T177 Effects of OmniGen-AF on milk production and on lactation persistence in a commercial dairy setting. J. Chapman*[1], S. Puntenney[2], J. Verano[3], J. Heeg[4], Y. Wang[2], and N. Forsberg[2], [1]*Prince-Agri Products Inc., Quincy, IL*, [2]*Oregon State University, Corvallis*, [3]*Larson Dairy Inc., Okeechobee, FL*, [4]*Lakeland Animal Nutrition Inc., Lakeland, FL.*

The goal of this study was to evaluate effects of feeding OmniGen-AF, a commercially-available feed additive, on milk production and persistence of milk yield during a 60-day field trial. Holsteins cows (n=670), which included first, second and third lactation cows, were randomly assigned to a control treatment (n=342) or to a treatment which received OmniGen-AF (n=328) in the daily TMR. OmniGen-AF was fed at a rate of 56 g/hd/day for the first 30 days of the trial and at 28 g/hd/day for the second 30 days of the trial. Milk production records were collected throughout the study. Pre-experiment milk production levels of the control- and OmniGen-AF-fed groups were very similar (35.5 and 35.6 kg/hd/day, respectively). Effects of the two treatments on milk production were assessed statistically with a model which included pre-experiment milk production, days in milk, and lactation number as covariates. Addition of OmniGen-AF to the diet increased (P<0.05) absolute levels of milk production from 33.4 to 34.1 kg/hd/day during the 60-day feeding study. OmniGen-AF also significantly (P<0.05) increased persistence of milk production. Control-fed cows declined in production 2.42 kg/hd/day over the 60-day feeding study whereas milk production of OmniGen-AF-fed cows declined by only 1.08 kg/hd/day during the study. The benefit of the feed additive was more pronounced among multiparous cows. Specifically, control- and OmniGen-fed cows in first lactation lost similar amounts of milk (2.60 kg/hd/day and 2.22 kg/hd/day, respectively; P>0.05) during the 60-d study. Control-fed cows in third lactation lost 3.06 kg of milk/hd/day during the 60-day study whereas OmniGen-AF-fed third-lactation cows gained slightly (P<0.05) in production (+0.05 kg/hd/day) during the 60-day feeding study. These observations indicate potential for OmniGen-AF to increase milk production slightly and to improve persistence of milk production in multiparous cows.

Key Words: OmniGen-AF, Milk Production, Milk Persistence

T178 Principal component and multivariate analysis of milk fatty acid composition data from experiments designed to induce dietary milk fat depression in lactating cows. A. K. G. Kadegowda*, L. S. Piperova, and R. A. Erdman, *University of Maryland, College Park.*

The objective was to use principal component (PCA) and multivariate analysis (MA) to assess the relationship between milk fatty acid (FA) concentration (% of total FA methyl esters) and diet induced milk fat depression (MFD). Cow treatment observations (n=63) from 3 published feeding experiments with lactating dairy cows (Piperova et al. 2000, 2002, 2004 (J Nutr.130:2568, J Nutr.132:1235, and J. Dairy Sci. 87:3836, respectively) were used in the PCA. Principal component loading plots 1 and 2 described 55.9% of the total variation in milk FA and fat concentrations. Saturated FA (14:0, 16:0, 17:0) and milk fat showed negative loading for PC1 whereas trans t6-t15 18:1, along with t7c9, and t10c12 CLA showed positive (opposite) loading. Trans-16 18:1, 18:0, cis-18:1, cis 16:1, c11t13 CLA, and c9t11 CLA were associated with the PC2 axes (neutral), suggesting that they were not associated with changes in milk fat. Multivariate analysis using the SAS mixed procedure including experiment plus linear and quadratic terms for each of the PC1 positive loading variables showed significant regression coefficients (P < 0.05) for t6,7,8 (Fat % = 3.57 – 2.80X + 1.99X^2) and t10 (Fat % = 3.55 – .292X + .0121X^2) while all other trans-18:1 FA and CLA were nonsignificant. Subsequent MA was conducted on treatment means (n=33) from 9 independent literature experiments reporting milk t6-t11, c9t11 CLA, and t10c12 CLA. Significant effects of t9, t11 (P < 0.05), and t10 (P< 0.06), on milk fat percent were shown while t6,7,8 and c9t11 CLA and t10c12 CLA were nonsignificant. The PCA and MA analysis in the present study, confirms previous reports that t10 may be involved in MFD and suggest that t6,7,8 could also be important in MFD. Among the CLA isomers, the t10c12 CLA and t7c9 CLA isomer were consistently negatively correlated to milk fat. The analyses suggest that in addition to t10 18:1 and t10c12 CLA, the t6,7,8 18:1 and t7c9 CLA could be associated with MFD.

Key Words: Principal Component Analysis, Milk Fatty Acids, Milk Fat Depression

T179 In sacco forage fiber degradation in the rumen of lactating cows fed high- or low-forage diets supplemented with flaxseed or flaxseed oil. C. Benchaar*[1], H. V. Petit[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre, Lennoxville, QC, Canada.*, [2]*Agriculture and Agri-Food Canada, Lethbridge, AB, Canada*, [3]*Laval University, Quebec, QC, Canada.*

The objective of this study was to examine the effect of flaxseed (FS) and flaxseed oil (FO) supplementation (10 and 3%, respectively; DM basis) on ruminal in sacco fiber degradation in dairy cows fed high- (H) or low- (L) forage diets (70 and 30%, respectively; DM basis). Four lactating cows (BW=647 kg; DIM=96 d) used in a 4x4 Latin square design (4 wk/period) were fed: H+FS (HFS), H+FO (HFO), L+FS (LFS), and L+FO (LFO). Grass silage was ruminally incubated in duplicate nylon bags for 0, 2, 4, 8, 14, 24, 72, 48, and 96 h. Orthogonal contrasts (PROC MIXED, SAS) were used to determine the main effects of forage level, flaxseed source and their interaction. Significance was declared at $P \leq 0.05$, and tendencies at $0.05 < P \leq 0.10$. The rapidly degradable fraction of ADF (a) was similar among treatments (9.98%). The slowly degradable fraction (b) of ADF tended to be reduced when cows were fed L compared to H diets (55.9 vs. 69.8%). The degradation rate (c) of ADF was not affected by forage level (2.12%/h) but the lag time value (L) was higher with L than with H diets (5.3 vs. 2.4 h). The effective degradability (ED) of ADF was lower with L than with H diets (24.5 vs. 31.6%). Neither degradation kinetic parameters (a, b, c, L) nor ED of ADF were different between FS and FO. The fraction (a) of NDF was not affected by forage level (8.12%). The fraction (b) of NDF was not changed by forage level; although it was numerically lower for cows fed L compared to cows fed H diets (61.1 vs. 70.8%; P=0.18). Parameters (c) and (L) of NDF were not affected by forage level (2.07%/h and 2.0 h; respectively). The ED of NDF was lower with L than with H diets (24.5 vs. 30.9%; respectively). Degradation kinetic parameters and ED of NDF were similar between FS and FO. This study suggests that ruminal fiber degradability of grass silage is reduced when cows are fed low compared to high forage diets, but that feeding either flaxseed or flaxseed oil has no effect.

Key Words: Flaxseed/Flaxseed Oil, Forage Fiber, Ruminal in Sacco Degradation

T180 Effects of flaxseed and flaxseed oil supplementation on ruminal fermentation characteristics, and ruminal ciliate protozoal populations in cows fed high- or low- forage diets. C. Benchaar*[1], H. V. Petit[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre, Lennoxville, QC, Canada*, [2]*Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB, Canada*, [3]*Laval University, Quebec, QC, Canada.*

The objective of this study was to examine the effect of flaxseed (FS) and flaxseed oil (FO) supplementation (10 and 3%, respectively; DM basis) on ruminal fermentation characteristics and ruminal ciliate protozoal populations in dairy cows fed high- (H) or low- (L) forage diets (70 and 30%, respectively; DM basis). Four cows (BW=647 kg; DIM=96 d) used in a 4x4 Latin square design (4 wk/period) were fed: H+FS (HFS), H+FO (HFO), L+FS (LFS), and L+FO (LFO). Effects of treatments were determined (PROC MIXED, SAS) by orthogonal contrasts: H vs. L, FO vs. FS and their interaction. Significance was declared at $P \leq 0.05$, and tendencies at $0.05 < P \leq 0.10$. Ruminal pH was lower with L than with H (6.22 vs. 6.52) and was similar between FS and FO (6.35). Ruminal ammonia concentration was lower for cows fed L than for those fed H

(7.7 vs. 9.3 *mM*) but remained unchanged between FO and FS (8.5 *mM*). Ruminal total VFA concentration tended to be higher with L than with H (158. 7 vs. 148.1 *mM*), but did not differ between FO and FS (153.4 *mM*). Molar proportion of acetate was lower and that of propionate was higher for L than for H (57.2 vs. 65.5% and 27.1 vs. 19.4%; respectively). Molar proportions of these VFA were similar between FO and FS (61.3% and 23.3%; respectively). Acetate:propionate ratio was lower for cows fed L than for cows fed H (2.2 vs. 3.4) and it was similar between FO and FS (2.8). Total protozoa numbers were lower for cows fed L compared to cows fed H (2.6 vs. $5.3x10^5$/ml), but remained unchanged between FO and FS ($3.9x10^5$/ml). Only two genera of ruminal protozoa were detected. *Entodinium* numbers tended to be lower with L than with H (2.4 vs. 4.2 $x10^5$/ml) but were similar between FO and FS ($3.3x10^5$/ml). *Isotricha* numbers were similar among treatments ($0.14x10^5$/ml). This study suggests that ruminal fermentation characteristics and protozoa counts are not affected by FO and FS supplementation but they are influenced by forage level of the diet.

Key Words: Flaxseed/Flaxseed Oil, Ruminal Fermentation, Protozoa

T181 Effect of flaxseed and flaxseed oil supplementation on digestion, milk production, and milk composition in dairy cows fed diets with different forage levels. C. Benchaar*[1], H. V. Petit[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre*, *Lennoxville, QC, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [3]*Laval University*, *Quebec, QC, Canada.*

The objective of this study was to examine the effect of flaxseed (FS) and flaxseed oil (FO) supplementation (10 and 3%, respectively; DM basis) on digestion, milk production and milk composition in dairy cows fed high- (H) or low- (L) forage diets (70 and 30%, respectively; DM basis). Four lactating cows (BW=647 kg; DIM=96 d) used in a 4x4 Latin square design were fed: H+FS (HFS), H+FO (HFO), L+FS (LFS), and L+FO (LFO). Diets were formulated to be isonitrogenous, isocaloric and isolipidic. Orthogonal contrasts (PROC MIXED, SAS) were used to test the main effects of forage level (F), flaxseed source (FLA) and their interaction. Significance was declared at $P \leq 0.05$, and tendencies at $0.05 < P \leq 0.10$. DMI was higher with L than with H (26.2 vs. 22.0 kg/d) and was similar between FS and FO (24.1 kg/d). DM digestibility was higher with L than with H (68.0 vs. 62.6%) and with FO than with FS (66.6 vs. 64.0%). N digestibility was similar for H and L diets, but it was lower for FS than for FO (59.4 vs. 63.3%). NDF digestibility was lower for HFS than for HFO (51.9 vs. 55.8%) and it was higher for LFS than for LFO (51.1 vs. 48.5%), which resulted in an interaction of FxFLA. Milk yield was higher with L than with H (48.1 vs. 39.2 kg/d) and with FO than with FS (45.3 vs. 42.0 kg/d). Milk fat content was lower with L than with H (3.01 vs. 3.74%) and with FO than with FS (3.20 vs. 3.55%). Milk protein content was higher with L than with H (3.12 vs. 2.92%) and tended to decrease with FO compared to FS (2.99 vs. 3.05%). Milk lactose content was higher with L than with H (4.70 vs. 4.50%) and tended to be greater with FO than with FS (4.64 vs. 4.55%). Fat yield was similar among treatments (1.46 kg/d). Protein yield was higher with L than with F (1.50 vs. 1.14 kg/d) and tended to decrease with FS compared to FO (1.29 vs. 1.36 kg/d). This study suggests that both forage level of the diet and the source of flaxseed (FO vs. FS) influence digestion, milk production and milk composition. However, no interaction was observed between forage level and flaxseed source (whole seed vs. oil).

Key Words: Flaxseed/Flaxseed Oil, Digestion/Milk, Dairy Cows

T182 Effect of increasing oil from distillers grains or corn oil on lactation performance. C. Leonardi*, S. Bertics, and L. Armentano, *University of Wisconsin*, *Madison*.

The objective of this study was to evaluate lactation production response of dairy cows fed distillers dried grains with added solubles (DDGS). It was hypothesized that the oil present in DDGS would decrease milk fat yield. In four diets DDGS (0%, 5%, 10% and 15% of dietary DM) replaced a mixture of soy bean meal and soy hulls. A fifth diet contained 1.5% (DM basis) corn oil (OIL), but no DDGS. All diets contained 27.0% corn silage, 18.0% alfalfa silage, 1.4% blood meal and 1.0% fish meal (DM basis). Diets were formulated to be about 16.9% CP and have 28% NDF, but fatty acid content increased with increasing DDGS. In addition 15% DDGS and OIL were approximately equal in fatty acid content. The DDGS fed contained (± SD) 28.7 ± 0.9% CP, 25.9 ± 2.3% NDF, and 10.8 ± 0.5% fatty acids (DM basis). Twenty multiparous lactating Holstein cows were assigned to a replicated 5 x 5 Latin Square design, with periods of 21 days. Comparisons tested were: linear and quadratic effect of DDGS, and OIL vs. 0% DDGS. Increasing DDGS linearly increased milk production and milk true protein yield. Although increasing DDGS decreased milk fat percentage, it did not affect milk fat yield. Feeding OIL increased milk yield and tended to increase milk true protein yield despite decreased true protein percentage. In diets containing approximately 28% NDF, blood and fish meal, feeding DDGS or corn oil to a level that raised total dietary fatty acid to 5% increased milk and milk protein yield, without decreasing milk fat yield.

	Diet[1]					Contrast		
	0%	5%	10%	15%	Oil	Linear	Quadratic	0% vs. Oil
DMI, kg/d	26.7	26.4	27.1	26.6	26.9	0.66	0.75	0.65
Milk, kg/d	44.6	43.8	46.4	46.2	47.2	0.009	0.62	0.005
True Protein,%	3.08	3.05	3.10	3.09	3.01	0.35	0.58	0.006
True Protein,g/d	1363	1329	1431	1416	1408	0.002	0.60	0.09
Fat, %	3.38	3.35	3.33	3.24	3.28	0.05	0.52	0.14
Fat, g/d	1491	1446	1530	1488	1531	0.57	0.95	0.34

[1]Diet: diets contained 0, 5, 10 or 15% distillers dried grains with solubles (DDGS, DM basis). Oil = diet containing corn oil but no DDGS.

Key Words: Distillers Dried Grains with Solubles, Milk Fat Yield

T183 Effects of forage and oil supplementation on milk fatty acid composition in ewes. C. Reynolds*, V. Cannon, S. Loerch, G. Lowe, D. Clevenger, and P. Tirabasso, *The Ohio State University*, *Wooster*.

In a previous study, the positive effect of dietary oil on milk conjugated linoleic acid (CLA) level was greater in ewes fed diets based on corn silage compared to alfalfa meal. In the present study, our objective was to measure the response of milk fatty acid (FA) composition to dietary oil (3% of ration DM, 2:1 respectively, soybean oil:marine algal oil [Martek Biosciences]) in Hampshire x Dorset ewes (78.6 kg BW) fed alfalfa haylage (AH) compared to corn silage (CS). Ewes (48) were assigned to one of 4 treatments and 12 pens in a 2 X 2 factorial randomized block design on the basis of lambing date and number of lambs. Control rations (60:40 forage:concentrate, DM basis) based on AH or CS were each fed to 6 pens for 3 wk after lambing, then 3 pens each fed AH or CS were switched to oil supplemented rations (AHO and CSO). Milk yield over 3 h and composition were measured at 42 d postpartum. DMI was decreased ($P < 0.05$) by oil, but not affected by forage. Milk yield was decreased by oil for AH, but increased by oil for CS ($P < 0.03$). Milk fat content was increased by oil for AH, but decreased by oil for CS ($P < 0.08$). Total CLA (g/100 g FA) was increased ($P < 0.01$) for AH vs. CS and by oil, and the response to oil was greater for AH ($P < 0.01$). In contrast, total trans-C18:1 was higher for CS vs. AH, with a greater response to oil for CS ($P < 0.01$). Feeding marine oil increased C22:6 ($P < 0.01$), and the response was greater for AH ($P < 0.09$). Milk fatty acid responses to feeding vegetable and marine oils were affected by forage source, but responses to AH were not the same as we observed previously for alfalfa meal.

	AH	AHO	CS	CSO	SEM
DMI, kg/d	4.1	3.3	3.5	3.2	0.1
Milk yield, kg/d	2.1	1.2	2.1	2.4	0.2
Milk fat, %	8.42	9.80	8.96	7.79	0.60
Milk protein, %	5.02	5.72	4.95	4.73	0.11
Total CLA	0.74	3.31	0.70	1.44	0.25
Total *trans*-C18:1	3.53	19.29	4.96	25.68	1.04
C22:6 (n-3)	0.07	2.18	0.07	1.70	0.14

Key Words: Ewes, Forage, Fatty Acids

T184 Effect of supplemental fat source on production, immunity, and reproduction of periparturient Holstein cows in summer. B. C. do Amaral*, C. R . Staples, O. Sa Filho, T. R. Bilby, J. Block, F. Silvestre, F. M. Cullens, C. E. Alosilla, Jr., L. Badinga, and W. W. Thatcher, *University of Florida*, *Gainesville*.

Objective was to evaluate how dietary fat sources of oleic, trans-octadecenoic, linoleic, or linolenic acids affected the performance of periparturient Holstein heifers (n = 22) and cows (n = 32) during the summer season. Fat supplements were the following: 1) sunflower oil (Trisun, Humko Oil, 80% oleic acid), 2) Ca salt of trans-octadecenoic acids (EnerG TR, Bioproducts Inc, 57% trans 6-12), 3) Ca salt of vegetable oils (Megalac-R, Church & Dwight Co, 30% linoleic acid), and 4) linseed oil (Archer Daniels Midland, 56% linolenic acid and 16% linoleic acid). Supplemental fats were fed at 1.35% of dietary DM beginning at 29 d prior to expected calving date. After calving, fats were fed at 1.5% (oils) and 1.75% (Ca salts) of dietary DM for 15 wk. The mean DMI prepartum (8.8, 9.2, 8.7, and 9.4 kg/d; SE = 0.5) and postpartum (16.6, 16.2, 15.8, and 16.6 kg/d; SE = 0.6), mean milk yield (34.5, 34.7, 32.2, and 34.0 kg/d; SE=1.4), mean true protein concentration (2.75, 2.78, 2.75, and 2.78%; SE=0.06), and mean BW (586, 575, 555, and 558 kg; SE = 15) for treatments 1, 2, 3, and 4, respectively were not different among treatments groups. Milk from cows fed linseed oil had greater fat% (3.57%) than that from cows fed Ca salts of vegetable oils (3.22%) or trans-octadecenoic acids (3.15%). At 40 ± 2 d postpartum, the previously pregnant uterine horn was flushed with 25 ml of saline, flushing collected, and measured for neutrophils using a hemocytometer. Log of total neutrophils was lowest for heifers fed supplemental linseed oil (7.3, 6.7, 6.5, and 3.1; SE = 0.8) but not for cows (5.6, 5.0, 5.2, and 5.0; SE = 0.8) on treatments 1 to 4, respectively (treatment by parity interaction, P=0.047). Feeding linseed oil increased milk fat % and reduced neutrophils in uterine flushings.

Key Words: Fat, Reproduction, Immune Function

T185 Effect of feeding different levels of lauric acid on ruminal protozoa, and milk production in dairy cows. A. Faciola*[1], G. Broderick[2,1], A. Hristov[3], and M. Leão[4], [1]*University of Wisconsin*, *Madison*, [2]*U. S. Dairy Forage Research Center*, *Madison, WI*, [3]*University of Idaho*, *Moscow*, [4]*Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*.

Reducing ruminal protozoa may improve N utilization. Medium-chain saturated fatty acids such as lauric acid (C12:0) have been shown to suppress protozoa. Fifty-two Holstein cows (eight fitted with ruminal cannulae) averaging 607 kg were used to test the effectiveness of different levels of lauric acid (LA) for suppressing protozoal population in the rumen; milk production and ruminal parameters were measured. Cows were randomly assigned to four treatments: A) control, B) 80, C) 160, or D) 240 g/d of LA that was incorporated into the TMR, which was fed once a day for 8-wk. Prior to feeding the LA, all cows were fed the same diet (control) for a 2-wk covariate period and production of milk and protozoal counts were determined for use in statistical analysis. The TMR contained (DM basis): 29% alfalfa silage, 35% corn silage, 14% rolled high moisture corn, 8% soybean meal, 12% ground dry corn grain, 15.5% CP and 29% NDF. Cows were fed ad libitum, protozoal counts, pH measurement, and ruminal sampling were done every two weeks. Data were analyzed using proc mixed in SAS. Least square means are reported in the table below. Feeding LA in the diet at 80, 160, and 240 g/d did not reduce DMI, or affect ruminal parameters and milk production. LA fed at 160 and 240 g/d reduced ruminal protozoal population by only 25 and 30%, respectively, showing that these levels, or method of administration, were not effective for obtaining a ruminal LA concentration that suppressed protozoa.

Item/Treatment	A	B	C	D		
Dietary LA, g/d	0	80	160	240	SEM	P>F
DMI, kg/d	26.6	25.5	25.3	25.0	0.6	0.10
Milk, kg/d	35.3	36.1	35.8	36.5	0.8	0.73
Ruminal ammonia, mM	6.1	6.2	6.6	7.5	0.6	0.40
Ruminal total free AA, mM	11.6	9.5	12.4	9.4	1.0	0.23
Ruminal pH	6.6	6.6	6.5	6.4	0.1	0.23
Ruminal protozoa (x 10^6) cells/ml	5.0[a]	5.1[a]	3.8[b]	3.4[b]	3.8	0.05

Key Words: Lauric Acid, Protozoa, Dairy Cows

T186 Effect of feeding ground versus whole safflower seed and safflower oil on milk fatty acid composition in cows. R. Mohammed, D. Lee, E. Tong, S. Parmley, G. Khorasani, and L. Doepel*, *University of Alberta*, *Edmonton, Alberta, Canada.*

A key step in the formation of conjugated linoleic acid (CLA) in milk is the biohydrogenation of unsaturated fatty acids in the rumen. With this in mind, we conducted an experiment to determine the effect of altering lipid availability to the rumen microbes on milk CLA yield. Forty lactating Holstein cows, blocked by parity, days in milk, and milk production were assigned to one of four dietary treatments: 1) no added fat (CTL), 2) ground safflower seed (GSS), 3) whole safflower seed (WSS) and 4) safflower oil (SO). The safflower seed and oil were incorporated into the TMR in amounts supplying 3% lipid on a DM basis. Dry matter intake in the animals on GSS diets was significantly higher than those on SO and WSS diets (P=0.04). Milk yield, and milk fat and protein yields were not affected by treatment. Milk fat and protein percentage were significantly higher with CTL compared to GSS, WSS and SO (P=0.03 and 0.01 respectively). The concentrations of cis-9, trans-11 CLA and trans-11 C18:1 in milk were higher with SO than with GSS, but were not different between GSS and WSS. The milk concentration of trans-10, cis-12 CLA was significantly higher with GSS, WSS and SO compared to CTL (P=0.005). The results suggest that WSS is as effective as GSS in increasing milk CLA levels.

Effect of treatments on DMI, yield and composition of milk

	CTL	GSS	SO	WSS	SEM
DMI (kg/d)	21.2[ab]	22.2[a]	19.5[bc]	18.6[c]	1.00
Milk yield (kg/d)	27.6	30.3	27.3	26.3	1.22
Fat yield (kg/d)	1.0	1.0	0.9	0.9	0.05
Protein (kg/d)	0.9	0.9	0.9	0.8	0.04
Lactose yield (kg/d)	1.3	1.4	1.2	1.2	0.06
Fat %	3.7[a]	3.2[b]	3.4[b]	3.4[b]	0.12
Protein %	3.4[a]	3.1[b]	3.2[b]	3.2[b]	0.07
Lactose %	4.6	4.6	4.5	4.5	0.04
CLA c_9t_{11}	0.4[a]	0.7[b]	1.0[c]	0.9[bc]	0.08
$CLAt_{10}c_{12}$	0.01[a]	0.02[b]	0.02[b]	0.02[b]	0.003
$C_{18:1}$ t_{11}	1.29[a]	2.64[b]	3.81[c]	3.30[bc]	0.34

Within a row, means with different superscripts differ significantly (P<0.05)

Key Words: Safflower Seed, Milk Fatty Acid Composition, CLA

T187 Effects of bST and dietary fat in early lactation on lactational performance of Holstein cows. M. Carriquiry*, W. J. Weber, C. R. Dahlen, G. C. Lamb, and B. A. Crooker, *University of Minnesota*, *St. Paul*.

Multiparous cows (n = 59) in a 2 x 2 factorial design were used to determine effects of bST (POSILAC®) and supplemental dietary fat (Alifet-High Energy®

and Alifet-Repro®; AF) during the first 17 wks of lactation (WOL). Cows were blocked by expected calving date and previous 305ME and assigned randomly to consume fat (0 or 4% of dietary DM) from calving and/or receive bST (0 or 500 mg) every 10 d from 12 to 70 d in milk (DIM) and at 14 d-intervals thereafter. Diets contained 1.68 Mcal NEL, 185 g CP, and 200 g ADF per kg DM. Isocaloric diets were created by including whole, high-oil sunflower seeds (0 vs 10%) in the non-AF diet. Means from a repeated measures analysis differed when $P < 0.05$. Milk yield was not affected by AF but there was an interaction of bST and WOL as bST increased milk yield after 6 WOL (47.9, 50.3 ± 1.0 kg/d). Milk fat content increased (4.23, 4.56 ± 0.12%) and 4% FCM yield (45.5, 48.3 ± 1.2 kg/d) tended ($P=0.06$) to increase with bST during the first 17 WOL. Milk protein and lactose yield and dry matter and energy intake were similar among treatments. Body condition score was not affected by treatments. Postpartum body weight of bST cows was less than non-bST cows (641, 626 ± 7.6 kg). Backfat thickness was increased by AF (3.5, 4.1 ± 0.2 mm) and tended ($P = 0.08$) to decrease with bST (4.2, 3.6 ± 0.2 mm). Energy balance nadir (-15.1 ± 1 Mcal/d at 2 WOL) did not differ among treatments but energy balance decreased with bST (-4.2, -7.6 ± 0.7 Mcal NEL/d) during the first 17 WOL. There was a trend ($P = 0.06$) for an interaction of bST and AF as AF decreased the impact of bST on energy balance. Positive energy balance occurred at 15 WOL for bST cows fed no AF and at 13 WOL for the other treatments. Gross efficiency was greater for bST cows (2.07, 2.29 ± 0.05 kg FCM/kg DMI). Initiation of bST administration at 12 DIM increased milk yield after 6 WOL and prolonged the period of negative energy balance but did not cause cows to reach a lower energy balance nadir.

Key Words: Somatotropin, Fat, Lactation

T188 Effect of varying levels of free fatty acids from palm oil on milk production and feed intake in Holstein cows. S. Mosley*[1], E. Mosley[1], B. Hatch[1], J. Szasz[1], A. Corato[2], N. Zacharias[1], D. Howes[3], and M. McGuire[1], [1]*University of Idaho*, *Moscow*, [2]*University of Padova*, *Padova, Italy*, [3]*Howes Management Services*, *Nampa, ID*.

To determine the optimum feeding level for free fatty acids of palm oil (PALM) (Energizer RP10; 92% palmitic acid), lactating cows (n =18) were randomly assigned to a treatment sequence in replicated 4 x 4 Latin squares. Animals were assigned to squares by parity (3 multiparous and 1 primiparous with primiparous in the incomplete square). The four diets were designed to provide 0, 500, 1000 and 1500 g of PALM per day. The amount of free fatty acids was adjusted on a daily basis to be 0, 1, 2 or 3% of the total mixed ration based upon the ration dry matter. Cows were fed individually with feed intake determined daily. Each period lasted 16 d with milk production and composition determined the final 2 d. Milk production, milk composition and feed intake data were analyzed using the MIXED procedure of SAS. Milk yields were 30.9, 34.0, 34.2 and 34.2 kg/d (SEM = 1.9) for the 0, 500, 1000 and 1500 g levels, respectively. Milk yield was increased ($P<0.001$) by the addition of PALM; however, there were no differences among the levels of PALM. Fat percent was also increased ($P<0.01$) by the addition of PALM from 3.44% for 0 g to 3.93% for 500 g (SEM = 0.17) but there were no differences among the PALM treatment levels. Dry matter intakes were 23.4, 26.3, 24.4 and 23.4 kg/d (SEM = 1.4) for the 0, 500, 1000 and 1500 g levels, respectively. The addition of PALM increased milk yield, fat percentage and feed intake, while no adverse effects on milk protein concentration were observed. Feeding 500 g/d of PALM maximized milk yield, milk fat percentage, and feed intake.

Key Words: Dietary Lipid, Palmitic Acid, Milk Yield

T189 Effects of intravenous infusion of tallow emulsion on responses to glucose and insulin challenges of Holstein cows. J. A. A. Pires*, A. H. Souza, and R. R. Grummer, *University of Wisconsin*, *Madison*.

The objective was to test whether the induction of elevated blood NEFA by intravenous infusion of tallow emulsion alters glucose tolerance and insulin responsiveness in Holstein cows. Six non-lactating, non-gestating Holstein cows were assigned to a cross-over design. One cow was excluded from experiment due to complications from mastitis. Treatments consisted of 11 h intravenous infusions of saline (**S**) or 20% (w/v) triacylglycerol (**TAG**) emulsion derived from tallow (**T**) to elevate plasma NEFA. Each period consisted of 2 d of infusions (**I1** and **I2**), separated by 1 d in which cows were not infused. Bilateral jugular catheters were inserted 1 d before the first infusion and were maintained for the 3 d period. Treatments were administered continuously via drip infusion, at a targeted a rate of 0.1g TAG/kg BW /h for the T treatment. On I1 of each period, a glucose tolerance test (**GTT**) was performed (0.25g dextrose i.v. bolus/kg BW), starting 8 h after initiation of T or S infusions. On I2, an insulin challenge (**IC**) was performed (0.1 IU insulin i.v. bolus/kg BW). Blood samples were collected every 2 h during the first 8 h of infusion, and 16 samples from -15 to 180 min relative to GTT and IC. The infusion of S or T continued during the GTT and IC sampling period. Cows were fed every 4 h at a rate to meet energy requirements for 5 days prior to each period, and every 2 h during the first 8 h of infusions. Infusion of T increased nonesterified fatty acids (**NEFA**; $P < 0.001$) relative to S, during the first 8 h of infusions (303 vs. 86 µEq/L), during the GTT (306 vs.76 µEq/L) and during the IC (357 vs. 187 µEq/L). During GTT, neither glucose clearance rate (**CR**) nor glucose half life ($\mathbf{T^{1/2}}$) differed between T and S (1.7 vs. 2.4 %/min, and 48 vs. 31 min, respectively). After IC, CR was lower ($P < 0.05$) for T than S (1.5 vs. 2.5 %/min). Accordingly, $T^{1/2}$ was 46 min for T and 29 min for S ($P < 0.05$). These results suggest that elevated levels of NEFA cause a reduction in insulin responsiveness.

Key Words: Insulin Challenge, Glucose Tolerance, Dairy Cows

T190 Intake, duodenal flow and ruminal biohydrogenation of fatty acids in Holstein steers fed canola supplemented dairy lactation diets. S. E. Bedgar*, J. W. Schroeder, M. L. Bauer, and W. L. Keller, *North Dakota State University*, *Fargo*.

Fifteen cannulated Holstein steers (399 ± 21.7 kg initial body weight (BW)) were stratified by BW and assigned to treatments in a completely randomized design to evaluate the effects of feeding ground canola seed on change in fatty acid flow. Diets containing 0, 6.1, and 12.2% of the total ration dry matter (DM) as ground canola seed were offered ad libitum. Rations were formulated to represent high production lactation diets and to contain 20.5, 19.7, and 18.6% CP with 1.61, 1.65, and 1.71 Mcal of net energy per kg of DM, for the 0, 6.1, and 12.2% canola diets, respectively. The control diet was composed of corn silage, ground corn, alfalfa, soybeans, canola and blood meal, vitamins, minerals, and chromic oxide as an external marker. Ground canola seed (39.6% lipid, DM basis) replaced corn grain and canola meal in the diets. Steers were acclimated to treatment for 25 d prior to collections. Duodenal and ileal samples were taken to represent every 1.5 h in a 12 h period from d 29 through 31. Rumen fluid samples were taken at 0, 2, 4, 6, 8, 10, and 12 h post-feeding. Inclusion of ground canola seed did not affect DM intake. Intake of total fatty acids and long-chain fatty acids increased linearly ($P < 0.001$) with dietary canola. Flow of fatty acids increased ($P = 0.04$) to the duodenum and ileum as canola was added to the diet. Percentage biohydrogenation of C_{18} fatty acids increased linearly ($P = 0.02$) with canola. These data suggest that ground canola can be used as an ingredient to increase the flow of fatty acids to the small intestine without negatively affecting digestion and ruminal fermentation. While saturated C_{18} fatty acid flow to the small intestine increased because of increased ruminal biohydrogenation, delivery of $C_{18:1}$ and $C_{18:3}$ to small intestine also increased with increasing dietary canola.

Key Words: Canola, Dairy, Fatty Acid

T191 Effect of supplementation with Ca-salts of fish oil on omega-3 fatty acids in milk fat. E. Castaneda-Gutierrez*[1], W. R. Butler[1], M. J. de Veth[1], A. L. Lock[1], D. A. Dwyer[1], D. Luchini[2], and D. E. Bauman[1], [1]*Cornell University*, *Ithaca, NY*, [2]*Bioproducts Inc.*, *Fairlawn, OH*.

Omega-3 fatty acids play an important role in reproductive processes in dairy cows and are associated with beneficial health effects in humans; thus, en-

hancement of their intake and content in milk is desirable. The objective of this study was to evaluate the effect of rumen protection of fish oil at two doses on the transfer of EPA, DPA and DHA into milk fat. Four lactating Holstein cows (143 ± 31 DIM) were randomly assigned in a Latin square design to the following treatments: 1) rumen infusion of Ca-salts of fish oil and palm fatty acid distillate, low dose (CaFO-1), 2) rumen infusion of Ca-salts of fish oil and palm fatty acid distillate, high dose (CaFO-2), 3) rumen infusion of fish oil (RFO), and 4) abomasal infusion of fish oil (AFO). CaFO-1 provided 146 g/d of fat containing 8.3, 1.8 and 10.6 g/d of EPA, DPA and DHA, respectively; CaFO-2 provided twice these amounts. RFO and AFO supplied 145 g/d of fat which provided 16.2, 3.8, and 22.0 g/d of EPA, DPA and DHA, respectively. A 10 d pre-treatment period was used as a baseline, followed by 10 d treatment periods with intervals of 10 d in between. Supplements were infused every 6 hr and milk samples taken the last 3 d of baseline and treatment periods. Milk and milk protein yield were unaffected by treatment. RFO reduced DMI by 15% and milk fat yield by 20% ($P < 0.02$). Milk fat yield was increased by CaFO-2 compared with AFO and RFO ($P < 0.01$). Milk secretion of EPA, DPA and DHA was increased by all treatments as compared to pretreatment baseline values (Table 1). Fat content and transfer percent of EPA, DPA and DHA to milk fat were significantly higher with AFO ($P < 0.01$), but did not differ among other treatments. Ca-salts did not increase output of omega-3 fatty acids in milk fat compared with rumen infusion of unprotected oil; however, the milk fat content of these fatty acids was increased over pretreatment values without the negative effects on DMI and milk fat yield observed with the unprotected fish oil supplement.

FA in milk, g/d [1]	CaFO-1	CaFO-2	RFO	AFO	SEM	*P*-value
EPA	0.68[b]	0.83[b]	0.63[b]	3.76[a]	0.32	0.001
DPA	0.83[b]	0.94[b]	1.06[b]	2.31[a]	0.18	0.003
DHA	0.78[b]	1.06[b]	0.95[b]	4.30[a]	0.41	0.002

[1] Baseline values (unsupplemented) for EPA, DPA and DHA were 0.31, 0.57 and 0.14 g/d, respectively.

Key Words: Fish Oil, Omega-3 Fatty Acids, Ca-Salts of Fatty Acids

T192 Rumen vs. abomasal infusion of fish oil as a novel approach to determine the extent of rumen biohydrogenation of omega-3 fatty acids and their transfer into milk fat. C. McConnell, A. L. Lock, and D. E. Bauman*, *Cornell University*, *Ithaca, NY*.

Fish oils are rich in the omega-3 fatty acids, eicosapentaenoic (20:5 n-3; EPA) and docosahexaenoic acid (22:6 n-3; DHA). These fatty acids are of interest in human health, particularly for their beneficial effects in reducing the risk of atherosclerosis. Thus, current research is pursuing opportunities to enhance omega-3 fatty acids in many foods. The milk fat of dairy cows is very low in EPA and DHA, with their transfer from fish oil and fish meal being poor (~<1 to 4%). The objective of the current study was to compare the effects of supplying fish oil to the rumen vs. the abomasum on milk fatty acid composition and the transfer efficiencies of EPA and DHA to milk fat. The two methods provide a comparison of the extent to which ruminal biohydrogenation may reduce EPA and DHA transfer to milk fat. Three rumen fistulated lactating Holstein cows (235±73 DIM) were randomly assigned in a 3 X 3 Latin square experiment. Treatments were: 1) no supplement (control), 2) rumen infusion of fish oil (RFO; 150 g/d), and 3) abomasal infusion of fish oil (AFO; 150 g/d). Treatment periods were 7 d with a 9 d interval between periods. The concentrated fish oil contained 26% EPA and 28% DHA; daily infusions supplying 39 and 42 g/d of EPA and DHA, respectively. Milk fat content of EPA was 0.18, 0.18 and 1.36 and DHA content was 0.11, 0.08, and 1.13 g/100 g of fatty acids for the control, RFO and AFO treatments, respectively ($P < 0.01$). Transfer efficiencies were 30 and 25% for EPA and DHA, respectively on the AFO treatment, and <1% for EPA and DHA on the RFO treatment. Results indicate extensive biohydrogenation of fish oil fatty acids occurs in the rumen, which is supported by the fact that during RFO supplementation, the concentration of 20:0 in milk fat increased above that found in the control and AFO treatments (($P < 0.05$). In conclusion, the AFO treatment increased the EPA and DHA content of milk fat relative to RFO, and, thus, the major limitation to using an unprotected dietary supplement to increase omega-3 fatty acids is due to biohydrogenation of these fatty acids in the rumen.

Key Words: Milk Fat, Fish Oil

T193 The effect of docosahexaenoic acid on the production of vaccenic acid and conjugated linoleic acid from unsaturated C18 fatty acids in rumen cultures. A. AbuGhazaleh*, G. Apgar, and B. Jacobson, *Southern Illinois University*, *Carbondale*.

Previously, combining docosahexaenoic acid (DHA) with soybean oil in rumen cultures enhanced vaccenic acid accumulation. The objective of this experiment was to examine the effect of combining DHA along with oleic, linoleic, and linolenic acids to determine which combination would lead to maximum vaccenic acid and conjugated linoleic acid (cis-9, trans-11 CLA) accumulations. Treatments consisted of 1) 10 mg DHA (control), 2) control plus 20 mg oleic acid (DHAO), 3) control plus 20 mg linoleic acid (DHAL), and 4) control plus 20 mg linolenic acid (DHALN). Treatments were incubated in triplicate in 125 ml flasks containing 500 mg finely ground TMR, 10 ml of the strained ruminal fluid, 40 ml of media, and 2 ml of reducing solution. A 5-ml sample of culture contents was taken at 0 and 24 h for fatty acid analysis by gas liquid chromatography. After 24 h of incubation, the concentration of vaccenic acid (5.8, 6.0, 20.9, and 9.3 mg/culture, for treatments 1-4, respectively) was highest ($P < 0.05$) with the DHAL, intermediate with the DHALN, and least with the DHAO. The concentration of cis-9, trans-11 CLA (0.1, 0.1, 0.7, and 0.1 mg/culture) in cultures increased ($P < 0.05$) only with the DHAL. Addition of linolenic acid to cultures caused a dramatic increase ($P < 0.05$) in the concentration of cis-15, trans-11C18:2 (0.2, 0.3, 0.5, and 9.8 mg/culture). Concentration of hydroxy stearic fatty acid (0.2, 1.1, 0.2, and 0.2 mg/culture) increased ($P < 0.05$) only in cultures containing added oleic acid. Combining DHA with linoleic acid most effectively increased concentrations of vaccenic acid and cis-9, trans-11 CLA in rumen cultures.

Key Words: Docosahexaenoic Acid, Conjugated Linoleic Acid, Vaccenic Acid

T194 The effect of low pH on the production of trans monoenes and conjugated linoleic acid in rumen cultures containing docosahexaenoic acid and unsaturated 18 carbons fatty acids. A. AbuGhazaleh*, G. Apgar, and B. Jacobson, *Southern Illinois University*, *Carbondale*.

Previously, combining docosahexaenoic acid (DHA) with linoleic acid in rumen cultures at pH 6.9 enhanced vaccenic acid and c9, t11 conjugated linoleic acid (CLA) accumulations. The objective of this experiment was to examine the effect of low pH on trans monoenes and CLA accumulations in rumen cultures incubated with DHA and oleic, linoleic, and linolenic acids. Treatments consisted of 1) 10 mg DHA (control), 2) control plus 20 mg oleic acid (DHAO), 3) control plus 20 mg linoleic acid (DHAL), and 4) control plus 20 mg linolenic acid (DHALN). Treatments were incubated in triplicate in 125 ml flasks containing 500 mg finely ground TMR, 10 ml of the strained ruminal fluid, 40 ml of media, and 2 ml of reducing solution. Ruminal fluid was collected from fermenters fed high grain diet. The pH of cultures averaged 6.1 and 5.5 at 0 and 24 h, respectively. A 5-ml sample of culture contents was taken at 0 and 24 h for fatty acid analysis by gas liquid chromatography. Data were analyzed using the GLM procedure of SAS. Results are expressed by their least square means. After 24 h of incubation, t10 C18:1 (4.8, 5.0, 12.8, and 4.5 mg/culture, for treatments 1-4, respectively) was the main trans monoene isomer in cultures and was highest ($P < 0.05$) with the DHAL. Similarly, t10, c12 CLA (0.1, 0.1, 1.5, and 0.2 mg/culture, for treatments 1-4, respectively) was the main CLA isomer in cultures and was highest ($P < 0.05$) with the DHAL. Additions of linolenic acid to rumen cultures caused a dramatic increase ($P < 0.05$) in the concentration of t11, c15 C18:2 (0.5, 0.5, 0.5, and 8.5 mg/culture, for treatments 1-4, respectively) and t11, t13 CLA (0.1, 0.1, 0.1, 1.0 mg/culture for treatments 1-4, respectively). Hydroxy stearic fatty acid concentration (0.4, 2.6, 0.3, and 0.2 mg/culture, for treatments 1-4, respectively) increased ($P < 0.05$)

only with the DHAO. Lowering culture pH increased accumulations of t10 C18:1 and t10, c12 CLA and the increase was highest when DHA was combined with linoleic acid.

Key Words: Docosahexaenoic Acid, Trans Monoenes, pH

T195 Production of trans monoenes and conjugated linoleic acid in continuous cultures fed diets containing fish oil and sunflower oil with decreasing levels of forage. A. AbuGhazaleh*[1], B. Jacobson[1], R. Buckles[1], and K. Kalscheur[2], [1]*Southern Illinois University*, *Carbondale*, [2]*South Dakota State University*, *Brookings*.

Previously, feeding fish oil (FO) and sunflower seeds to dairy cows resulted in the greatest increases in the concentrations of vaccenic acid and conjugated linoleic acid (CLA) in milk fat. The objective of this study was to evaluate the effects of forage level in diets containing FO and sunflower oil (SFO) on the production of trans monoenes and CLA by mixed ruminal microbes. A dual-flow continuous culture system consisting of 3 fermenters was used in a 3 x 3 Latin square design. Treatments were 1) 75% forage, 25% concentrate mix containing 1% FO and 2% SFO; 2) 50% forage, 50% concentrate mix containing 1% FO and 2% SFO; 3) 25% forage, 75% concentrate mix containing 1% FO and 2% SFO. The forage source was alfalfa pellets. Corn, soybean meal, limestone, vitamins and minerals made up the concentrate mix. During 10-d incubations, fermenters were fed treatment diets three times daily (150g/d, divided equally between three feedings) as TMR diet. Effluents from the last 3 d of incubation were composited for analysis. The concentrations of t10 C18:1 (0.0, 10.5, 33.5 mg/g DM overflow for treatments 1 to 3, respectively) and t10, c12 CLA (0.08, 0.18, 0.35 mg/g DM overflow) increased linearly ($P < 0.05$) as dietary forage levels decreased. The concentrations of vaccenic acid (14.7, 12.9, 0.0 mg/g DM overflow) and c9, t11 CLA (1.78, 1.52, 0.03 mg/g DM overflow) decreased ($P < 0.05$) in a linear manner as dietary forage levels decreased. The concentration of hydroxy stearic fatty acid (1.1, 3.3, 1.4 mg/g DM) showed a quadratic ($P < 0.05$) response to dietary forage levels. The biohydrogenation of oleic (78.8, 85.2, and 80.7), linoleic (92.9, 93.7, and 88.4) and linolenic (92.6, 94.6, and 87.0) acids were not affected ($P > 0.05$) by forage levels. Decreasing dietary forage levels resulted in t10 C18:1 and t10, c12 CLA replacing vaccenic acid and c9, t11 CLA, respectively, in fermenters fed FO and SFO.

Key Words: Fish Oil, Forage Level, Trans Fatty Acids

T196 Conjugated linoleic acid (CLA) content of milk and meat products and its intake in humans. T. R. Dhiman*, A. L. Ure, and S. Nam, *Utah State University*, *Logan*.

Conjugated linoleic acid (CLA) has been shown to have potential health benefits in animal models. A review of published research was conducted on factors affecting the CLA content of milk and meat and its influence on CLA intake in humans. The *cis*-9, *trans*-11 $C_{18:2}$ isomer is the principle dietary form of CLA found in ruminant products and is produced by partial ruminal biohydrogenation of linoleic and linolenic fatty acids or by endogenous synthesis in the tissues themselves. Increasing the CLA contents of milk and meat has the potential to raise the nutritive and therapeutic values of dairy and meat products. The CLA contents in milk and meat are heavily influenced by the diet fed to the animal. Dairy cows grazing on pasture produced milk fat containing 0.59-2.21% CLA. Cows fed plant oils at 3-5% of the diet produced milk containing 0.71-2.13% CLA as a proportion of fat. Beef from cattle grazing on pasture had 0.48-1.35% CLA as a proportion of fat. Beef from cattle supplemented with feed sources rich in linoleic or linolenic fatty acids had similar or slightly higher CLA compared to control beef. The CLA content in milk or dairy products available on the market ranges from 0.34 to 1.07% of fat (Mean = 0.53%). The CLA content in raw or processed beef available on the market ranges from 0.12 to 0.68% of fat (Mean = 0.37%). The mean CLA content of meat from chicken, pork, and rabbit is 0.12% of fat (range = 0.06-0.17). The CLA in turkey meat ranged from 0.16-0.25% of fat. It is currently estimated that the average human adult consumes only one third to one half of the amount of CLA that has been shown to reduce cancer in animal studies. A person consuming one serving of standard whole milk, cheese, and beef, daily, would have a CLA intake of 114 mg/d. However, a person consuming one serving each of CLA-enriched whole milk, cheese, and beef would have an average CLA intake of 428 mg/d. The greatest potential to increase CLA intake of humans is through the consumption of CLA-enriched milk and cheese. While beef raised on pasture may have higher CLA content as a proportion of fat, the total fat content is reduced.

Key Words: Conjugated Linoleic Acid, Milk, Meat

T197 Conjugated linoleic acid from water buffaloes milk fat in tropical region. S. Fernandes[1,2], W. Mattos[1,2], S. Matarazzo[1,2], D. Lanna*[1,2], and M. Gama[1,2], [1]*Universidade Estadual do Sudoeste da Bahia*, *Itapetinga, Bahia, Brazil*, [2]*Universidade de São Paulo*, *Piracicaba, São Paulo, Brazil*.

The intake of milk will be enhancing with natural properties with the potential benefit human health, such as conjugated linoleic acid (CLA) an anticarcinogenic agent. The CLA research has been demonstrated almost exclusively with bovines in temperate environment. Few data are available in the literature regarding the effects of tropical feeds on the CLA contents in water buffaloes milk fat. A trial was carried out to verify the CLA contents in water buffaloes milk (mid and late lactation) fed pasture or feedlot in Sao Paulo state, Brazil. Eight animals at each farm were randomly allocated to five farms. All data were used to evaluate the effects of season in same farm ($P \leq 0.05$) by Student t test. The samples were collected in July (dry) and November (rainy) 2002. In Farm 1 (F1) animals were housed in feedlot and were fed corn silage plus wet brewers grain (WBG); Farm 2 (F2): corn silage (dry) and chopped Pennisetum purpureum (rainy) plus WBG all the year; Farm 3 (F3): pasture of Brachiaria decumbens (rainy) and B. decumbens plus chopped sugar cane (dry). Animals in this farm were supplemented with WBG all the year; Farm 4 (F4): B. decumbens and corn silage (dry) and B. decumbens supplemented with WBG (rainy); Farm 5 (F5): pasture of B. ruziziensis supplemented with grass silage of B. ruziziensis (dry) and pasture (rainy). The animals in F5 were supplemented with TMR all the year. The highest CLA contents in milk (Table 1) were observed in November, when animals grazed lush pasture in two farms (F2 and F3). In F2 (feedlot) in November, the roughage was fresh grass (highest C18:3) and in July was corn silage. In F3 (pasture), the availability of pasture was lower in dry season and increased in rainy season, when C18:3 availability (metabolic precursor of CLA) was highest. It can be concluded that in water buffaloes under tropical conditions the CLA contents in milk fat was larger in rainy season.

CLA (C18:2c9t11) contents from water buffaloes milk fat in tropical region

Farm	Fat (average, %)	July (%)	November (%)
F1	7.5±0.16	1.12±0.10a	0.98±0.30a
F2	7.2±0.15	0.73±0.10b	1.32±0.24a
F3	6.8±0.16	1.40±0.10b	2.10±0.23a
F4	6.6±0.17	1.16±0.14a	1.57±0.26a
F5	6.6±0.15	1.10±0.10a	1.46±0.24a

* – standard error; Different letter in the same row, represent different means (P£0,05) by Student t test.

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Key Words: Fat Acid, Tropical Pasture, Wet Brewers Grain

T198 1^3C studies on glucose metabolism in dairy cows fed a fat-enriched diet. P. Junghans*[1], K. Gaafar[1], F. Schneider[2], C. C. Metges[1], G. Gäbel[3], J. R. Aschenbach[3], and J. Voigt[1], [1]*Research Institute for the Biology of Farm Animals (FBN), Research Unit Nutritional Physiology*, *Dummerstorf, Germany*, [2]*Research Unit Reproductive Biology*, *Dummerstorf, Germany*, [3]*University Leipzig*, *Leipzig, Germany*.

This study explores whole body glucose metabolism in lactating cows fed a fat-enriched diet. The experiment was carried out on eight Holstein-Friesian cows (591 ± 28 kg BW) during the first 6 to 10 wk of their first or second lactation. The experimental design was a 2 x 2 cross-over design using two 2-wk periods. The cows were fed isoenergetic and isonitrogenous diets based on corn silage. In the diet of the fat group about 1.8 kg of tapioca starch was substituted by about 0.7 kg of rumen-protected fat (Ca salts of palm oil). To determine the glucose turnover 0.8 mg/kg BW D-[U-$^{13}C_6$]glucose (99 atom % ^{13}C) was given i.v. as single bolus. Blood samples were collected at -5, 5, 10, 15, 20, 30, 45, 60, 90, 120, 150, 240 min after tracer administration. Isotope ratios between [U-$^{13}C_6$]glucose and [U-$^{12}C_6$]glucose as aldonitrile pentaacetate derivative were measured by selected ion monitoring GC-MS at m/z 334 and 328. Whole body glucose flux, glucose pool, and mean transit time were calculated by a noncompartmental approach. The whole body flux of glucose was not different between the diets (Table 1). Glucose turnover was 1.5 times in cows fed a fat diet, because the body pool of glucose was decreased. The lower body glucose pool corresponds with lower plasma glucose (n. s.) and insulin concentrations. The data suggest that the higher starch intake explains the increased glucose pool. Possible changes of gluconeogenesis, glycogenolysis and/or glucose oxidation by dietary fat remain to be investigated.

Table 1. Milk yield and glucose metabolism in lactating dairy cows

Item	Diet Starch (n = 8)	Diet Fat (n = 8)
FCM	34.3 ± 2.6	36.2 ± 3.5
Glucose, mmol/l blood	3.38 ± 0.22	2.93 ± 0.20
Insulin, mU/l blood plasma	17.2 ± 2.5[a]	10.4 ± 1.1[b]
Glucose pool, g	100.3 ± 8.7[a]	67.0 ± 6.3[b]
Glucose flux, kg/d	2.86 ± 0.21	2.98 ± 0.16
Mean transit time, min	51.5 ± 4.5[a]	33.7 ± 4.6[b]

Values represent mean ± SE. Different superscripts denote significant differences between diets (P<0.05)

Key Words: Lactating Cow, Glucose Metabolism, Stable Isotope

T199 Glucose rate of appearance (Ra) responses to isoenergetic infusions of glucose (GLC), propionic acid (C3) and non essential amino acids (NEAA) in dairy cows. S. Lemosquet*[1], E. Delamaire[1], J. Guinard-Flament[1], and H. Lapierre[2], [1]*UMR INRA Agrocampus Rennes Production du Lait*, *St-Gilles, France*, [2]*AAC*, *Lennoxville, Canada*.

The effects of GLC, C3 and a mixture of glucogenic NEAA on Ra and milk lactose yield were determined in four mid-lactation Holstein cows, fitted with both duodenum and rumen cannulas, used in a 4 × 4 Latin square design with 14 d-periods. Cows were fed a grass silage-based diet (Ctrl) that provided almost no by-pass starch. Ctrl cows received 93.5% of net energy of lactation and 114% of protein requirements. Isoenergetic infusions (5.15 Mcal/d of gross energy) of GLC in the duodenum (7.65 mol/d), C3 in the rumen (14.1 mol/d) or a mixture of 5 NEAA in the duodenum (in mol/d; Asp: 0.60; Ala: 1.59; Glu: 5.92; Ser: 2.44; Gly: 1.21) were given in supplement to the Ctrl diet. For each period, on d 13, [6,6-$^2H_2$]glucose (40 µmol/kg/h for 2 h) was infused into one jugular vein. Four blood samples were taken from the other jugular vein to measure glucose enrichments in the last 30 min of infusion. Ra averaged 12.1, 17.9, 14.4, 13.8 ± 0.4 mol/d for Ctrl, GLC, C3 and NEAA, respectively. Ra increased with energy supply (Ctrl *vs.* infusions, $P < 0.01$) but differently according to the nutrients infused. GLC increased Ra more than both glucogenic precursors (GLC *vs.* C3 + NEAA, $P < 0.01$). Ra was not different between C3 and NEAA ($P = 0.4$), but the amount of glucogenic NEAA infused was very high with NEAA plus diet covering 186% of protein requirements. The variations of Ra were not related to plasma jugular concentrations of glucagon (97, 94, 91 and 362 ± 42 ng/L, for Ctrl, GLC, C3 and NEAA, respectively). Milk lactose yield averaging 3.46, 3.55, 3.58 and 3.27 ± 0.07 mol/d was not modified by the energy supply (Ctrl *vs.* infusions, $P = 0.9$), but was lower with NEAA compared to C3 ($P < 0.02$). Changes in Ra were not paralleled by changes in lactose yield. On an energetic basis, intestinal GLC was the most efficient nutrient to increase Ra. However, there was no direct link between increase in whole body glucose availability and milk lactose yield.

Key Words: Dairy Cow, Glucose, Isotope

T200 Effect of casein (Cas) and propionate (C3) supply on whole body protein kinetics in lactating dairy cows. G. Raggio*[1], G. E. Lobley[2], S. Lemosquet[3], H. Rulquin[3], and H. Lapierre[4], [1]*Laval University*, *Quebec, QC, Canada*, [2]*Rowett Research Institute*, *Aberdeen, UK*, [3]*INRA*, *Saint Gilles, France*, [4]*Agriculture and Agri-Food Canada*, *Lennoxville, QC, Canada*.

The effects of Cas and C3 and their interaction on whole body leucine (Leu) metabolism were determined in three multiparous Holstein cows, fitted with both duodenum and rumen cannulas, used in a Youden replicated square with 14 d-periods. All cows were fed a grass silage-based diet estimated to supply 29.7 Mcal d^{-1} of NEL and 1593 g d^{-1} of protein digested in intestine (PDI-INRA, 1989). Cas (743 g d^{-1} in the duodenum) and C3 (1041 g d^{-1} in the rumen) infusions were tested in a factorial arrangement. For each period, on d 11, L[1-^{13}C]Leu (4.5 mmol h^{-1} for 7.5 h) and on d 13, [^{13}C]sodium bicarbonate (4.05 mmol h^{-1} for 5 h) were infused into a jugular vein. Blood samples were taken from the carotid artery to measure enrichments of $^{13}CO_2$ (d 11 and 13) and of ^{13}C[4-methyl 2-oxopentanoate] (MOP, d 11), used as representative of Leu precursor pool. Only Cas treatments increased milk yield, but both Cas and C3 treatments increased milk protein concentration. Increases in Leu whole body (WB) irreversible loss rate (ILR) with Cas treatments exceeded ($P = 0.10$) the extra Leu from abomasal infusion and the overall increments in Leu ILR, oxidation, protein synthesis, and in milk (all $P < 0.001$) suggest a general response in protein turnover. C3 treatments tended to increase Leu WB ILR, protein synthesis and in milk but with a tendency for a Cas x C3 interaction on WB Leu oxidation. The latter suggests that the impact of energy on protein metabolism depends of the level of protein supply.

	Treatment					P values		
	Ctrl	Cas	C3	Cas+C3	SEM	Cas	C3	CasxC3
Milk yield, g d^{-1}	26.9	31.4	27.1	32.1	0.71	0.001	0.51	0.74
True Protein, g kg^{-1}	29.6	30.7	30.9	32.8	0.43	0.009	0.005	0.32
Leu WB kinetics, mmol h^{-1}								
- Duodenal infusion		20.9		20.9				
- ILR	95.2	119.9	100.1	126.1	2.77	0.001	0.07	0.79
- Oxidation	7.2	21.2	8.8	18.2	1.13	0.001	0.57	0.09
- Protein synthesis	87.9	98.7	91.3	107.9	3.5	0.001	0.08	0.44
- Milk	23.1	27.8	24.4	29.6	0.66	0.001	0.03	0.66
CER	14.5	15.3	15.5	16.1	0.19	0.006	0.003	0.61

WB: whole body; ILR: irreversible loss rate; CER: carbon dioxide entry rate.

Key Words: Kinetics, Leucine, Dairy

T201 See Abstract 48.

T202 Effect of rumen energy and nitrogen balance on milk urea nitrogen in Chinese Holstein cows. S. W. Zhai*[1] and Y. Ma[2], [1]*Zhejiang University*, *Hangzhou, Zhejiang, China*, [2]*Northwest Sci-Tech University of Agriculture and Forestry*, *Yangling, Shaanxi, China*.

Nutrient requirement of Chinese dairy cattle emphases the importance of rumen energy and nitrogen balance (RENB) on production performance. RENB is the balance between the amount of microbial protein that is potentially pos-

sible from the available energy extracted during fermentation in the rumen and the amount of microbial protein that is potentially synthesized from the available rumen-degradable protein. There was no information of effect of RENB on milk urea nitrogen (MUN) in Chinese Holstein Cows. The objective of this study was to investigate the response of milk production performance and MUN concentration in Chinese Holstein lactating cows to different RENB levels diets. Eighteen multiparous lactating cows were divided by days in milk and milk yield into six groups. Diets were formulated to have three RENB levels (-153, 5 and 150 g/d). Experiment was conducted according to a replicated 3 × 3 Latin Square design with six replicates and each period consisted of 21 days, with d 1 to 14 for adjustment and d 15 to 21 for data and sample collection. All data were analyzed using the SPSS analysis program (SPSS, 1999). Effects were considered significant at P<0.05. Dry matter intake (kg/d), milk yield (kg/d), milk protein (%), milk fat (%), and milk lactose (%) for -153, 5, and 150 RENB g/d group were not affected by treatment (P>0.05) and were: 20.1, 19.9, and 19.6; 23.9, 24.5, and 24.5; 3.28, 3.31, and 3.35; 4.67, 4.70 and 4.72. However, significant difference was found in MUN concentration between treatments (P<0.01) and MUN for -153, 5, and 150 RENB g/d group were 10.8, 9.3 and 7.6. Urea nitrogen in milk was mainly from the excess protein in rumen, the result of this study indicated MUN might be used as an indicator of ration RENB for Chinese dairy cows.

Key Words: Milk Urea Nitrogen, Rumen Energy and Protein Balance, Dairy Cows

T203 Effects of monensin on diurnal rhythmicity of blood metabolites in dairy cows at different stages of lactation. J. C. Plaizier*[1], A. Fairfield[2], P. A. Azevedo[1], T. F. Duffield[2], G. H. Crow[1], R. Bagg[3], P. Dick[3], and B. W. McBride[2], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*University of Guelph*, *Guelph, ON, Canada*, [3]*Provel, A Dvision of Eli Lilly, Inc.*, *Guelph, ON, Canada*.

Effects of a prepartum administration of a monensin Controlled Release Capsule (M) or a placebo (C) and stage of lactation (LS) on diurnal variation of blood metabolites were determined in 16 Holstein dairy cows. Cows were fed a total mixed ration ad-libitum twice daily at 0700 h and 1300 h. At calving, cows were switched from a close up dry cow diet to a lactating cow diet. Cows were blood sampled every three hours for 24 h at three stages of lactation, including 1 Wk before calving (Wk -1), 1 Wk after calving (Wk 1) and six weeks after calving (Wk 6). Average dry matter intakes were 11.2, 16.0 and 20.5 kg/d at Wk -1, Wk 1 and Wk 6, respectively. Average milk yields were 26.8 and 38.0 kg/d at Wk 1 and Wk 6, respectively. Serum concentrations of glucose, β hydroxybutyrate (BHBA), non-esterified fatty acids (NEFA), and urea exhibited significant diurnal variation. Glucose and NEFA were on average 0.09 mmol/L and 0.08 mmol/L lower between 1030 h and 2230 h than between 2230 h and 1030 h, respectively. The BHBA and urea were on average 95.1 µmol/L and 0.49 mmol/L higher between 1030 h and 2230 h than between 2230 h and 1030 h, respectively. The diurnal variations in glucose, BHBA and NEFA were not affected by monensin and by stage of lactation. Diurnal variation in urea was affected by stage of lactation, but not by monensin. Monensin did not significantly affect urea and NEFA in this study. At Wk 1, monensin numerically increased glucose and reduced BHBA, but not at Wk -1 and Wk 6. Glucose was lower and BHBA and NEFA were higher at Wk 1 compared to Wk -1 and Wk 6. Urea was higher in Wk 6 compared to Wk -1.

	Wk -1		LS Wk 1		Wk 6		*P value*		
	M	C	M	C	M	C	SE	M	LS
Glucose, mmol/L	3.64	3.53	3.10	2.63	3.56	3.55	0.28	NS	<0.0001
BHBA, mmol/L	568	525	1122^{b}	1459^{a}	639	612	250	NS	<0.0001
NEFA, mEq/L	0.32	0.24	0.68	0.81	0.19	0.19	0.07	NS	<0.0001
Urea, mmol/L	5.28	4.93	5.81	5.27	6.08	5.80	0.48	NS	0.13

Key Words: Blood Metabolites, Diurnal Variation, Monensin

T204 Effects of monensin and dietary soy oil on milk fat percentage in lactating cows. O. Alzahal*[1], N. E. Odongo[1], T. Mutsvangwa[2], T. F. Duffield[1], R. Bagg[3], P. Dick[3], G. Vessie[3], and B. W. McBride[1], [1]*University of Guelph*, *Guelph, Ontario*, [2]*University of Saskatchewan*, *Saskatoon, Saskatchewan*, [3]*Elanco Animal Health, Division Eli Lilly Canada Inc.*, *Guelph, Ontario, Canada.*

Seventy-two lactating Holstein dairy cows (100-150 DIM) were used in a 2 X 3 factorial experiment to investigate the effects of monensin and dietary soy oil inclusion on milk fat percentage. Treatments were (DM basis) 1) Control TMR (no monensin, no soy oil); 2) Treated TMR (Rumensin Premix®, 22 ppm; no soy oil); 3) Control TMR + 1.7% soy oil; 4) Treated TMR + 1.7% soy oil; 5) Control TMR + 3.5% soy oil; and 6) Treated TMR + 3.5% soy oil. The TMR (% DM; corn silage, 34%; haylage, 22.7%; hay, 4.5%; high moisture corn, 20% and protein supplement, 18.8 %) was offered *ad-libitum*. The trial consisted of a 2-week baseline period (data used as a covariate), a 3-week adaptation period, a 2-week treatment period, and a 4-week wash-out period. Feed and milk samples were taken three times per week and composited over each experimental period. Monensin reduced milk fat percentage and milk fat yield ($P < 0.05$). Soy oil linearly ($P < 0.05$) increased milk yield and milk protein yield and linearly ($P < 0.05$) reduced milk fat yield. Monensin reduced milk fat percentage by 11 % at 1.7 % soy oil inclusion and by 23 % at 3.5 % soy oil inclusion. Monensin and soy oil had no effect ($P > 0.05$) on DMI. These results show that monensin depresses milk fat percentage and that the depression of milk fat percentage is dependent on the level of dietary soy oil inclusion.

	Control			Monensin			*P*value		
Item/Soy Oil, DM%	0	1.7	3.5	0	1.7	3.5	A	B	C
DMI, kg/d	21.3	20.8	20.9	20.6	21.0	21.5	0.85	0.82	0.42
Milk yield, kg/d	27.5	29.5	29.4	26.9	28.9	30.1	0.92	<0.01	0.56
Fat, %	3.76	3.59	3.14	3.74	3.21	2.43	<0.01	<0.01	0.07
Fat yield, kg/d	1.03	1.05	0.91	0.99	0.91	0.73	<0.01	<0.01	0.28
Protein, %	3.35	3.26	3.27	3.31	3.24	3.23	0.22	0.06	0.93
Protein yield, kg/d	0.92	0.96	0.95	0.88	0.93	0.97	0.51	0.04	0.26

A=main effect of monensin, B=main effect of soy oil, C=monensin X soy oil.

Key Words: Monensin, Soy Oil, Fat Percentage

T205 Monensin and oil can have additive and synergistic effects on performance and milk fatty acid profiles. E. da Costa Eifert[2], R. de Paula Lana[3], D. P. D. Lanna*[2], M. I. Leão[3], and P. B. Arcuri[4], [1]*Supported by*, *CNPq, Brasil*, [2]*LCNA-ESALQ/USP*, *Piracicaba, Brasil*, [3]*DZO-UFV*, *Viçosa, Brasil*, [4]*Embrapa*, *Dairy Cattle*.

Four 7/8 Holstein-Zebu cows in early lactation were used in a 4x4 Latin Square design to determine the effects of monensin (0 and 33 ppm, MN) and soybean oil (0 or 4%, SBO) on performance and milk fatty acid profile. Corn silage and concentrate (53:47 % DM) were fed twice a day, with oil mixed to the concentrate. No interaction between oil and MN effects were observed for DMI and MY, however SBO decreased DMI (18.2^{a}vs 16.5^{b}kg/d; ^{a,b}, P<0.05) and MY (24.2^{a}vs 22.8^{b}kg/d). This decrease could be explained by the diet high oil content. Lactose and milk protein content were not influenced by treatments, but MN (3.48^{a}vs 2.95^{b}%) and SBO (3.51^{a}vs 2.93^{b}%) reduced milk fat content. Effects on DMI, MY and milk fat content were greater for MN+SBO combination, suggesting an additive effect. MN had no effect on short and medium-chain FA (SCFA), but increased unsaturated FA (32.7^{a}vs 34.7^{b}%). SBO reduced SCFA (10.4^{a}vs 6.5^{b}%), MCFA (52.4^{a}vs 34.9^{b}%) and increased UFA (27.7^{a}vs 39.6^{b}%). All trans-C18:1 isomers were increased by SBO (2.5^{a}vs 5.8^{b}%) and MN (3.4^{a} vs 4.9^{b}%), except t11-C18:1, which was altered only by SBO (1.10^{a}vs 1.64^{b}%). SBO and MN increased t6-8, t9 and t10-C18:1 concentrations, but the combination had a synergistic effect (interaction MN+SBO, P<0.05). Value of t10 (control=0.26; Mn=0.59; SBO=1.53; MN x SBO=2.67%) followed t10,c12 CLA concentrations (control=0.002; MN=0.008; SBO=0.033; MN+SBO=0.048 %). MN and SBO had additive effects for t10,c12 CLA. C9,t11 CLA was not influenced by treatment (control=0.54; MN=0.66; SBO=0.55;

MN+SBO=0.73%) and Δ^9-desaturase activity was reduced in SBO diets. Effects of MN and SBO on performance were mainly additive. However, changes in milk fat composition and FA profile were greater when MN and SBO were supplied together, with additive and synergistic effects on lipid bio-hydrogenation.

Key Words: Biohydrogenation, Ionophore, Soybean Oil

T206 Diet composition determines the type of response of cows fed monensin. K. McGuffey* and J. Wilkinson, *Elanco Animal Health Research*.

Quadrant analysis (QA) is a method of examining the importance of two traits that may respond independently but taken together indicate a degree of the desired state. QA was applied to the 9 Trial North American Monensin Dose-titration study after discovering that trials could be grouped in one of three outcomes based on milk fat and milk protein yields. Yield groupings for monensin (M) treatments compared to control (C) were: higher fat-higher protein (HFHP), lower fat-higher protein (LFHP), and lower fat-lower protein (LFLP). Cows fed M compared to C at HFHP sites averaged 1.2 to 2.1 kg/d more milk with small differences in milk fat percent (<0.1%) and milk protein percent (<0.05 %). Dry matter intake was similar for M and C. Cows fed M compared to C at LFLP sites averaged 0.7 to 1.6 kg/d more milk but a large difference in milk fat percent (Î”= 0.1 to 0.4%) and small differences in milk protein percent (<0.05 %). Dry matter intake was similar for M and C. At LFLP sites, milk was similar for cows fed M compared to C. Milk fat percent decreased linearly from C (3.63%) to 24 ppm M (3.40%). Milk protein percent was similar. Dry matter intake for 8, 16 and 24 g M per kg averaged 0.2, 1.0 and 1.2 kg/d less than C. Average feed composition of TMR and the nutrient analysis for each feed at each site were entered into the Cornell Net Carbohydrate Net Protein model (CNCPS), and output used to identify diet components related to each type of response to M. At HF sites, diets were higher (P<0.01) in NDF (32.9 v 29.8 and 28.4) and lower (P<0.05) in NFC than LF sites. At HP sites, diets delivered more (P<0.05) total metabolizable protein (MP) with MP of bacterial origin greater (P<0.05) than LP sites. Dietary concentrations (% of DM) of crude protein, fat and linoleic acid were not different across outcome groupings. Diets that promote ruminal fermentation of fiber and microbial growth optimize the lactation response of cows fed monensin.

Key Words: Monensin, Lactation, Ration

T207 Performance of dairy cows fed ensiled high moisture corn of a flint or a dent hybrid. F. M. J. Costa, J. F. dos Santos, and M. N. Pereira*, *Universidade Federal de Lavras*, *Lavras, Minas Gerais, Brazil.*

Corn grown in Brazil is mainly flint type. Flint corn has lower ruminal digestibility than soft texture, dent grain. The texture effect on grain digestibility is accentuated in plants approaching the black layer stage of maturity. We evaluated the effect of corn texture on the performance of lactating cows fed high moisture, black layer stage grain silage. Treatments were: Flint (Tork) or dent (AG 4051) corn factorialized with 9% or 18% of corn grain in diet DM. Pellets of citrus pulp replaced corn in the low starch diet, citrus pulp inclusions were 16.2 or 25.6% of diet DM. Other feed ingredients as a % of diet DM were 33.9% corn silage (47.7% NDF), 15.6% tifton hay (73.6% NDF), 13.6% soybean meal and 0.85% urea. The TMR contained 50% forage, 15.3% CP and 27.7% forage NDF. Twelve Holsteins in mid lactation received a sequence of the four treatments in three, 21-day period, 4x4 Latin Squares. Data was analyzed with the GLM procedure of SAS with a model containing the effects of square, period, cow within square, texture, starch and interaction. There was no treatment effect on milk urea content (P>0.28), mean value was 15.3 mg dl^{-1}. The high starch diets decreased milk fat content from 3.38 to 3.26% (P=0.04) and increased protein content from 2.99 to 3.03% (P=0.05). There was no detectable grain texture effect on milk solids content (P>0.35). Daily production of milk was 27.9 kg for flint corn and 28.8 kg for dent (P=0.19) and protein production was 0.84 and 0.87 kg (P=0.17), respectively. Intake of digestible organic matter was 11.7 kg for flint and 12.3 kg for dent corn (P=0.05). Total tract apparent digestibility of the non-NDF organic matter was 82.4% for flint and 83.6% for dent corn (P=0.10). The high dietary starch content decreased the 12-hour post feeding, single point ruminal pH more in the dent corn diet than it did in the flint corn diet (P=0.06 for the interaction between texture and starch content). Dent corn numerically increased milk production, although P values were high, however some digestion parameters suggest that high moisture dent corn silage was more fermented in the rumen than flint corn silage.

Acknowledgements: Funded by FAPEMIG

Key Words: Corn Texture, Citrus Pulp, Brazil

T208 Balancing grass silage based rations to dairy cows with regards to rumen degradable fiber. M. Murphy[1], T. Andersson*[1], and I. Andersson[2], [1]*Lantmännen Animal Feeds*, *Stockholm, Sweden*, [2]*Swedish University of Agricultural Sciences*, *Uppsala, Sweden.*

To exploit differences in the nutrient composition of grasses, dairy cow diets were based on substrate rumen degradation characteristics rather than energy. Total Mixed Rations (TMR) were computed to contain the same amounts of rumen degradable NDF, protein and starch, and equally balanced for other nutrients. Thirty-two multiparous dairy cows were used in a balanced change-over trial with two treatments and an extra period to account for residual effects. Two grass silages were cut at different stages (Early, 38.5% NDF, and Normal, 46.2% NDF) and complemented with barley, oats, beet fiber and protein sources. Feed ingredients of the TMR differed. The Early TMR contained 34% silage, DM-basis, and the Normal TMR contained 43% silage. TMR were formulated to contain 34% NDF of which 51% was rumen degradable. TMR were fed ad lib and intake was recorded using gate maneuvered feeding bins. Indigestible fiber (INDF) was used as a marker in fecal grab samples from eight cows. Milk yield was recorded. Degradation characteristics for NDF and protein were determined in sacco for all feeds. Data were statistically analyzed using the PROC MIXED procedure of SAS. Intake and production with the TMR based on Early (20 kg DM and 30 kg milk) were greater (P<0.01, DMI SEM=0.67, milk SEM= 0.81) than for the Normal TMR (19 kg DM and 29 kg milk). Milk fat content was the same but milk protein was higher with Early TMR, 3.51 % compared to Normal, 3.46 % (P<0.001, SEM=0.05). NDF total tract digestibility did not differ between diets. Degradation characteristics of silage NDF differed from the computed characteristics based on harvest samples and the rumen digestible NDF content in Normal TMR was 42 % of NDF compared to 50 % in Early TMR. Cows ate more than expected but the intake of INDF was the same for both TMR, 1.5 kg d-1. The INDF might have been limiting intake. Economic benefits of the increased production and intake with Early TMR were offset by a higher feed cost due to lower harvest yields. Formulating diets based on average degradation characteristics is a feasible alternative to energy systems but accurate assessment of the characteristics is necessary.

Key Words: NDF, Grass, Rumen Degradation

T209 Effects of physically effective NDF on ruminal pH and nutrient digestion of dairy cows fed diets based on corn silage. W. Z. Yang* and K. A. Beauchemin, *Research Center, Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

A study was conducted to investigate the effects of physically effective fiber (peNDF) content of dairy cow diets on ruminal pH and feed digestion in the total digestive tract. Corn silage, chopped fine, medium and coarse, was used in the study designed as a replicated 3 x 3 Latin square using six lactating dairy cows with ruminal cannulas. The fine, medium and coarse silages were combined with a corn-based concentrate to provide three levels of peNDF (forage:concentrate ratio of 45:55). Particle distribution of the diets was determined using the Penn State Particle Separator with a top sieve (19-mm), middle sieve (8-mm) and pan. The peNDF contents of the diets were 10.4, 14.0 and 17.0% for low, medium and high peNDF diets, respectively. Cows were offered ad libitum access to a TMR. Dry matter intake ranged from 23.5 to 24.8 kg/d for the treatments and was not affected by dietary peNDF levels. Although digestibility of DM (range of 62.6 to 64.5%) in the total tract was not significantly different among the treatments, digestibility of NDF (43.5, 46.9 and 47.4%

for low, medium and high peNDF, respectively) tended (P<0.15) to be linearly increased, and in contrast, digestibility of starch (85.0, 80.1 and 80.4% for low, medium and high peNDF, respectively) tended (P<0.12) to be linearly decreased with increasing peNDF content of the diets. In addition, altering dietary peNDF contents did not affect mean ruminal pH (6.01, 5.95 and 6.06 for low, medium and high peNDF, respectively), area between the pH curve and pH 5.8 or 5.5, and time that pH was below 5.8 or 5.5. The results indicate that manipulation of the peNDF content of corn-based diets can improve fiber digestion in the total tract, but has limited effects on ruminal pH in cows not experiencing subacute acidosis.

Key Words: Physically Effective NDF, Ruminal pH, Digestion

T210 Evaluation of kernel hardness parameters and degradabilities of Zimbabwean commercial and research corn hybrids. D. Ngonyamo-Majee*[1], R. Shaver[1], J. Coors[1], D. Sapienza[2], J. Lauer[1], and X. Mhike[3], [1]*University of Wisconisn*, *Madison*, [2]*Sapienza, Analytica*, *Johnston, IA*, [3]*Crop Breeding Institute, AREX*, *Zimbabwe*.

Our objective was to characterize kernel hardness parameters related to degradability in selected Zimbabwean commercial and research corn hybrids. Fifteen hybrids comprising germplasm from six seed companies selected to cover the diverse genetic background of the region were evaluated. Hybrids were grown at three locations in Zimbabwe; two in Harare and one at Gwebi Research Station during summer 2003-2004 in 2*5 m row plots in a split-plot design with two replicates. Harvest was at two maturities (HS1=½ milk line; HS2=black layer). Dried kernels were transported to UW-Madison for all analyses. A 100 g sample of whole kernels was used for near infrared transmittance (NIT) prediction of density (D), starch and protein contents using Pioneer Hi-Bred Int. calibrations. Laboratory data included pycnometer D, visual vitreousness (V), and degradabilities (in-situ ruminal DM degradability (RDMD) and total DM degradability (TDMD) using Pioneer Hi-bred Int. in vitro enzymatic method on ruminal residue) on samples ground to pass a 6mm Wiley mill screen. Correlations between degradabilities and kernel hardness parameters were evaluated, and r-values are presented in the table. Variation in kernel hardness parameters and degradabilities among the Zimbabwean hybrids evaluated was high. All kernel hardness parameters were correlated (P<0.0001) with degradability measurements. Ruminal DMD was highly correlated with TDMD (r=0.933).

Variable	n	Range	Mean	STDEV	NITD	PYCD	0-hr	RDMD	TDMD
Vitreousness	168	10-100	75.6	21.2	0.79	0.78	-0.58	-0.71	-0.58
NIT Density	166	1.23-1.35	1.31	0.03		0.89	-0.68	-0.82	-0.71
Pycnometer Den	167	1.02-1.29	1.20	0.06				-0.75	-0.62
0-hr	166	8.3-24.5	14.9	2.7				0.76	0.69
RDMD	166	36.2-66.0	50.1	6.5					0.93
TDMD	166	64.2-85.2	74.4	4.2					

Key Words: Corn, Vtreousness, Degradability

T211 The effect of silage additives and delayed filling on the fermentation of ryegrass silage. R. Schmidt*, D. Kleinschmit, R. Teller, and L. Kung, *University of Delaware*, *Newark*.

Annual ryegrass (28% DM) was chopped (late boot) and immediately treated and packed (direct filling) in laboratory silos, or left in the forage wagon overnight (10 h), and then treated and packed (delayed filled). The treatments added to the forages were: a) nothing or control (C); b) *Lactobacillus buchneri* 40788 (400,000 cfu/g of wet forage) and *Pediococcus pentosaceus* (100,000 cfu/g) (Lallemand Animal Nutrition, Milwaukee, WI) (LBC); c) *P. cerevisiae* and *P. acidilactici* (100,000 cfu/g, Lallemand Animal Nutrition) (P2); d) Silage Savor (SS), 0.5 kg/t of wet forage (Kemin Industries, Des Moines, IA), a buffered propionic/acetic acid based product; and e) SS, 1 kg/t. A 2 × 5 factorial design was used to determine the effects of delayed filling, treatments, and their interactions. After 90 d of ensiling, delayed filling caused silages to undergo a clostridial fermentation regardless of added treatment. These silages had the highest pH (> 5.8 vs. about 4.7), greatest concentrations of butyric acid (> 0.2% vs. 0) and ammonia-N (> 0.9% vs. about 0.35%), and lowest concentrations of lactic acid (< 1.5% vs. about 7%), compared to silages that were directly filled ($P < 0.05$). After 7 d, direct filled silages treated with P2 and LBC had lower pH and higher ratios of lactic:acetic acids (L:A) (about 10:1) when compared to silage that was untreated (about 8:1) ($P < 0.05$). After 60 and 90 d, silages treated with LBC had a L:A of about 1:2 indicating a major conversion of lactate to acetic acid ($P < 0.05$). At these openings, the L:A decreased for silage treated with P2 but to a lesser extent (about 2:1). After 90 d of ensiling the concentrations of propionic acid from direct filled silages were 0.21, 1.84, 0.85, 0.83, and 0.81% for treatments a, b, c, d, and e, respectively. Treatment with SS had minor effects on the fermentation of direct filled silages. Delayed filling of silage is an unacceptable practice that cannot be overcome by the use of additives.

Key Words: Ensiling, Ryegrass, Inoculant

T212 Effect of corn silage harvest method on intake and production by mid lactation dairy cows. G. I. Zanton*, M. J. Vassallo, D. R. Buckmaster, and A. J. Heinrichs, *Pennsylvania State University*, *University Park*.

The objective of this research was to elucidate the effects of different corn silage harvest methods on rumen parameters, dry matter intake, feed sorting, and milk production in mid lactation Holstein cows. Corn silage was harvested with different methods (CS = chopped short; CL = chopped long and processed; SH = shredded) yielding very different particle size distributions at harvest and fed as the sole forage source in a TMR (60% of dietary DM). The largest differences in corn silage particle size distribution, as assessed by the Penn State Particle Separator, were in mass of particles larger than 30 mm (5.59, 14.14, and 36.96% AF basis for CS, CL, and SH, respectively; P<0.05). In a replicated 3x3 Latin square design experiment, 6 cows (3 rumen-cannulated) were fed treatment rations for 21 days per period. Cows fed CS and CL consumed less particle mass larger than 30 mm than did cows fed SH (1.8, 3.8, and 9.7 kg/d; AF basis; P<0.05). Also, cows fed CS and CL consumed less feed with particles smaller than 2.75 mm than cows fed SH (6.9, 7.3, and 8.6 kg/d; AF basis; P<0.05). Dry matter intake, however, did not differ between treatments (P>0.05), averaging 28.35 (+0.26) kg/d. Cows fed CS selectively refused particles larger than 30 mm to a larger extent than those fed CL or SH, but no differences between treatments were noted for other particle sizes. Mean rumen pH and minimum pH, VFA, and ammonia concentrations did not differ between treatments and diurnal pH variation was also not different between treatments (P>0.05). Production of 4% fat corrected milk was maximized with CS or CL (43.1, 42.7, and 40.2 kg 4%FCM/d for CS, CL, and SH; P<0.05). Milk fat percentage was greatest for the cows fed SH and lowest for CS and CL, though generally low (3.1, 3.1, and 3.2 %; P<0.05 for SH versus CS and CL). It is concluded that particle length of corn silage, produced by different harvest methods, can affect the FCM production independent of changes in DMI or rumen parameters.

Key Words: Corn Silage Harvest Methods, Particle Size, Sorting

T213 Adding value to corn through the use of a corn grazing system on dairy farms. T. R. Smith*[1], M. Boyd[1], G. Triplett[1], A. Chapa[1], C. Herndon[1], J. Murphy[2], and B. J. McClenton[1], [1]*Mississippi State University*, *Starkville*, [2]*Coastal Plain Branch Experiment Station*, *Newton, MS*.

Corn silage is the basis of dairy rations throughout the US. But, due to the labor, expense and specialized equipment needed to prepare and feed corn silage, its use has limitations, particularly on small dairies. Grazing dairy cows on corn could add value to the crop and flexibility to dairy management practices. A lactation trial was conducted to evaluate the impact of corn grazing on milk production, animal well being and dairy profitability. Two groups of 18 lactating Holsteins were randomly selected and balanced for DIM, production and weight. Control cows were fed a TMR, ad libitum throughout the study.

Cows in the Grazing group were allowed access to a 1.62-ha plot, of Terral TV2140RR corn planted March 23rd. The 2-wk adaptation period began July 10th, with corn at the late roasting-ear stage, and a 10-week trial followed. In the first 4 wks of the trial, grazing cows were restricted to 70% of the TMR fed to controls and they consumed 80% of the available forage DM. The savings in TMR averaged 8.5 kg/hd/d or $351 over the 26-d interval. As the forage matured, cows began removing just the grain off the ears and grazing cows consumed 7.9 kg/hd/d of corn, removing 83.6% of the available corn after 1 wk of grazing and 95% after 3 wks. During this time, grazing cows were full-fed, but all corn grain (6.80 kg/hd/d) was removed from their TMR and at $7/45 kg, this saved $794 over the next 42-d interval. Milk production averaged 25.1 ± 1.19 kg/d, but neither milk production nor composition differed between groups. Similarly, there were no differences in body weight or condition score change between groups. The total savings in feed costs for grazing cows was $1,145 over 10 wks. The grain yield averaged 49.9±6.5 bu/ha and at $2.47/bu, the value of corn on 1.33 ha used in the trial was $744.80. Thus, in this study, grazing added 53% to the value of the crop over other potential uses. Further, corn provides an excellent forage in the summer when other high-quality forages are limiting and dairy cows can graze corn with no detrimental impact to production. Supported by the Mississippi Agricultural and Forestry Experiment Station.

Key Words: Corn Grazing, Dairy Nutrition, Dairy Management

T214 Ruminal and intestinal digestibility of distillers grains with solubles varies by source. D. H. Kleinschmit, J. M. Ladd*, D. J. Schingoethe, K. F. Kalscheur, and A. R. Hippen, *South Dakota State University*, *Brookings*.

Two ruminally cannulated Holstein cows (263 DIM) producing 32 kg/d of milk were used to determine the ruminal degradability of DM and CP in soybean meal (SBM), dried distillers grains with solubles (DGS) from five sources (A, B, C, D, and E) and one source of wet DGS (W). Feeds were incubated in the rumen for 3, 6, 12, 18, 24, and 36 h on three consecutive days. Intestinal CP digestibility was measured on feeds at 12 h. The MIXED procedure of SAS was performed and the statistical model was y = treatment + cow + time + day + time × treatment with cow being random. Other interactions were not significant. Significance was declared at $P < 0.05$. Ruminal DM and CP degradation rates were greater in SBM compared with DGS. W had a greater ruminal DM degradation rate compared with A, B, and D and a greater ruminal rate of CP degradation compared with A, B, C, and D, but not E. The rates of NDF digestibility among DGS ranged from 0.0253 to 0.0315/h. Ruminal undegradability of DM (RUDM) was less in SBM compared with DGS. A and D had more RUDM compared with B, C, and E and W. In addition B was greater for RUDM compared with W. Ruminally undegradable protein (RUP) for SBM was less than for DGS. W had less RUP than in dried DGS. The RUP of C and E was lower than in A, B, and D with A having more RUP than B and D. Intestinal digestibility (ID) of SBM was greater than in all DGS. B and C had greater ID compared with A, D, and E. The ID in W was similar to all other DGS, except for A, which was lower. In conclusion, the RUP in SBM was lower than in DGS. Wet DGS had less RUP than dried DGS, but among the dried DGS, RUP varied considerably. Processing differences between ethanol plants may significantly affect DGS quality.

Treatment	SBM	A	B	C	D	E	W
Ruminal DM degradation/h	0.0858^{a}	0.0209^{c}	0.0237^{c}	0.0261^{bc}	0.0232^{c}	0.0274^{bc}	0.0334^{b}
Ruminal CP degradation/h	0.0852^{a}	0.0134^{c}	0.186^{c}	0.0214^{c}	0.0161^{c}	0.0256^{bc}	0.0340^{b}
RUDM, %	29.4^{d}	57.0^{a}	53.8^{b}	52.0^{bc}	56.6^{a}	51.1^{bc}	50.8^{c}
RUP, %	38.9^{e}	78.0^{a}	67.8^{b}	63.6^{c}	71.0^{b}	63.5^{c}	56.5^{d}
ID, %	87.5^{a}	62.5^{d}	77.4^{b}	77.4^{b}	66.1^{cd}	65.9^{cd}	71.7^{bc}

^{a,b,c,d,e}Means in rows with unlike superscripts differ ($P < 0.05$).

Key Words: Distillers Grains, Protein, Dairy Cattle

T215 Feedstuff stability, intake, and performance of dairy cows fed wet distillers grains treated with a preservative. K. F. Kalscheur*, J. Baez, and D. R. Henning, *South Dakota State University*, *Brookings*.

The objective of this study was to determine the impact of adding a preservative to wet distillers grains (WDG) on feedstuff stability, intake, and performance of lactating dairy cows. Fifteen primiparous and fifteen multiparous Holstein cows were assigned to one of three diets, each which contained 15% distillers grains but of different types: 1) dried distillers grains (DDG); 2) untreated-WDG (UWDG); and 3) treated-WDG (TWDG). All distillers grains were produced by the same ethanol plant. The preservative (CakeGuard™; Alltech, Inc.) was applied at a rate of 1 kg/t and mixed thoroughly to make TWDG. The WDG arrived the day before the start of the experiment and was stored outside in replicated, uncovered boxes for the duration of the experiment. The WDG averaged 31.5% DM, 29.3% CP, 23.1% NDF, 13.9% ADF, 3.8% starch, 14.2% fat, 3.53 pH, and 8.3% lactic acid. Dry matter loss attributed to visual spoilage was greater ($P < 0.01$) in UWDG (3.1%) than in TWDG (1.3%). Dry matter loss not attributed to visual spoilage was greater ($P < 0.01$) for TWDG (5.4%) than for UWDG (3.5%). Total DM loss was not different between UWDG and TWDG. All cows were fed the DDG diet the week prior to the start of the experiment, which was used as the covariate period. Cows fed WDG had lower DMI than cows fed DDG (22.7 and 26.4 kg/d; $P < 0.02$). Dry matter intake decreased in cows fed UWDG, but increased in cows fed the DDG and TWDG over the course of the study (treatment by week interaction; $P < 0.01$). Milk production was not affected by diet (37.9, 37.7, and 38.1 kg/d for DDG, UWDG, and TWDG). Feed efficiency (energy-corrected milk/DMI) tended to be greater for cows fed WDG compared to DDG diets (1.65 and 1.46; $P < 0.10$). Milk fat % (3.48, 3.29, and 3.41) and protein % (3.13, 3.17, and 3.10) did not differ across diets. In addition, fat and protein yield, milk urea nitrogen, body condition score, and body weight did not differ across diets. Although total DM loss was similar for both WDG diets, intakes of cows fed TWDG did not decline as did cows fed UWDG.

Key Words: Wet Distillers Grains, Preservative, Dairy Cows

T216 See Abstract 46.

T217 Effects of time of feeding and forage to concentrate ratio on rumen fermentation and productivity of lactating dairy cows. A. Nikkhah*, J. C. Plaizier, C. Furedi, and A. D. Kennedy, *University of Manitoba*, *Winnipeg, MB, Canada*.

Effects of time of feeding and dietary forage to concentrate ratio (F:C) on feed intake, rumen fermentation and milk production were determined in 8 cows using a 4 × 4 Latin square design. Cows received a higher concentrate total mixed ration (TMR) with a F:C of 38:62 or a lower concentrate TMR with a F:C of 49:51. Fresh TMR was provided either at 9 am or at 9 pm. Rumen fluid was sampled at 0100 and 1300 h using an oral probe. Animals were not heat stressed during any time of the day. Time of feeding and F:C did not affect dry matter intake and milk yield. Changing time of feeding from 9 am to 9 pm did not affect average rumen pH, acetate to propionate ratio, milk protein and body condition score, tended to increase milk fat percentage from 2.57 to 2.76% ($P = 0.10$) and increased body weight change from -0.32 to 0.29 kg/d ($P < 0.05$). The differences in ruminal fluid pH, VFA and ammonia levels between 4 h and 16 h after feeding were greater ($P < 0.01$) for cows fed at 9 pm compared to cows fed at 9 am. Reducing F:C reduced rumen pH from 6.33 to 6.19 ($P = 0.009$), acetate to propionate ratio from 2.79 to 2.05 ($P < 0.0001$) and milk fat percentage from 2.88 to 2.55% ($P = 0.001$), and increased milk protein percentage from 3.36 to 3.53% ($P < 0.001$), body weight change from -0.37 to 0.32 kg d-1 ($P = 0.02$), and body condition score from 3.01 to 3.16 ($P = 0.03$). Interactions between time of feeding and F:C on production and rumen parameters were not significant. Results suggest that evening feeding improved the energy balance of the cows without negatively affecting milk production.

Acknowledgements: This study was supported by grants from Dairy Farmers of Canada and Dairy Farmers of Manitoba

Key Words: Time of Feeding, Forage to Concentrate Ratio, Milk Production

T218 Effect of free stall pen design on feeding behavior. R. Mentink*, K. Nordlund, T. Bennett, and N. Cook, *University of Wisconsin*, *Madison*.

The purpose of this study was to determine if a difference exists in group feeding behavior in dairy cows housed in free stall pens with either 2-rows or 3-rows of stalls. The high yielding, mature cow pens in 12 herds were filmed for a 24 hour period. 6 herds had 2-row pen designs (mean 1.52 cows per feed space) and 6 had 3-row pen designs (mean 2.07 cows per feed space). Video tapes were scanned at 10 minute intervals to produce charts of feed bunk utilization, recording the proportion of feed spaces (24 inches wide) occupied by cows at each time interval. Cows in the feed alley were continuously monitored for physical and non-physical aggressive displacements. Herd feeding behavior data were aligned according to peak feed bunk utilization following fresh feed delivery (primary peaks) and following return from milking without fresh feed delivery (secondary peaks). Comparisons between feeding behavior patterns were made using an autoregressive (AR-1) repeated measures model in SAS (SAS, 1999). There was no difference in feed bunk utilization by pen design for the 90 minute period after primary peaks (P=0.24). Feed bunk utilization for 90 minutes following secondary peaks did significantly differ between 2-row and 3-row pens (P=0.008). Peak feed bunk utilization did not reach 100% in either pen design, but was greater in 3-row pens and took longer to decline to baseline levels. Although no significant difference in the rate of aggressive displacements was observed after primary peaks between pen designs, cows in 3-row pens experienced significantly more aggressive displacements during the day (0.246 per cow per hour) than cows in 2-row pens (0.128 per cow per hour), (P=0.008). Feed bunk utilization is a function of several competing drives, namely; hunger and desire to access fresh feed, allelomimetic drive, and social issues of rank and a desire to maintain space and separation between herdmates. Differences in feeding behavior in pens with varying feed space allowances may require different management approaches to feeding, in order to ameliorate potential negative effects on health and productivity.

Key Words: Free Stall Design, Feeding Behavior, Dairy Cattle

T219 Effect of feed intake variation on the performance of dairy cows in early lactation. M. A. Shah*[1], K. S. Schwartzkopf-Genswein[1], P. S. Mir[1], and M. R. Murphy[2], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [2]*University of Illinois*, *Urbana*.

Data from 86 cows in early lactation from three locations (Alberta, Illinois, and New Hampshire) were compiled to study the effect of dry matter intake (DMI) variation on feed consumption and production in a completely randomized design. Variation in daily DMI for 6 to 70 d in milk was calculated for individual cows. Data for wk 1 of lactation were excluded because of abnormal variation associated with parturition. Based on DMI variations, cows at each location were divided into low (LV, 22% of cows), medium (MV, 61%), and high (HV, 17%) variation groups. Average milk fat and lactose contents were highest for MV (3.67 and 4.62; $P < 0.09$) compared to LV (3.44 and 4.52; $P < 0.02$) and HV (3.54 and 4.33) cows. There was no ($P > 0.10$) difference in DMI, milk, milk fat, milk protein, and milk lactose yields (21.6, 42.4, 1.51, 1.30, and 1.73 kg/d, respectively) among the three groups. However, evaluation of the first 5 wk of lactation revealed that LV and MV cows consumed more DM (20.6 and 20.2 kg/d, $P < 0.05$) than HV cows (17.6 kg/d). Greater intakes for LV and MV cows resulted in higher milk yields (41.3 and 41.6 kg/d, $P < 0.05$) compared to HV cows (36.9 kg/d). Milk yield was closely correlated with DMI ($r = 0.81$, $P < 0.0001$) for the LV and MV groups during the first 5 wk of lactation, but correlation for the HV group was low ($r = 0.40$). More than 80% of cows lost body weight (BW) during the first 5 wk of lactation. A higher percentage of HV cows (78%) lost ≥40 kg of BW compared to the LV (29%) and MV (37%) groups. Cows in the HV group likely mobilized more body stores to maintain milk yield and composition during early lactation, potentially increasing the risk of metabolic disorders and reducing subsequent reproduction efficiency.

Key Words: Feed Intake Variation, Dairy Cow, Early Lactation

T220 Effect of forage particle size on sorting dietary particles by dairy cows. W. Z. Yang* and K. A. Beauchemin, *Research Center, Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

Three studies were conducted to determine whether particle size of forage affects sorting of feed by dairy cows fed diets varying in types of forages and grains. Corn silage, chopped fine, medium or coarse, was combined with barley grain (CS-B, study 1), or with corn grain (CS-C, study 2), and barley silage, chopped fine, medium or coarse, was combined with barley grain (BS-B, study 3). Each study was designed as a replicated 3 x 3 Latin square. Particle distribution of the diets was determined using the Penn State Particle Separator with a top sieve (0.75"), middle sieve (0.31") and pan. The physically effectiveness factor (pef), calculated as the sum of the particles retained on the two sieves, was 0.35, 0.32 and 0.29 of DM for CS-B diets, 0.56, 0.49, and 0.32 for CS-C diets, and 0.41, 0.37 and 0.33 for BS-B diets, for coarse, medium and fine silages, respectively. Data were analyzed using the mixed model of SAS to account for effects of treatment (fixed) and square, period within square, cow within square (random). For cows fed CS-B diets, proportion of long particles (0.75") left in the orts 24 h after feeding was reduced by 29, 78, and 97% for coarse, medium and fine diets, respectively. Therefore, the pef of the diets was always greater than the pef of the orts (0.23, 0.20 and 0.16, for coarse, medium and fine, respectively). For cows fed BS-B diets, proportion of long particles and pef in the orts (0.33, 0.31 and 0.28, for coarse, medium and fine, respectively) were also smaller than in the original diets. In contrast, for cows fed CS-C diets, the proportion of long particles was greater in the orts (13.6, 10.6 and 3.7%) than in the original diets (7.6, 4.8 and 2.3%) for coarse, medium and fine, respectively. The results suggest that dairy cows fed highly fermentable barley grain intentionally select long particles to meet their need for physically effective fiber. Inversely, cows select small particles over long particles when a less fermentable grain source, such as corn, is fed.

Key Words: Forage Particle Size, Sorting, Dairy

T221 Effects of corn grain endosperm type and conservation method on milk production and feeding behavior of lactating dairy cows. Y. Ying*, M. S. Allen, *Michigan State University*, *East Lansing*.

Effects of endosperm type and conservation method of corn grain on milk yield, DMI, and feeding behavior of cows were evaluated. Eight ruminally and duodenally cannulated Holstein cows (73 ± 39 DIM; mean ± SD) were used in a duplicated 4 x 4 Latin square design with 21-d periods. A 2 x 2 factorial arrangement of treatments was used with main effects of corn grain endosperm type (floury or vitreous) and conservation method (dry or high-moisture, HM). Diets were formulated to 26.6% neutral detergent fiber and 16.5% crude protein. Treatment corn grain supplied 86.6% of dietary starch. No differences were detected for yields of milk, 3.5 % FCM, milk fat, protein, lactose or SNF; mean yield of 3.5% FCM across treatments was 47.5 kg/d. However, an interaction was observed for efficiency of production (3.5% FCM/ DMI). Floury endosperm increased efficiency 0.05 kg 3.5% FCM per kg DMI in dry corn diets but decreased it by 0.14 kg 3.5% FCM per kg DMI in HM corn diets ($P = 0.09$). An interaction was observed for effect of treatment on milk protein concentration ($P = 0.06$). Milk protein concentration was increased by vitreous endosperm when fed as dry corn (2.68 vs. 2.62%) but not in HM corn diet. Solids not fat concentration was increased by dry corn compared to HM corn (8.45 vs. 8.37%, $P = 0.01$) from combined effects of treatment on milk protein and milk lactose concentrations. DMI was increased 1.3 kg/d by dry corn treatments compared to HM treatments ($P = 0.03$). The increase in DMI by dry corn was from a shorter intermeal interval (104.4 vs. 118.2 min/day, $P = 0.04$) because meal size was not affected by treatment. Body weight was not affected by treatment but vitreous endosperm tended to increase body condition loss($P = 0.07$). Dry corn decreased ruminating bout length and number of chews per bout. Corn endosperm type and conservation method interact to affect efficiency of milk production and milk protein concentration in high producing dairy cows.

Key Words: Corn Grain Endosperm Type, Conservation Method, Milk Production

T222 Effects of feeding time and forage to concentrate ratio on water intake and drinking behavior of dairy cows. J. Plaizier*, D. Fulawka, A. Nikkhah, and A. Kennedy, *University of Manitoba*, *Winnipeg, MB, Canada*.

Effects of time of feeding (TF) and forage to concentrate ratio (F:C) on drinking behavior were determined in eight lactating Holstein cows housed in individual tie stalls. Cows had unlimited access to fresh water only through their own water bowl. A four by four Latin square with experimental periods of 2 wk adaptation and 1 wk of data collection was used. Data were analyzed using the SAS Mixed procedure with TF and diet as fixed factors. Cow and period were random factors. Cows received a total mixed ration (TMR) with a F:C of 38:62 or a TMR with a F:C of 49:51. Fresh TMR was provided either at 9 am or at 9 pm. Water consumption was determined by continuous measurement of the flow of water through each water bowl. Drinking bouts were defined as the combination of drinking events that were less that 4 min apart. The number of drinking bouts and water consumption during each 3 h period were determined. Dry matter intake and milk yield were not affected by diet and TF and were 20.6 kg/d and 37.0 kg/d across treatments, respectively. Both diet and TF did not affect total water consumption, the water consumption per bout, the duration of drinking bouts and the drinking rate. Averages for these parameters across treatments were 73.7 L/d, 2.9 L, 3.3 min, and 1.07 L/min, respectively. Drinking behavior varied significantly among cows. Diet did not affect the number of drinking bouts per day, the total time spent drinking, and the distribution of drinking throughout the day. Cows fed at 9 am had more drinking bouts per day (28.3 vs. 25.6) and spent more time drinking (94.4 vs. 81.7 min/d) than cows fed at 9 pm. More drinking bouts and more water consumption were found for cows fed at 9 am during all 3 h periods from 9 am to 9 pm. Thereafter, the number of drinking bouts and water consumption were greater in cows fed at 9 pm (9 pm to 12 pm; 6 am to 9 am) or similar (12 pm to 3 am; 3 am to 6 am) for the two TF treatments. Results show that TF affects distribution of drinking bouts throughout the day.

Acknowledgements: This study was supported by grants from Dairy Farmers of Canada and Dairy Farmers of Manitoba

Key Words: Drinking Behavior, Time of Feeding, Dairy Cows

Ruminant Nutrition: Methodology and Modeling

T223 Influence of fermentation method on NDF degradation parameter estimates. D. Bossen[1], D. R. Mertens*[2], and M. R. Weisbjerg[1], [1]*Danish Institute of Agricultural Sciences*, *Foulum, Denmark*, [2]*US Dairy Forage Reseach Center*, *Madison, WI*.

Effect of three methods of fermentation on degradation parameters was studied using feeds ground to different sizes. Corn silage (CS), grass silage (GS), barley grain (B), sugar beet pulp (BP), and rape seed cake (RSC) were ground using a shear mill. Silages were ground through 8, 4, 2 or 1-mm screens (G8, G4, G2, G1, respectively) and concentrates through 4, 2 or 1-mm screens, except RSC that was ground through 2 or 1-mm screens. Materials were incubated twice for 0, 6, 12, 24, 48 and 96 h either in situ (IS) in four lactating cows, in vitro (IVn) with media pH of 6.8, or in vitro (IVa) with media pH adjusted to 6.0 using citric acid. Inoculum for IVn and IVa was prepared as a composite from the same four cows used for IS. Feeds and residues were analysed using the amylase-treated NDF method. Potentially degradable aNDF (D_0, g kg^{-1} DM), indegradable aNDF (I, g kg^{-1} DM), discrete lag time (L, h) and fractional rate of aNDF degradation (k_d, h^{-1}) were estimated using NLIN in SAS. Differences within each feed were determined using GLM in SAS. Initial aNDF was 399, 431, 197, 480 and 251 g kg^{-1} DM for CS, GS, B, BP, and RSC, respectively, for G1, but increased with increasing screen size. Grinding screen size affected k_d for CS and B, and D_0 for B, possibly due to incomplete extraction of starch for G4 and G8. Fermentation method affected all degradation parameters for all feeds except RSC, where method only affected D_0 and k_d. Higher D_0 were obtained using IVn compared to IVa, but the difference was significant only for CS. The D_0 was higher for IVn than IS for B, CS and GS, but not BP. Method IVa gave highest I for all feeds except RSC. Method IVn obtained higher k_d than IVa, and especially IS. Average k_d were .06, .10, and .17 for G1 and G2 of all feeds, using methods IS, IVa and IVn, respectively. However, the differences were much larger for BP than for CS. Method IVa gave markedly higher L compared to IVn and IS for all feeds except B. The results demonstrate a marked effect of method on parameter estimates, and indicate that low pH increases lag time and decreases fractional rate of aNDF degradation.

Key Words: Degradation, NDF, Kinetics

T224 The application of a novel, wireless, automated system for determining the fermentation gas production kinetics of feeds. A. Adesogan*[1], S. Kim[1,2], and N. Krueger[1], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *Jinju, South Korea*.

This study describes a novel automated method of measuring the fermentation gas production kinetics of feeds that intermittently measures and relays the pressure arising from the fermentation of feeds in culture bottles to a server using a wireless, radio frequency (RF) signal. The fermentation parameters of three ground (1 mm) feeds (corn, citrus pulp and Pensacola bahiagrass hay, Experiment 1) or esterase enzyme-treated (0, 1 and 2 g/100 g DM) bermudagrass hay (Experiment 2) were determined using the RF sensors and compared to those determined with a digital manometer. Feed samples were incubated in buffered, rumen fluid in quadruplicate (Experiment 1) or triplicate (Experiment 2) in 250 ml, gas-tight, culture bottles at 39 °C. Pressure sensors mounted on each culture bottle were set to take hourly pressure measurements for 96 h and a digital manometer was used to take pressure readings after 0, 2, 4, 6, 8, 12, 24, 48, 60, 72 and 96 h of incubation. An exponential model was fitted to the fermentation gas production data from the sensors and the digital manometer. The fermentation parameters were compared using a 3 x 2 factorial (Experiment 1) and a completely randomized design (Experiment 2). In both experiments, the method of gas pressure measurement did not affect ($P>0.05$) fermentation parameters and there was no method x feed interaction ($P>0.05$). In Experiment 1 the concentrates had greater ($P<0.001$) gas pool size, a faster fermentation rate and a slower lag phase than the hay; and the corn had a longer ($P<0.05$) lag phase, a similar ($P>0.05$) fermentation rate and a greater ($P<0.01$) gas pool size than the citrus pulp. In Experiment 2, increasing esterase enzyme application did not affect the fermentation rate ($P>0.05$), but increased the lag phase ($P<0.05$) and tended ($P=0.063$) to increase the gas pool size. There was a good relationship between RF sensor and manometer-based estimates of gas pool size ($r^2 = 92$), fermentation rate ($r^2 = 83$), and lag phase ($r^2 = 60$). This study demonstrates the potential of the new RF sensor technique for differentiating between the fermentation kinetics of feeds.

Key Words: Gas Production, Kinetics, Fermentation

T225 Comparison of two molecular methods to assess the shift in bacterial population in continuous culture receiving fresh alfalfa or hay with different concentrations of sucrose. C. Ribeiro*, S. Karnati, J. Sylvester, Z. Yu, and M. Eastridge, *The Ohio State University*, *Columbus*.

Identifying shifts in rumen bacterial populations while also measuring nutrient digestibility and the disappearance of unsaturated fatty acids will improve our understanding of the contribution of specific bacterial species to the overall biohydrogenation (BH) process. Denaturing gradient gel electrophoresis (DGGE) and ribosomal intergenic spacer length polymorphism (RIS-LP) were used to determine the effect of forage conservation and sucrose addition on bacterial populations. Four continuous culture fermenters were used in a 4 X 4 Latin square design. The treatments were: 1) fresh alfalfa, 2) alfalfa hay, 3) alfalfa hay plus 4% sucrose, and 4) alfalfa hay plus 8% sucrose. Effluent and bacterial