % corn silage (DM basis), 10 % dehydrated alfalfa and a compound feed with 20 % extruded oilseeds (linseed or L vs rapeseed or R). Goats received the diets during the four weeks before kidding and the first six weeks of lactation. Oilseeds had similar fat content, as did the diets (5.75 %/DM). Each goat was sampled at the third and at the fifth weeks of lactation. Analyses of milk fat were performed on a capillary column of a gas chromatograph. The following effects were tested: diet (linseed vs rapeseed), stage of lactation (third vs fifth week after parturition), parity of goats (primiparous vs multiparous) and the interactions between these factors. The sums of the percentages of short and medium chains fatty acids did not significantly differ between the two groups, such as the sum of the C18 (55.5 %). The percentages of the different C18 acids were expressed as their sum. The percentage of the stearic acid was similar for the two diets: 27.5 % for L diet and 28.9 % for R one. The oleic percentage was lower for the L diet (61.2 % vs 64.0 %). Percentages of linoleic acid was higher for the L diet (6.6 % vs 5.8 %), as was % of linolenic acid (4.7 % vs 1.3 %). The other factors tested had no significant effect on any of the parameters. In this experiment, the modification of only 8%DM of the diet had a significant influence on C18 milk fatty acids composition: the use of linseed seeds increased significantly the percentages of unsaturated fatty acids in agreement with the consumer's wishes. Moreover,

these grains are also rich in energy; this is useful in early lactation, when the animals have high energy requirements.

Key Words: milk fatty acids, unsaturation of dietary fat, goats

1263 Milk fatty acid profiles of cows fed fish oil with fat sources that differed in fatty acid profiles. A. A. Abu-Ghazaleh*[1], D. J. Schingoethe[1], A. R. Hippen[1], K. F. Kalscheur[1], and L. A. Whitlock[1], [1]*South Dakota State University.*

The objective of this experiment was to examine the effect of feeding fish oil (FO) along with fat sources that varied in their fatty acid compositions (high stearic, high oleic, high linoleic, or high linolenic acids) in order to determine which combination will lead to maximum conjugated linoleic acid (*cis-9, trans-11* CLA) and transvaccenic acid (TVA) concentrations in milk fat. Twelve Holstein cows (eight multiparous and four primiparous cows) at 73 (33-130) DIM were used in a 4 ×4 Latin square with 4 wk periods. Treatment diets were 1) 1% FO plus 2% fat source high in stearic acid (HiS); 2) 1% FO plus 2% fat from high oleic acid sunflower seeds (HiO); 3) 1% FO plus 2% fat from high linoleic acid sunflower seeds (HiLO); and 4) 1% FO plus 2% fat from flax seeds (high linolenic; HiLN). Diets formulated to contain 18% crude protein were composed of 50% (dry basis) concentrate mix, 25% corn silage, 12.5% haylage, and 12.5% alfalfa hay. Milk production (36.3, 37.0, 36.6, and 34.8 kg/d for diets 1 to 4) tended ($P > 0.05$) to be lower with HiLN. Milk fat percentages (3.14, 2.89, 2.72, and 3.06) were lowest ($P < 0.10$) for HiLO. Milk protein percentages (2.99, 2.98, 3.01, and 3.07) were similar ($P > 0.10$) for all diets. Dry matter intake (25.8, 23.4, 24.2, and 24.6 Kg/d for diet 1 to 4) were highest ($P < 0.08$) when cows were fed HiS diets. Milk CLA concentrations (0.75, 1.00, 1.67, and 1.07 g/100g fatty acids 4) and yields (81.6, 107.2, 164.8, and 111.5 g/d for diet 1 to 4) were highest ($P < 0.05$) with the HiLO and were the lowest with HiS. Milk CLA concentrations and yields were similar between cows fed HiO and HiLN diet. As with milk CLA, milk TVA (1.75, 2.41, 3.86, and 2.38 g/100g fatty acids 4) was highest ($P < 0.05$) with the HiLO diet and lowest with HiS diet. In summary, feeding a high linoleic acid fat source with fish oil most effectively increased concentrations and yields of milk CLA and TVA.

Key Words: conjugated linoleic acid, transvaccenic acid, milk fatty acids

1264 Investigation of exogenous fibrolytic enzyme activity on barley straw using in vitro incubation. Y. Wang* and T.A. McAllister, *Agriculture and Agri-Food Canada, Lethbridge, AB.*

The effects on nutrient utilization of adding exogenous fibrolytic enzymes (EFE) to livestock diets have been inconsistent. To isolate factors that may influence the overall effectiveness of EFE treatments, native and ammoniated (5%, w/w) ground barley straw (S and AS) were each prepared six ways for use in batch culture incubation: 1) control (treated with water), 2) treated with EFE (and used directly), 3) treated with EFE and held at 39°C for 24 h prior to incubation (i.e., prehydrolyzed), 4) prehydrolyzed and washed (PW) to remove EFE and hydrolysis products, 5) PW followed by re-application of autoclaved (inactivated) EFE, and 6) PW followed by re-application of hydrolysis product (reducing sugars, RS). The 12 substrates (500 mg DM) were incubated anaerobically at 39°C in 20 mL buffered ruminal fluid, with $(^{15}NH_4)_2SO_4$ included as a microbial marker ($n = 3$). At all time points (4, 12, and 48 h), DM disappearance (DMD), gas production (GP) and incorporation of ^{15}N into particle-associated microbial N (^{15}N-PAMN) were higher ($P < 0.001$) with AS than with S. Application of EFE increased ($P < 0.001$) DMD and GP at 4 and 12 h, but not ($P > 0.05$) at 48 h. Enzyme applied onto S increased ($P < 0.01$) ^{15}N-PAMN only at 4 h ($P > 0.05$ at 12 and 48 h), but EFE on AS increased ($P < 0.001$) ^{15}N-PAMN at all time points. Prehydrolysis increased ($P < 0.01$) DMD from both S and AS at 4 and 12 h, but reduced ($P < 0.01$) ^{15}N-PAMN early in the incubation (4 h), as compared to non-prehydrolyzed samples. Comparing treatments 5 and 6 with treatment 4 isolated the effects of post-washing supplementation with autoclaved EFE or RS. Both supplements linearly increased ($P < 0.05$) DMD at all time points, and GP and ^{15}N-PAMN at 4 and 12 h, but not at 48 h. Application of EFE to barley straw prior to incubation increased bacterial colonization of the substrate, but hydrolytic action of EFE decreased it, at least initially - the RS resulting from hydrolysis did promote colonization. Ammoniation enhanced the efficacy of enzyme action.

Key Words: Barley Straw, Ammoniation, Exogenous Fibrolytic Enzymes

1265 Calcium salts of conjugated linoleic acid were more effective than calcium salts of *trans* fatty acids in reducing milk fat of lactating cows. U. Moallem*, B. Teter, L. Piperova, J. Sampugna, and R. Erdman, *University of Maryland, College Park, MD.*

The objective of this study was to determine the effects of feeding supplements containing calcium salts of *trans* fatty acids (Ca-tFA) or conjugated linoleic acid (Ca-CLA) on milk fat production in lactating dairy cows. Forty-five lactating Holstein cows (15 primiparous and 30 multiparous) were fed a basal TMR (Control), containing 51% forage and 49% concentrate (DM basis) supplemented with 400 g of Energy-II (Ca-salts of fatty acids) during 2 wk adjustment period. After the adjustment period cows were assigned to one of five treatments: Control; and 4 diets supplemented with either 100 g (Ca-CLA100), or with 100 g (Ca-tFA100), 200 g (Ca-tFA200), and 400 g of (Ca-tFA400) in a randomized block design. The Ca-tFA and Ca-CLA supplements substituted for equal parts of Energy-II in the treatment diets. The treatment period lasted 4 wk followed by a 2 wk post-treatment period when cows again were fed the Control diet. Milk production and feed intake were recorded daily. The average DMI was decreased by 2.5% ($P< 0.02$) in cows fed the Ca-tFA400 diet. Daily milk production was reduced by 6.4% ($P < 0.0001$) with the Ca-tFA200 and Ca-tFA400 treatments, while no effects of Ca-CLA100 on milk production were observed. The Ca-CLA100 diet decreased milk fat percent and milk fat yield by 26% and 24% respectively. The Ca-tFA200 and Ca-tFA400 treatments were also effective in reducing milk fat (11-16%) and yield (10-13%). Milk CLA and tFA increased with the supplementation and returned to the control values during the post-treatment period. The recovery of milk fat was faster in cows received diets supplemented with Ca-tFA than in cows fed the Ca-CLA100 diet. Isomers of tFA and CLA containing a *trans*-10 double bond have been associated with reduction of milk fat synthesis. Analysis of CLA and tFA isomers of the diet supplements, indicated that 1.5 g/d of *trans*-10, *cis*-12-18:2 provided by the Ca-CLA100 diet were more effective in reducing milk fat production than 6.5 g/d of *trans*-10-18:1 supplied with the Ca-tFA400 diet.

	Treatments					
Items	Control	Ca-tFA100	Ca-tFA200	Ca-tFA400	Ca-CLA100	SEM
DMI, kg/d	23.5^{c}	25.1^{a}	24.0^{b}	22.9^{d}	23.4^{c}	0.2
Milk yield, kg/d	38.3^{a}	37.6^{a}	36.0^{b}	35.9^{b}	38.1^{a}	0.3
Fat, %	3.39^{a}	3.30^{a}	3.04^{b}	2.98^{b}	2.54^{c}	0.06
Fat yield, kg/d	1.24^{a}	1.19^{ab}	1.11^{bd}	1.04^{d}	0.95^{e}	0.03

Means within a row without common superscripts differ ($P< 0.03$).

Key Words: Calcium salts of *trans* fatty acids, Calcium salts of conjugated linoleic acid, Milk fat yield

1266 Digestion and ruminal parameters of fresh winter oats supplemented with protected fatty acids in substitution or addition to corn grain energy. P. V. van Olphen*[1], F. J. Santini[1−2], E. Pavan[2], G. A Gagliostro[2], and J. C. Elizalde[1−3], [1]*Facultad de Ciencias Agrarias, Universidad Nacional de Mar del Plata,* [2]*Instituto Nacional de Tecnologia Agropecuaria, Balcarce,* [3]*CONICET.*

Six steers (BW 428 kg) fitted with ruminal, duodenal and ilean cannulas were used to evaluated the fermentation and total DM (DMD) and NDF (NDFD) digestiblility of fresh winter oats (WO) supplemented by addition or substitution of ground corn grain by calcium salts of fatty acids (Ca-FA). Treatments were: C) only WO, HC) 50% WO + 50% of ground corn grain, LC) 65% WO + 35% ground corn grain, and FA) 58.5% WO + 35% corn grain + 6.5% of Ca-FA. HC and FA supplement were isoenergetic. Winter oats (22% DM, 68% IVDMD, 16.8% CP, 44.5% NDF) was cut daily and offered with the supplement three times per day. Total DMI was restricted to 90% of ad libitum. Data were analyzed under a 6 x 4 Youden square design, and treatments were compared by the following contrasts: C vs HC, HC vs FA (substitution effect) and LC vs FA (addition effect). Mean total DMI was 10 kg per day. Results are show in the table below. It is concluded that the supplementation of winter oats with HC reduce total DMD and NDFD, but similar level

of energy may be supplied without negative effects on total DMD and NDFD by substitution of corn by Ca-FA. Although, the addition of Ca-FA as supplement depresses DM and NDF ruminal digestibility, these effects disappear in the total tract digestion.

		Treatments [a]					Contrasts [b]		
Item		C	HC	FA	LC	SEM	Cvs HC	LCvs FA	HCvs FA
Apparent digestion		% of intake							
Rumen	DM	50.1	52.2	43.2	54.5	2.76	NS [c]	< .01	.03
	NFD	60.0	56.6	58.2	68.5	3.06	NS	.02	NS
Total tract	DM	62.4	57.8	63.1	64.4	1.32	.02	NS	.01
	NFD	61.0	52.1	60.3	61.6	2.55	.03	NS	.03
pH		5.99	5.63	5.87	5.82	.08	< .01	NS	.01
Total VFA, mM		91.2	94.9	85.1	95.9	13.1	NS	.03	.04
A:P [d]		3.32	2.56	2.95	3.05	.29	< .01	NS	.05

[a] C) only WO, HC) 50% WO + 50% of ground corn grain, LC) 65% WO + 35% ground corn grain, and FA) 58.5% WO + 35% corn grain + 6.5% of Ca-FA. [b] Contrasts effects. [c] Not significant (P> .10). [d] acetate : propionate ratio.

Key Words: calcium salts of fatty acids, fresh forage, corn grain

1267 Effects of feeding encapsulated and unprotected docosahexaenoic acid on feed intake, milk production, milk composition, and fatty acid profile in dairy cows. S.A. Crowder*[1], J.E. Garrett[2], and S.S. Donkin[1], [1]*Purdue University, West Lafayette,IN,* [2]*OmegaTech, Boulder,CO.*

Milk enriched with docosahexaenoic acid (DHA) could provide consumers with alternatives for attaining adequate omega-3 fatty acids from natural sources. Enriching milk with DHA is potentially challenged by rumen metabolism. The objective of this study was to determine the effects of DHA derived from marine algae (DHA Gold, Omega Tech, Inc., Boulder, CO) on milk production, composition, and fatty acid profile when fed as a rumen unprotected DHA source or one of two rumen-protected DHA to dairy cows. Within the rumen unprotected DHA source the level of DHA feeding was examined. Forty-eight Holstein cows were assigned to six groups and supplemented for 11 weeks with 0, 50, 100, or 150 g/d of rumen unprotected DHA or 100 g/d with one of two encapsulated DHA sources (B and P). Average milk production did not differ for the treatment groups, but DHA feeding decreased milk production after 4 weeks (time x treatment, P<0.05). Feed intake was decreased (P<0.05) by 14% for all DHA sources and was more pronounced after 3 weeks. Feeding DHA decreased (P<0.05) milkfat percent and yield regardless of DHA level or source. Milk fatty acids (g/100g) were: conjugated linoleic acid (CLA) 0.27, 0.88, 1.07, 0.97, 0.75, and 1.150.07; eicosapentaenoic acid (EPA) 0.07, 0.59, 0.28, 0.30, 0.14, and 0.590.11; DHA 0.19, 0.42, 0.64, 0.64, 0.45, and 0.590.06 for 0, 50, 100, 150 g/d unprotected DHA and encapsulates B and P respectively. Feeding DHA elevated (P<0.05) milk CLA, EPA and DHA. The effects of unprotected DHA were linear and quadratic for CLA and DHA and quadratic for EPA. Feeding DHA increased (P<0.05) total unsaturated fatty acids an average of 19% (23.9 and 28.5 0.77) regardless of DHA level or source but did not alter total saturated fatty acids. The data indicate DHA enrichment of milk that does not depend on protection from rumen metabolism but is responsive to level of DHA feeding.

Key Words: Omega-3 fatty acids, DHA, CLA

1268 Dry matter intake and rumen-fill from lactating cows receiving elephant grass (*Pennisetum purpureum*, Schum.) at three harvesting date. J.P.G. Soares[1,4], L.J.M. Aroeira*[2], F. Deresz[2], T.T. Berchielli[3], R.S. Verneque[2], and P. Andrade[3], [1]*Embrapa Rondonia, Porto Velho - RO - Brasil,* [2]*Embrapa Gado de Leite, Juiz de Fora - MG - Brasil,* [3]*FCAVJ/UNESP, Jaboticabal - SP - Brasil,* [4]*Part of Ph.D. Thesis of the 1st author at FCAVJ/UNESP, supported by FAPESP.*

Dry matter intake (DMI), neutral detergent fiber intake (NDFI) and rumen fill from nine Holstein x Zebu (520kg) lactating (13.2kg), fistulated cows were evaluated in a split plot experiment. Three cows were distributed in a Latin Square design to testing three treatments (elephant grass cut at 30, 45 and 60 days old, offered chopped *ad libitum*). The Latin Square was repeated three times. Within each treatment a split-plot design was included to test four schedules of ruminal evacuation: 0, 2, 4 and 6 hours after feeding. DMI and NDFI were measured gravimetrically in a Calan Gates system by the difference between offered and refused feed. The chemical composition, *in vitro* dry matter digestibility (IVDMD) of the grass and the ruminal content varied in relation to the forage growth stage (P <0.05). Values for IVDMD were 58.7, 57.7 and 55.2% and for NDF 62.9, 65.5 and 70.1% for forage 30, 45 and 60 days old, respectively. The results showed that elephant grass 30 days old had higher IVDMD and lower NDF (P <0.05) when compared to samples from forage 60 days old. Mean DMI (8.0 kg/cow/day) and NDFI (5.0 kg/cow/day) values observed from animals fed elephant grass aged 30 days were less (P <0.05) than those from forage 45 days-(10.5 and 6.6 kg/cow/day) and 60 days-old (11.0 and 7.7 kg/cow/day). Mean DMI values for the last two treatments forage cut at 45 and 60 days re-growth were similar to each other (P>0.05). Maximum ruminal contents were observed at 4:22, 3:55 and 3:49 hours after feeding with neutral detergent fiber fill (NDFFILL) of 7.0; 6.3 and 8.4 kg/day from elephant grass 30, 45 and 60 days old, respectively. However, no difference was found. In this trial the hypothesis that rumen fill was the limiting factor of DMI, in tropical forages was not proved.

Cut age	DMI	NDFI	NDFFILL
days	kg/day	kg/day	kg/day
30	8.0±0.41 b	5.0±0.23 c	7.0±0.21 a
45	10.5±0.41 a	6.5±0.23 b	6.3±0.21 a
60	11.0±0.41 a	7.7±0.23 a	8.4±0.21 a
Average	9.8	6.4	7.3
CV(%)	24.6	24.6	16.7

a>b (P < 0.05) in the column, by Newman-Keuls test

Key Words: Elephant grass, Intake, Rumen fill

1269 The effect of diet on milk production, lactation curve, composition, and processing characteristics in dairy goats. B.R. Min*[1], K.A. Soryal, S.P. Hart, S. Zeng, R. Puchala, A. Goetsch, and T. Sahlu, [1]*E (Kika) dela Garza Institute for Goat Research, Langston University, OK 73050, USA.*

This study investigated effects of different levels of concentrate supplementation on milk production (MP), composition, and processing characteristics (PC) with dairy goats grazing from April 2000 to September 2001. Forty-four Alpine goats (54±10 kg BW) were randomly allocated to four groups and supplemented with 0.66 (A and B), 0.33 (C), and 0 kg concentrate (D) per kg of milk over 1.5 kg/d. Mixed vegetative forages were rotationally grazed except for A (confined and fed alfalfa hay). The MP was recorded daily and milk samples were collected twice monthly and analyzed for fat (F), protein (P), lactose (L), solids-not-fat (SNF), total solids (TS), and PC (Year 2001 only). Egyptian Domiati cheese yield and organoleptic PC were analyzed fresh or after 1 or 2 mo pickling in whey solution. The lactation curve was calculated by Wood's incomplete gamma function. Average MP (kg/d) increased (R^2=0.59; y=1.72x+1.51; P<0.001) with increasing level of concentrate supplementation. Average MP during both years was 3.7, 3.3, 3.3 and 2.8 kg/d for A, B, C, and D, respectively (P<0.01). Initial MP and the rate of increase to the peak were similar among treatments, but the mean date of peak MP for D (29 d) was earlier (P<0.05) than for A, B, and C (43, 35, and 36 d, respectively). Persistency was not affected (6.2) by treatment in 2001, but for D (5.6) was lower than for A, B and C in 2000 (6.5, 6.2 and 6.1, respectively). Milk F concentration was similar among treatments; however, milk P and L concentrations for D were lower than for A, B, and C (P<0.01). Average milk concentrations of F, SNF, TS, P, and L decreased linearly (P<0.01) as lactation progressed. Cheese yield was 17% higher (P<0.01) for B at the beginning and end of lactation than for other groups. Greatest cheese flavor was for D during summer (June-July; P<0.01). In conclusion, MP, composition, and PC, as well as the lactation curve, were affected by the feeding treatment and stage of lactation.

Key Words: goat milk, cheese.

1270 Intake preferences and nitrogen metabolism in beef steers grazing Bermudagrass, Caucasian bluestem, or Gamagrass. G.B. Huntington*[1], J.C. Burns[2], and S.A. Archibeque[1], [1]*North Carolina State University,* [2]*USDA-ARS*.

Our objective was to evaluate three warm-season grasses from the perspective of forage composition, selection by grazing beef steers, and nitrogen (N) metabolism in ruminants. Paddocks of bermudagrass (*Cynodon dactylon*, BG), caucasian bluestem (*Bothriochloa caucasica*, CBS), and gamagrass (*Tripsacum dactyloides*, GG) were fertilized with 70 lb of N per acre about 60 and 30 d before sample collection. In 2000 and 2001, 12 steers (250 kg BW) were blocked on the basis of liveweight and then randomly assigned to a replicated, randomized complete block design with 2 paddocks of each forage and 2 steers per paddock. After at least 14 d adaptation, urine and blood samples were collected from each steer for determination of serum urea N (SUN, mM) and percentage of urinary N in the form of urea (PCTUREA). One steer per paddock was infused i.v. with $^{1}5, 15$ N-urea for 48 h before urine was collected for 6 h to measure enrichment of urea N, urea entry rate (UER, mmol N/h), and urinary urea excretion (UUE, mmol N/h). Three other steers with esophageal fistulas were used to collect masticate samples that represent the steers' intake preferences. Forage and masticate composition data are for 2000 only. The CP (% of DM) and NPN (% DM) content were highest for BG canopy (12.0 and 3.1), followed by GG (10.9 and 1.9) and CBS (9.1 and 1.8). True protein (% DM) was similar in GG (9.0) and BG (8.9) canopy followed by CBS (7.3). However, crude protein was higher in masticate for GG (13.8) than BG (11.8) or CBS (9.8). Masticate from GG was higher in true protein (12.2) than masticate from BG (8.7) or CBS (8.1). Steers grazing CBS had lower ($P < 0.05$) SUN, PCTUREA, and UER(2.49, 31.5, and 177) than steers grazing BG (12.23, 69.9, and 294) or GG (10.14, 66.3, and 266). The proportion of UER excreted as UUE was lower ($P < 0.10$) for CBS (0.11) than for BG (0.54) or GG (0.35). Responses in SUN and PCTUREA, and UER reflect canopy or masticate crude and true protein content. However, NPN was similar in canopy and masticate for CBS and GG, but those two forages differed in SUN, PCTUREA, and UER. We conclude that compositional differences among the forage species affected proportions of nitrogen absorbed as non-protein N and affected urea production and recycling by the steers.

Key Words: Beef steers, Forages, Nitrogen metabolism

1271 Effect of feed intake on mean retention time of fibre in the rumen. M.R. Weisbjerg*, P. Lund, and T. Hvelplund, *Danish Institute of Agricultural Sciences, DK-8830 Tjele, Denmark*.

Rumen metabolism of neutral detergent fibre (NDF) was investigated in four 4x4 Latin square experiments with rumen, duodenum and ileum fistulated Danish Holstein Friesian cows with an average weight of 616±92 kg. Eight different forages (early cut and late cut grass silage, grass-clover silage, pea whole crop silage, barley whole crop silage, corn silage, grass hay, alfalfa hay) were fed ad libitum, either as the sole feed (two experiments) or supplemented with concentrate (two experiments). Concentrate was low in fibre, and daily offer was 5 kg of wheat meal and 1.5 kg of soybean meal. Forages showed a large variation in NDF content (269 # 659 g/kg DM) and indigestible NDF (INDF) content (46 # 172 g/kg DM). Intake, intestinal flow and faecal output were measured over three days in the third week in each period, followed by a week where three rumen evacuations were performed on different days and at different times (8, 14, 20), for estimation of mean rumen pool size of INDF. INDF content of rumen digesta and faeces was determined by 21 days rumen incubation in nylon bags. Mean rumen retention time (MRT, h) of INDF was calculated as 24*[(mean rumen INDF pool (kg))/(daily faecal INDF output (kg))]. Data were analysed for a general effect of dry matter (DM) intake on MRT of INDF using PROC MIXED (SAS Institute) and with experiment and cow interaction as random effects. A total of 60 observations were used with a variation in MRT of INDF from 30 to 118 h, and in feed intake from 6.1 to 20.1 kg DM/day. The analysis showed a decreasing MRT of INDF with increasing feed intake (P=0.007). However, the variation caused by type of forage was larger (P<0.0001) with least square means for MRT of INDF from 35h (corn silage) to 82h (early cut grass silage), but there was no significant interaction between forage and DM intake on MRT of INDF. The following equation for calculation of MRT was estimated (as a mean over forages): MRT of INDF (h) = 87.0(±9.5) # 2.04(±0.7)*(daily DM intake (kg)).

Key Words: INDF, Mean rumen retention time, Rumen evacuation

1272 Effect of diet forage:concentrate ratio on odd-chain fatty acids in milk from Holstein-Friesian cows. R. J. Dewhurst[1], J. M. Moorby*[1], J. Danelón[2], and J. K. S. Tweed[1], [1]*Institute of Grassland and Environmental Research, Aberystwyth, UK,* [2]*University of Buenos Aires, Argentina*.

Odd-chain fatty acids (OCFA) in milk are potential markers of microbial synthesis in the rumen. There is further interest in OCFA because recent studies showed anti-cancer effects. This experiment investigated the effect of varying diet forage-to-concentrate ratio on OCFA in milk. The companion paper gives further details and showed the substantial changes in composition of DM fermented in the rumen as concentrate feeding increased (20, 35, 50 and 65% of DMI for the 4 treatments). The experiment was a 4 × 4 Latin Square with 4-week periods. Milk samples were taken during the final week of each period and analysed for fatty acids by GC after a one-step preparation of methyl esters. Results were tested by ANOVA with orthogonal contrasts and the significance of linear effects is given. Odd-chain fatty acids were detected at low levels in the grass silage (0.11, 0.32, 0.25, 0.08, 0.09 and 0.29 % of total fatty acids as *iso*C15:0, *anteiso*C15:0, C15:0, *iso*C17:0, *anteiso*C17:0 and C17:0 respectively) and extremely low levels in concentrates (0.08 and 0.11 % of total fatty acids as C15:0 and C17:0 respectively; traces of others). There was no difference in concentrations of OCFA in morning and afternoon milk. The concentrations of some OCFA in milk (% of total fatty acids) remained the same (mean=0.44 and 0.22 for *anteiso*C17:0 and *iso*C17:0 respectively) as concentrate proportion increased. Concentrations of others decreased (*iso*C15:0: 0.32, 0.30, 0.30 and 0.26; SED=0.021; P<0.05; *anteiso*C15:0: 1.59, 1.49, 1.50 and 1.38; SED=0.104; P=0.11; C15:0: 1.85, 1.67. 1.53 and 1.35; SED=0.071; P<0.001; C17:0: 0.81, 0.74, 0.66 and 0.62; SED=0.018; P<0.001; C17:1: 0.54, 0.45, 0.38 and 0.35; SED=0.033; P<0.001). Patterns of OCFA in milk did not reflect differences in the OCFA content of diets, presumably because of differences in the pattern of microbial synthesis of OCFA. For example, increased synthesis of *anteiso*C15:0 with high-concentrate diets is consistent with earlier results showing high levels of this fatty acid in liquid-phase bacteria.

Key Words: Odd-chain fatty acids, Milk, Rumen

1273 Effect of diet forage:concentrate ratio on digesta flow and milk production in mid-lactation Holstein-Friesian cows. J. M. Moorby*[1], R. J. Dewhurst[1], J. Danelón[2], R. T. Evans[1], and M. A. Neville[1], [1]*Institute of Grassland and Environmental Research, Aberystwyth, UK,* [2]*University of Buenos Aires, Argentina*.

Four Holstein-Friesian dairy cows in mid-lactation were used to investigate the effect of forage-to-concentrate ratio (FC) on digesta flow to the duodenum and milk production and composition in a 4 × 4 Latin Square changeover experiment with 4-wk periods. Four treatments, based on ad libitum access to ryegrass silage (12.2% CP and 62% NDF in the DM) and a standard dairy concentrate (comprising 31% wheat, 15% rape meal, 15% corn gluten feed, 12% linseed meal, 11% sunflower meal and 16% others; 22.8% CP, 24.8% NDF, 22.1% starch), differed in FC: 80:20, 65:35, 50:50 and 35:65 DM. Concentrate allowances were calculated from 3 d rolling averages of silage intake. Results were tested by ANOVA with polynomial contrasts. Total DM intakes increased linearly (P<0.001) with decreasing diet FC (13.2, 15.5, 18.4 and 20.7 kg DM/d; SED=0.85, for 80, 65, 50 and 35% forage), with a slight but significant (P<0.01) linear substitution effect on silage intake (10.5, 9.8, 9.3 and 8.1 kg DM/d; SED=0.63). Flows of DM, N, NDF and starch to the duodenum all increased linearly with decreasing diet FC (all P<0.001). Apparent ruminal digestion of DM (5.0, 6.2, 6.4 and 8.8 kg/d; SED=0.76; P<0.01), N (-2, 27, 3 and 105 g/d; SED= 26.1; P<0.05) and starch (0.45, 0.97, 1.71, 2.42 kg/d; SED=0.184; P<0.001) increased linearly with decreasing diet FC, while that of NDF was not different among treatments (grand mean 4.5 kg/d). Milk yields increased linearly (17.3, 18.7, 20.8, 24.8 kg/d; SED=0.98; P<0.001) as DM intakes increased. Yields of milk fat (P<0.01) and protein (P<0.001) increased linearly, but fat concentrations decreased (P<0.01) and protein concentrations increased (P<0.01) with decreasing diet FC. In conclusion, increasing the proportion of concentrates in the diet increased feed intake which increased nutrient supplies to the animal and led to increased milk and milk component yields. Effects on milk odd-chain fatty acids can be found in a companion abstract.

Key Words: Forage:Concentrate Ratio, Milk Production, Rumen Digestion

1274 Milk production and composition from Holstein cows fed a total mixed ration or grazing different types of pasture under an intensive management system. C. Benchaar[1], T. D. Whyte*[2], R. Berthiaume[1], G. F. Tremblay[3], T. Astatkie[2], A. H. Fredeen[2], R. C. Martin[2], and P. Y. Chouinard[4], [1]*Agriculture and Agri-Food Canada, Lennoxville, QC,* [2]*Nova Scotia Agricultural College, NS,* [3]*Agriculture and Agri-Food Canada, Ste-Foy, QC,* [4]*Universite Laval, QC.*

The objective was to compare milk production and composition in cows fed a total mixed ration (TMR) or grazing different pasture species. Thirty-two lactating Holstein cows were randomly allocated to one of four treatments: 1) TMR, 2) permanent pasture (PP) containing a mixture of grasses and legume species, 3) pasture consisting of red clover (RC), and 4) PP during the day and annual ryegrass at night (PP/ARG). All cows received a supplement mix of similar composition. From the last week of June to the end of August, milk samples were collected from four consecutive milkings at wk 0 (covariate), 2, 4, 6, and 8 of the trial. Data were analysed as repeated measures using Proc Mixed of SAS. Effects of treatments were determined by orthogonal contrasts: TMR vs all pastures, PP vs (RC+PP/ARG), and RC vs ARG/PP. Throughout the experiment, milk production was not different ($P>.10$) between grazing groups (30.5 kg/d) and cows fed TMR (28.4 kg/d). Fat and total solids contents were similar (3.5 and 12.0%, respectively, $P>.05$) between grazing cows and confined cows. Protein percentage was not different between confinement cows and pasture-fed cows at wk 2 (3.01 and 2.94%, respectively, $P=.44$), but it increased linearly and was higher ($P<.01$) for the TMR-fed group than for the grazing groups (3.23 vs 2.95%) for the rest of the season. For both groups, lactose content decreased linearly over weeks, and was higher at wk 4 and 6 with TMR than with pasture treatments (4.65 vs 4.56%, $P=.01$ and 4.56 vs 4.43%, $P=.03$, respectively). Cows performances were not different between PP and (RC+ARG/PP). Milk production was similar between cows consuming RC and those grazing ARG/PP pastures (28.8 and 31.1 kg/d, respectively). Milk composition was relatively unchanged between RC and ARG/PP treatments. Only at wk 2 of the experiment, fat percentage was higher for RC group than for cows grazing ARG/PP pastures (4.02 vs 3.53%, respectively, $P=.03$). This study showed that milk production did not differ between cows grazing different pasture species and cows fed TMR. Except for milk protein, milk composition was not affected by grazing treatments.

Key Words: Milk production, TMR, Pasture

1275 Effects of forage particle size, forage source and corn processing on ruminal pH, chewing activity and milk production in dairy cows. K. M. Krause* and D. K. Combs, *University of Wisconsin-Madison.*

The objective of this study was to investigate the effects of and interactions between increasing levels of ruminally fermentable carbohydrates and forage particle size on ruminal pH. Twelve ruminally cannulated Holstein cows were used in two 6 x 6 Latin squares. Diets were arranged as a 3 x 2 factorial with three levels of ruminally fermentable carbohydrates and two levels of forage particle size (coarse:5.3 and 5.7 mm, fine: 2.6 and 2.6 mm for alfalfa and corn mean particle size, respectively). Ruminally fermentable carbohydrates were increased by replacing 50% of the alfalfa silage DM with corn silage and by replacing dry cracked corn with high moisture corn. Diets were: dry corn/coarse alfalfa silage (DCCA), dry corn/coarse alfalfa plus corn silage (DCCAC), dry corn/fine alfalfa silage (DCFA), dry corn/fine alfalfa plus corn silage (DCFAC), high moisture corn/coarse alfalfa plus corn silage (HMCCAC), and high moisture corn/fine alfalfa plus corn silage (HMCFAC). Diets were fed as TMRs with a 60:40 concentrate to forage ratio. Alfalfa silage based diets contained 29.1% starch and 1.60 Mcal NEl/kg, alfalfa/corn silage based diets contained 37.0% starch and 1.61 Mcal NEl/kg; all diets contained 25.0% NDF (DM basis). Effects of forage particle size (fps), corn processing (C), forage source (F) and interactions were tested using preplanned contrasts. Decreasing fps had a positive effect on milk production, but decreased chewing activity. Increasing level of fermentable carbohydrates decreased fat % and yield. Ruminal pH was only affected by corn processing.

	Diet						Contrast		
	DC-CA	DCC-AC	DC-FA	DC-FAC	HMC-CAC	HMC-FAC	fps	C	F
DMI, kg	24.4	23.5	22.6	22.0	21.8	20.3	**	*	NS
Milk yield, kg	39.8	41.6	43.0	42.0	41.6	42.1	*	NS	NS
Fat, %[a]	3.32	3.19	3.38	2.89	2.72	2.43	*	***	**
Fat yield, kg[b]	1.30	1.34	1.44	1.22	1.10	1.02	NS	***	*
Protein, %	2.86	2.92	2.83	2.89	2.84	2.83	NS	*	*
Ruminal pH	5.96	5.79	5.87	5.85	5.73	5.62	NS	*	NS
Eating, min/d	273	255	224	214	242	201	***	NS	NS
Ruminating, min/d	402	451	306	346	461	373	***	NS	*

* $P<0.05$, ** $P<0.01$, *** $P<0.001$, NS $P>0.01$ [a]fps x F interaction ($P=0.08$) [b]fps x F interaction ($P=0.007$)

Key Words: Ruminal pH, Forage particle size, Fermentable carbohydrates

1276 Feeding behavior of dairy cows in hot climate. I. Halachmi, E. Maltz, N. Livshin, A. Antler, D. Ben-Ghedalia, and J. Miron*, *ARO, The Volcani Center, Bet Dagan, Israel.*

Feeding behavior of cows in Israeli hot climate was measured and analyzed for simulation purposes. Forty cows kept in a group in an open cowshed, were divided into two feeding groups and fed individually ad libitum, one of two TMR: a TMR containing 18% forage NDF (CS), and a similar TMR containing 12% forage NDF in which the corn silage component was replaced by soybean hulls (SH). A fully automated system monitored each feeding event, of every cow in the group, as well as milk yield at every milking (06:00, 13:00, 20:00), and body weight (BW) after each milking. Food was given once a day at 10-11 AM. On average, a cow visited a feeding trough 14.3 times/d. Feeding duration and timing, and average DM intake (25.8±4.2 and 25.1±2.7 kg DM/d for the CS and SH groups, respectively) were not effected by the TMR, perhaps because of the similar physical density of the diets. The most intensive feeding activity was recorded at food distribution time when the cow consumed 17.4±3.4 % of the daily feed within 1h, and additional 3% during the consecutive hour. The lowest food consumption (22.9±1.7 % of total daily intake) was recorded between night and morning milking, compared to 38.4±0.7, and 38.7±1.4 % between the two following milking intervals. This was also represented by lower BW recorded after the morning milking (601±61 kg compared to 605±58 and 621±63 kg after the afternoon and night milking, respectively). Feeding activity and consumption correlated with food freshness rather than daily temperature, partly because milking stimulated feeding (14.2±1.4%, 16.8±1.5%, and 8.5±1.8% of daily feed consumption occurred during the first two h after 1st, 2nd, and 3rd milking respectively). However, during a particular hot day (>30°C), food consumption during the night was elevated to 28.4%, reduced between morning and noon milking to 32.6%, and elevated again to 39.0% between noon and night milking. This indicates that above a certain heat level, cows prefer feeding in the cooler hours of the day.

Key Words: Dairy cows, Feeding bahavior, Hot climate

1277 Daily energy intake influences fat and protein concentration of the milk. C.F. Borsting*, M.R. Weisbjerg, and V.F. Kristensen, *Danish Institute of Agricultural Sciences, DK-8830 Tjele, Denmark.*

The effect on milk composition (Danish Holstein Friesian cows) of increasing concentrate:forage ratio was examined with three types of forage. The forages were grass silage (first cut with organic matter digestibility, OMD: 0.75), whole crop barley silage (OMD: 0.70) and ammonia treated barley straw (OMD: 0.56). Each type of forage was examined in TMR diets fed ad libitum at three different concentrate:forage ratios, these ratios differing between forages aiming at equal levels of energy intake. The experiment was carried out twice with forages from the harvest of two years. Each year 7 cows were allocated to each of the 9 diets. The net energy (NE) of the diets varied between 6.6 and 8.0 MJ/kg dry matter. The daily ad libitum intake of NE varied from 118 to

209 MJ. There was an overall average increase of 0.43 g protein/kg milk for each increase of 10 MJ NE intake. For grass silage diets the increase was only 0.20 g, whereas it was 0.48 g for whole crop barley silage diets and 0.62 g for straw diets. For fat there was an overall average decrease of 0.61 g/kg milk for each increment of 10 MJ NE. Also for milk fat the changes were smaller for grass silage diets with a decrease of 0.13 g per increase of 10 MJ, compared to 0.62 g for barley silage diets and 1.08 g for straw diets. As expected also milk yield was affected by energy level, however, across the three energy concentrations there were no differences due to type of forage. Average daily milk yields were 34.1, 34.3 and 33.9 kg for grass silage, barley silage and straw diets, respectively, during week 3 to 15 post partum. The increase in milk yield was higher (0.9 kg) for silage diets (grass and whole crop barley) than for straw diets with an increase of 0.2 kg per additional 10 MJ NE. However, the effects of increasing energy level on the concentrations of protein and fat in milk increased from grass silage over whole-crop silage to straw. These different effects may be explained by a decreasing difference between proportions of concentrate between forages, from grass over whole crop to straw diets, when the overall level of concentrate (energy level) increased.

Key Words: Dairy cows, Milk protein, Milk fat

1278 Increasing feed availability for dairy cows. T. J. DeVries*[1], M. A. G. von Keyserlingk[1], J. A. Shelford[1], D. M. Weary[1], and K. A. Beauchemin[2], [1]*The University of British Columbia, Vancouver, Canada,* [2]*Agriculture and Agri-Food Canada, Lethbridge Research Centre, Canada.*

When cows are fed from a feed alley, they will consume, push away, and sort the feed in the time between feedings. To improve feed availability and quality, some producers push feed closer to the cows in the period between feedings. The objectives of this study were to monitor the effects of increasing the number of times feed is pushed up to cows on feed availability, feed quality, and feeding behaviour. We used 11 primiparous and 13 multiparous cows housed in a free-stall barn and fed a TMR twice daily. These cows were fitted with transponders that allowed us to automatically monitor the location and duration of each visit to the feed bunk, using a computerized monitoring system. Cows were subjected to two different feed push-up schedules. In the baseline schedule, cows were fed at 0600h and 01500 h, and feed was pushed closer to the cows at 1100h and 2130h. In the alternative schedule, feed was also pushed up to the cows at 0030h and 0330h. We found that the higher pushing up frequency resulted in an increased amount of feed available for the cows ($P < 0.05$). We also found that the amount of short fibre material (as determined by the Penn State Particle Size Separator) decreased with time after feeding ($P < 0.05$). However, this decline was reduced when feed push-up frequency was increased ($P < 0.05$). Interestingly, we did not find any difference in feeding frequency or duration between the two treatment conditions ($P > 0.05$). This data indicates that increasing the number of push-ups improves feed availability and quality, but may have little effect on feeding behaviour.

Key Words: Feeding Management, Feeding Behaviour, Feed Quality

1279 The effect of non-nutritional factors on Milk Urea Nitrogen levels in Ayrshire dairy cows. P. Arunvipas*, I. Dohoo, J. VanLeeuwen, E. Leger, and G. Keefe, *Atlantic Veterinary College, UPEI.*

This study was conducted to determine the effects of non-nutritional factors such as parity, days in milk, milk production, milk quality, and milk components on milk urea nitrogen (MUN). A total of 10 dairy farms in Prince Edward Island (PEI) containing 587 lactating Ayrshire cows participated in the research. Individual cow milk samples (n = 4,080) were collected monthly from July, 1999 to June, 2000 from each farm as part of the DHI milk recording system. Milk urea nitrogen levels and milk component (fat, protein, and somatic cell count (SCC)) were measured using a Fossomatic 4000 Milkoscan Analyzer at the PEI Milk Quality Laboratory. Mixed linear regression models were used to investigate the relationships between MUN and the cow and test-day factors, while controlling for the effect of clustering of MUN test dates within cow, and clustering of cows within herd, respectively. The overall average MUN was 11.17 mg/dl. Only the relationship between parity and MUN values was not significant ($P > 0.05$). The average MUN was low during the first month of lactation (10.14 mg/dl), rose to peak at 4 months of lactation (11.80 mg/dl), and decreased to the end of lactation (10.56 mg/dl). With each liter increase in milk production per cow per day, the average MUN value increased by 0.05 mg/dl. With each 0.1% increase in milk protein%, the average MUN value decreased by 0.2 mg/dl, while each unit increase in linear score decreased the average MUN value by 0.4 mg/dl. Lower MUN values occurred at low and high fat percentages. MUN values were elevated in late winter/early spring (March, April) and through the summer/fall months, with the highest average MUN values occurring in July and August (13.10 mg/dl). Results were very similar to those observed for the much larger sample of Holstein herds, except the proportion of variance at the herd level was much lower for Ayrshire herds, presumably due to more uniform feeding management.

Key Words: Milk Urea Nitrogen, Non-nutrition factors

1280 The effect of steam flaked or ground corn and supplemental phytic acid on N excretion in lactating cows and ammonia emission from manure. K. Burkholder*, A. Guyton, J. McKinney, and K. Knowlton, *Virginia Polytechnic Institute and State University.*

The effect of starch source and supplemental phytic acid on N excretion and ammonia volatilization from dairy manure was evaluated with 8 lactating cows. Cows were assigned to one of four treatments in 2, 4x4 Latin squares with 18 d periods. Diets were 61% forage, 37% starch, 16.6% CP, and 31% NDF, and included dry ground corn (DG) or steam flaked corn (SF), with no supplemental P (L; 0.34%P) or supplemental purified phytic acid (PA; 0.45%P) to provide additional P from an organic source. Total collection of milk, urine, feces, feed, and orts was conducted on d 16-18 of each period. Cows fed SF had lower DMI, higher feed efficiency (milk/DMI), and reduced feces and urine excretion compared to cows fed DG (data reported elsewhere). Nitrogen intake was not affected by dietary starch source (mean = 672.6 g/d), but N excretion in feces and urine was lower in cows fed SF than in cows fed DG (248.8 and 128.8 g/d vs. 284.6 and 145.1 g/d for SF and DG). Milk N as a percent of N intake was not affected by dietary starch source (mean = 27.6%), but cows fed SF had lower MUN than those fed DG (8.65 vs. 9.65 mg/dl), indicating improved N utilization with SF. Addition of PA did not affect N intake or utilization. For measurement of ammonia emission, feces and urine were sub-sampled on d 18 of each period and feces:urine ratio was calculated for each cow. Wet feces and urine were weighed into chambers in the proportions excreted, and ammonia volatilization was measured for 32 h using acid traps. Nitrogen at time zero (Ao), rate of ammonia emission (k), and residual N (R) were calculated using the exponential decay model $A_t = A_o\ e^{-kt} + R$. The interaction of starch source and PA affected rate of ammonia emission from manure (0.11, 0.13, 0.13, and 0.10 mg/h for DG-L, DG-PA, SF-L, and SF-PA). Altering source of dietary starch may provide opportunity to improve utilization of dietary N and reduce N excretion by lactating cows.

Key Words: steam flaked corn, ammonia emission, nitrogen excretion

1281 Use of cannulated pigs to model intestinal nutrient disappearance in cattle. D. Loveday[1], J.J. McKinnon[1], P. Thacker[1], and A. Mustafa[2], [1]*University of Saskatchewan,* [2]*McGill University.*

The objective was to use the mobile bag technique to determine if cannulated pigs can be used to estimate intestinal (I) and total tract (TT) crude protein (CPD) and dry matter digestibility (DMD) of ruminal undegradable residues (RUR) of various feed samples in cattle. Feeds varying in rumen degradability were utilized including heated (145°Cfor 1 h) and unheated samples of canola meal, soybean meal, barley distillers# grains, and barley silage as well alfalfa hay, dehydrated alfalfa pellets, and barley straw. Two Hereford steers (665 ± 13 kg) with ruminal and duodenal cannulas were used. RUR of each feedstuff were obtained by incubating large nylon bags (9 x 21 cm; pore size 40 mm) containing either 7 g of protein supplement or 5 g of forage sample in the rumen for 12 h. Subsequently, RUR of each feedstuff (0.52 g of protein supplement or 0.15 g of forage) were placed into 8 polyester bags (2.5 x 4.0 cm; 48 mm pore size) and inserted into the duodenum of the steers. Another 8 bags of each sample were randomly allocated to 6 Yorkshire x Lacombe gilts (50 ± 1.2 kg) and inserted into the duodenum of the pigs. All bags were recovered in the feces. Linear regression was used to relate I and TT DMD and CPD of pigs to that of steers. Intercepts

not different from zero were forced through zero to obtain a measure of bias and loss of precision resulting from forcing the zero intercept. The non-zero regression equations predicting steer estimates from those of pigs were −3.14 + 0.95X (r^2 = 0.98 SE 0.043) and −0.14 + 0.96X (r^2 = 0.99 SE 0.029) for I and TT DMD, respectively. Respective CPD estimates were 0.33 + 0.96X (r^2 = 0.98 SE 0.045) and 0.21 + 0.99X (r^2 = 0.99 SE 0.035). Forcing the non-zero intercept resulted in a bias of −10 and −4% with a SE of 0.03 and 0.01, respectively for I and TT DMD. Respective values for CPD were −3 and −1% for bias with a SE of 0.03 and 0.01. It is concluded that pigs can be used to model I and TT DMD and CPD of RUR in cattle.

Key Words: model, cattle, pigs, nutrient disappearance

1282 Development and evaluation of models to predict the feed intake of dairy cows in early lactation. M. A. Shah* and M. R. Murphy, *University of Illinois at Urbana- Champaign.*

The objective of the present study was to develop an accurate, robust and broadly applicable model for predicting dry matter intake, and to compare it with the current (2001) National Research Council model for dairy cows in early lactation. Among various functions, an exponential model was selected for its best fit to dry matter intake data of dairy cows in early lactation. Daily dry matter intake data (n = 8547) for three groups of Holstein cows (at Illinois, New Hampshire, and Pennsylvania) were used in this study. Cows at Illinois and New Hampshire were fed totally mixed diets for the first 70 d of lactation. At Pennsylvania data were for the first 63 d postpartum. Data from Illinois cows were used as the developmental data set and the other two data sets were used for model evaluation and validation. Data for body weight, milk yield, and milk composition were only available for Illinois and New Hampshire cows; therefore, only these two data sets were used for model comparisons. The exponential model, fitted to the individual cow daily dry matter intake data, explained an average of 74, 49, 67 and 64% of the total variation in daily dry matter intake for Illinois, New Hampshire, Pennsylvania, and overall, respectively. Based on all model selection criteria used in this study, the exponential model for prediction of weekly dry matter intake of individual cows was much superior to the current National Research Council equation. The exponential model explained 85% of the variation in weekly mean dry matter intake compared to 42% for the National Research Council equation. Compared to the exponential model a high relative prediction error was associated with prediction using the National Research Council equation (6 and 14%, respectively). The overall mean square prediction error value for individual cows was fivefold higher for the National Research Council equation than the exponential model (10.4 vs. 2.0 kg^2/d^2). The consistently accurate and robust prediction of dry matter intake by the exponential model for all data sets suggested that it could safely be used for predicting dry matter intake in many circumstances.

Key Words: intake, model, lactation

1283 Effect of stage of lactation on visceral tissue mass and intestinal proliferation. R. L. Baldwin*[1], K. R. McLeod[1], and A. V. Capuco[1], [1]*USDA, ARS, Beltsville, MD 20705.*

Twenty multiparous, nonpregnant, lactating dairy cows were used to assess the impact of stage of lactation on visceral tissue mass and small intestinal cell proliferation. Cows were housed in tie stalls with 12 h of light/dark and were milked twice daily at 0700 and 1800 h. Cows had ad libitum access to water and were fed a common corn silage based total mixed ration. Four to six cows were slaughtered at each of four stages of lactation: 14 d (n = 4), 90 d (n = 5), 120 d (n = 6) and 240 d (n = 5) of lactation. Following exsanguination, visceral organs were separated and weighed. Additionally, intestinal lengths were determined and tissue sections were sampled for composition analysis. Duodenal mucosa (100 mg wet wt.) was obtained by scraping with a glass slide and incubated for 1 h in the presence of tritiated-thymidine to assess proliferative activity. Dry matter intake increased with stage of lactation through 120 d with intake at 90 d and 240 d being similar ($P < 0.05$). Conversely, empty body wt. (EBW) declined with stage of lactation through 120 d ($P < 0.05$) and by 240 d was not different ($P > 0.1$) from 14 d cows. As a percentage of EBW , hepatic, ruminal and small intestinal weights were increased with increasing stage of lactation through 120 d ($P < 0.05$), and then either declined (liver) or remained the same through 240 d. However, stage of lactation did not have a measurable affect on Reticular, Omasal, Abomasal, or large intestinal weights as a percentage of EBW ($P > 0.1$). Visceral adipose tissue mass as a percentage of EBW declined with stage of lactation to a minimum at 120 d and was not different from 90 d by 240 d ($P < 0.05$). Duodenal incorporation of tritiated-thymidine was greatest at 90 and 120 d of lactation with rates of incorporation being similar 14 and 240 d of lactation ($P > 0.1$). These data demonstrate that dairy cattle visceral tissues increase in mass, as a percentage of EBW, in order to meet the energetic demands of lactation.

Key Words: viscera, lactation, proliferation

1284 Effects of duodenal amino acid and starch infusion on milk production and nitrogen balance in dairy cows. H. Volden and O. M. Harstad, *Agricultural University of Norway.*

A 6x6 Latin square designed experiment was conducted with 6 ruminally and duodenally cannulated dairy cows to evaluate the response of duodenal infusion of histidine, a mixture of histidine, methionine and lysine, wheat starch, and a combination of starch and present amino acids. Cows averaged 567 22 kg BW and 119 9 d postpartum, and were fed a basal diet consisting of grass silage (50 % of diet DM, 14.2 % CP) and a barley/oat based concentrate mixture (15.3 % CP). Infusion treatments (g/d) were water (Control), 4.1 g histidine (H), 4.0 g histidine + 5.4 g metionine + 14.3 g lysine (HML), 536 g starch (S), 4.1 g histidine + 532 g starch (HS), and 4.1 g histidine + 5.6 g metionine + 14.9 g lysine + 532 g starch (HMLS). Each period was divided into 7 d of water infusion and 14 d of treatment infusion. Treatments showed no effect on DM intake, which averaged 17.8 0.22 kg/d. As compared with the control, infusion of histidine alone or in combination with methionine and lysine resulted in higher milk protein production. Infusion of starch, (Control vs.S) increased milk protein production, whereas a combination of starch and amino acids showed no further increase. All starch treatments reduced milk urea, and reduced the proportion of dietary N excreted in the urine. From this study it is concluded that histidine is more limiting than methonine and lysine on grass silage based diets, and that post-ruminal starch supply increased N balance due to increased milk and tissue N retention.

	Control	H	HML	S	HS	HMLS	SEM
Milk, kg/d	22.7	24.1	24.7	24.4	24.1	24.4	0.4
Protein, g/kg	33.0	32.8	33.2	32.7	32.8	32.9	0.4
Protein, g/d	743^a	787^b	816^b	794^b	789^b	801^b	14
Fat, g/kg	38.7	37.5	37.8	37.0	36.7	36.6	0.7
Fat, g/d	876	910	931	902	885	893	16
Milk urea, mM	4.68^a	4.75^a	4.85^a	4.28^b	4.32^b	4.33^b	0.13
Milk N, % of N intake	25^a	27^b	27^b	28^b	28^b	28^b	0.7
Fecal N, % of N intake	31	31	32	33	33	33	0.8
Urine N, % of N intake	36^a	37^a	35^a	28^c	31^b	30^b	1.2

^{a,b,c} Means in rows with different superscripts differ ($P < 0.05$)

Key Words: Histidine, Starch, Nitrogen utilization