resulted in an under-prediction of protein feeding status compared to using TMR analyses, but most dairy producers were feeding over NRC recommendations for protein.

Key Words: Milk urea ditrogen, Dietary protein

239 Effect of increased rumen-undegradable protein fed prepartum on milk production and milk protein yield in early lactation for high producing Holstein cows. K. M. Kouri*, S. M. Andrew, and T. A. Hoagland, *University of Connecticut, Storrs, CT, USA.*

Thirty-six, twenty-four multiparous and twelve primiparous, Holstein cows were assigned to one of three treatments to evaluate the impact of feeding higher rumen-undegradable protein (RUP) for four weeks prepartum on milk production, milk protein content and yield of milk protein during early lactation in corn silage-based rations. The prepartum basal diet consisted of 37% corn silage, 11.3% alfalfa silage, 35.8% mixed hay and 10.3% concentrate mix (DM basis) fed as a TMR. The control treatment (CT) was formulated to provide RUP at 31% of CP using soybean meal (SBM). Diet RUP was increased for the other two treatments to 36% of CP, by substituting either heat-treated soybean meal (HTSBM) or animal-marine byproduct (AMP) for SBM. Cows were blocked by parity, expected calving date, body condition score (BCS) and randomly assigned to one of the three treatments. Prepartum treatment rations were fed to maintain BCS for at least 28 d prepartum. Following parturition cows were fed a common lactating cow ration for 56 d postpartum. Daily dry matter intake (DMI), weekly body weight (BW), and bimonthly BCS were measured throughout the entire experiment. Upon parturition, daily milk weights were recorded and weekly milk samples were collected for determination of milk true protein, milk fat, milk urea nitrogen (MUN), somatic cell count (SCC), and total solids (TS). There were no treatment differences for DMI, BW, BCS, milk protein, SCC or TS. There was a trend for increased milk production (P=0.07) and milk protein yield (P=0.17) for multiparous cows fed HTSBM compared with multiparous cows fed CT. No treatment difference in these variables was observed for primiparous cows. MUN tended to be higher for multiparous cows fed HTSBM, compared to multiparous cows fed the CT. Increasing the RUP in the prepartum ration by feeding HTSBM tended to increase milk production and milk protein yield in the subsequent lactation for multiparous cows fed higher levels of RUP.

Key Words: Rumen undegradable protein, Prepartum, Milk protein

240 Strategic ration balancing by supplementing lysine, methionine, and Prolak® on efficiency of milk protein production and potential environmental impact. J. H. Harrison[1], R. L. Kincaid[1], W. Schager[1], L. Johnson*[1], D. Davidson[1], L. D. Bunting[2], and W. Chalupa[3], [1]*Washington State University,* [2]*Archer Daniels Midland Co.,* [3]*University of Pennsylvania.*

The primary objective of this study was to reduce dietary CP of lactating cows without reducing milk yield. A second objective was to reduce farm N import. Three diets were formulated using the CPM Dairy model to vary in content of CP, metabolism protein balance, and predicted balance of Met and Lys. According to estimated % Lys and Met sufficiency, treatments were defined as Lys/Met = 89/91 (control), Lys/Met = 99/116, and Lys/Met = 116/109. Ration CP was effectively reduced by 14% (18.6 % CP vs 16.0 % CP) with inclusion of a commercial source of free lysine (Archer Daniels Midland, Decatur, IL),Met (Alimet®, Novus International, St Louis, MO), and a commercially available RUP source (Prolak® H J Baker, Atlanta, GA). Respective diets were fed in a 14-week continuous trial design. Cows (n = 36) were paired for parity and PTA prior to initiation of the study, then fed individually via Calan® headgates. Cows were milked 2x/day and were provided Posilac®. Diet reformulation was successful in reducing (P < .05) N imported by 8.6 %, increasing FCM, reducing MUN, and improving efficiency of milk protein yield. A proper balance of Lys/Met was necessary to maintain milk production when CP% was reduced in the diet. The apparent imbalance of Lys/Met in the second treatment decreased milk fat% and production of FCM. This study illustrates the benefits of reducing dietary CP and improving efficiency of milk protein production. Detailed data are summarized below.

Item	Control 18.6% CP	16% CP Lys/Met (99/116)	16% CP Lys/Met (116/109)	SE	P<
DMI, kg	20.4	20.5	20.5	1.35	NS
CP Intake, kg	3.79	3.28	3.28	—	—
Milk, kg	35.8	35.4	37.5	2.32	NS
3.5% FCM, kg	37.2^a	33.4^b	38.6^a	2.29	.04
Milk Fat, kg	1.34^a	1.11^b	1.38^a	0.83	.02
Milk Protein, kg	1.10	1.08	1.13	.071	NS
MUN, mg/dl	18.8^a	13.0^b	14.4^b	.92	.01
Ratio of Milk True Protein to Intake Protein	.29	.33	.34	—	—

Key Words: Protein, Environment, Nutrient management

241 Effect of HMB and HMBi on milk production, composition, and N efficiency of Holstein cows in early and mid-lactation. J. T. Sylvester*[1], N. R. St-Pierre[1], B. K. Sloan[2], J. L. Beckman[1], and S. M. Noftsger[1], [1]*The Ohio State University, Columbus, OH, USA,* [2]*Adisseo, Alpharetta, GA, USA.*

Dietary supplementation of 2-hydroxy-4-(methylthio)-butanoic acid (HMB) results in inconsistent increases in milk yield, fat content and fat production. Chemical modification of HMB to an isopropyl ester (HMBi) increases its methionine (Met) bioavailability to approximately 50%. The objectives of this study were (1) to determine the lactation response (volume and components) to ruminally available Met (HMB), (2) to determine the lactation response to partially protected Met provided as HMBi, and (3) to evaluate whether HMBi supplied at 0.15% of the diet provides enough ruminally available HMB to achieve maximal production response. Sixty-one Holstein cows (24 primiparous, 37 multiparous) were assigned to one of four dietary treatments 21 to 28 days after calving. A base diet consisting of (DM basis) 32.5 % corn silage, 17.5 % alfalfa hay, 10 % whole cottonseed and 40 % of a pelleted concentrate made primarily of ground corn, soybean hulls, Megalac, dehulled-solvent extracted soybean meal, blood meal, urea, vitamins and minerals was fed for 16 weeks as a control diet (treatment 1), or was supplemented with 0.1% of diet DM with HMB (treatment 2), with 0.15% with HMBi (treatment 3), or with 0.045% HMB and 0.15% HMBi (treatment 4). The control diet contained an estimated 31.3 % NDF, 10.6 % RDP, 6.2 % RUP, 10.9% metabolizable protein (MP), 6.78% lysine (% of MP), and 1.79 % methionine (% of MP). Results were analysed as a randomized block design with repeated measurements using a mixed model with a first order autoregressive covariance of errors. Results showed a significant (P<0.05) increase in milk yield (2.9 kg/d), true protein composition (0.15%), true protein production (115 g/d), fat production (165 g/d), and lactose production (182 g/d) from the feeding of HMBi. Supplementation of HMB had non-significant effects on milk yield and composition with only lactose production showing a significant improvement. Dietary supplementation of HMBi reduced the amount of N excreted in the urine by increasing the amount of N secreted in milk.

Key Words: Methionine hydroxy analog, Dairy cattle, Milk yield and composition

Ruminant Nutrition: Dairy feedstuffs

242 Effect of *bmr*-6 and *bmr*-18 brown midrib genes on forage sorghum silage in lactating dairy rations. A. L. Oliver*[1], R. J. Grant[1], and J. F. Pedersen[2], [1]*University of Nebraska, Lincoln, NE,* [2]*USDA/ARS, Lincoln, NE.*

Diets of normal sorghum, brown midrib *bmr*-6 sorghum, *bmr*-18 sorghum, and corn silage were fed to determine the effect of these two sorghum brown midrib genes on lactational performance, ruminal metabolism, and digestion. Sixteen multiparous Holstein dairy cows (including four ruminally fistulated) averaging 124 ± 68 DIM were assigned to one of four diets in a replicated Latin square design with 3-week periods. Diets comprised of 40 % test silage, 10 % alfalfa silage, 3.7 % whole cottonseed, and 23.6 % concentrate mix. Cows were housed in a tie-stall barn and fed in individual feed boxes. Lignin was decreased

in the *bmr*-6 and *bmr*-18 sorghum silage when compared to the normal sorghum silage. In addition, the normal sorghum silage had greater NDF and ADF than *bmr*-6, *bmr*-18, and corn silage. There was greater DMI for *bmr*-6 (25.2 kg/d) sorghum silage than *bmr*-18 (23.4 kg/d) sorghum silage while no difference was seen between sorghum silages and corn silage. Milk production (kg/d) and 4 % FCM were significantly greater ($P < 0.10$) for those consuming the *bmr*-6 sorghum and corn silage than normal sorghum silage. Silage source had no effect on overall chewing time. Eating time was increased ($P < 0.10$) with the normal and *bmr*-18 sorghum silages. Rumination time was greatest with *bmr*-6 sorghum silage. Corn, *bmr*-6, and *bmr*-18 sorghum silage had greater ($P < 0.10$) DM digestibility when compared to normal sorghum silage. Corn silage and *bmr*-6 sorghum had higher NDF digestibility ($P < 0.10$) when compared to *bmr*-18 and normal sorghum silage.

Key Words: Brown midrib, Sorghum, Milk production

243 Comparison of a corn silage hybrid with high cell wall content and digestibility with a lower cell wall hybrid on lactational performance of Holstein cows.

S. K. Ivan*[1], R. J. Grant[1], D. Weakley[2], and J. Beck[3], [1]*University of Nebraska, Lincoln, NE,* [2]*Purina Mills, St. Louis, MO,* [3]*Syngenta Seeds, Golden Valley, MN.*

We hypothesized that substituting a corn silage hybrid with high cell wall content and digestibility for a lower cell wall hybrid with lower digestibility would improve feed intake and milk production in lactating Holstein cows. In trial 1, 40 cows (12 primiparous) ranging in milk production from 24.1 to 44.0 kg/d, after a 2-wk preliminary period, were used in a crossover design with 2-wk periods. Diets consisted of either 45% high cell wall and digestibility corn silage (HCW) or 45% lower cell wall corn silage (LCW) plus 10% alfalfa hay, and 45% concentrate. There was a 5.1 percentage-unit range in NDF content and a 5.3 percentage-unit range in 30-h in vitro NDF digestion between the two corn hybrids. The DMI (25.4 vs 24.2 kg/d) and 4% FCM yield (34.3 vs 31.7 kg/d) were higher ($P<0.05$) for cows fed the HCW diet compared with the LCW diet. Milk composition was unaffected by diet ($P>0.20$). When HCW was substituted for LCW on a DM basis, there was no relationship ($P>0.30$) between pretrial milk yield during the preliminary period and response to HCW silage. In trial 2, 40 cows (8 primiparous) ranging in milk production from 20.6 to 49.0 kg/d, after a 2-wk preliminary period, were used in a crossover design with 2-wk periods. Diets consisted of the same LCW diet as trial 1 and a diet containing HCW at a concentration (40% of DM) that resulted in equal NDF content (29.4%) between the two diets (HCWN). The DMI (26.8 kg/d) was unaffected by diet ($P>0.30$), although there was a trend ($P<0.13$) for greater DMI (% of BW) for cows fed the HCWN diet compared with LCW silage (4.24 vs 4.12). Milk fat % (3.91 vs 3.79) and 4% FCM yield (34.9 vs 33.4 kg/d) were greater for cows fed HCWN versus LCW diet ($P<0.07$). When HCW was substituted for LCW silage on a NDF basis, there was a linear and quadratic ($P<0.02$) relationship between pretrial milk yield and response to HCW: cows with greater milk production during the preliminary period had a greater milk response to HCW than lower producing cows. Results of these trials support our hypothesis that HCW corn silage results in greater DMI and milk yield than LCW silage, whether substitution occurs on a DM or NDF basis.

Key Words: Corn silage, Fiber digestibility, Milk yield

244 Effect of endosperm type of corn grain on starch degradability by ruminal microbes in vitro.

M. S. Allen*[1], R. J. Grant[2], G. W. Roth[3], W. P. Weiss[4], and J. F. Beck[5], [1]*Michigan State University,* [2]*University of Nebraska, Lincoln,* [3]*Pennsylvania State University, University Park,* [4]*The Ohio State University/OARDC, Wooster,* [5]*Syngenta Seeds, Golden Valley, MN.*

Six corn hybrids were grown in plots in 3 states (MI, NE, PA) in 1999. Hybrids differed in endosperm type: floury, opaque-2, waxy, dent, and flint (2). Corn grain was harvested at 40%, 30%, and 20% moisture, rolled and ensiled in duplicate 10- x 30-cm PVC silos. Whole kernels and rolled samples were frozen until analysis. Within each location, duplicate silos from each plot and maturity were opened after 35 d and 120 d and frozen until analysis. Samples were ground with dry ice (Wiley mill, 1-mm screen) before analysis. In vitro starch degradation was determined after incubation for 7 h in buffered media with 20% rumen fluid. Vitreousness of endosperm for hybrids ranged from 4 to 62%. Starch degradation was affected by hybrid (49.8 to 60.3%, $P < 0.001$) and increased with moisture content (46.0 to 65.8%, $P < 0.001$), ensiling (0 d vs. 35 d and 120 d, 46.3 vs. 59.3%, $P = 0.001$), and time of ensiling (35 d vs. 120 d, 57.4 vs. 61.2%, $P < 0.001$). However, several interactions were detected. Sample fragility, measured as DM of ground samples passing a 106-μm aperture screen, explained additional variation when included as a covariate ($P < 0.001$) and ranged by hybrid from 26.7 to 40.8% ($P < 0.001$). No interactions were detected when particle size was included as a covariate; starch degradation was increased by ensiling (52.6 vs. 56.2%, $P = 0.01$) and affected by hybrid (52.3 to 58.8%, $P = 0.001$), but not by moisture content or time of ensiling. Starch degradation of hybrids was highly related to vitreousness both with ($R^2 = 0.96$, $P < 0.001$), and without ($R^2 = 0.66$, $P < 0.05$) particle size as a covariate. Increased starch degradation with increased time of ensiling and moisture content was associated with increased kernel fragility. Corn hybrids vary in starch degradation by ruminal microbes because of fragility and vitreousness of endosperm.

Key Words: Corn grain, Starch degradation, Endosperm type

245 Effects of corn grain endosperm type and brown midrib corn silage on milk production and feeding behavior of lactating dairy cows.

C. C. Taylor* and M. S. Allen, *Michigan State University, East Lansing.*

Effects of endosperm type of corn grain and the brown midrib 3 mutation in corn silage on milk yield, DMI, and feeding behavior of cows were evaluated. Eight ruminally and duodenally cannulated Holstein cows (72 ± 8 DIM; mean ± SD) were used in a duplicated 4 x 4 Latin square design with a 2 x 2 factorial arrangement of treatments. Grain treatments were dry corn grain from hybrids with floury or vitreous endosperm and silage treatments were corn silage from a hybrid with the *bm3* mutation or an isogenic control hybrid without the *bm3* mutation. Diets were formulated to 27% neutral detergent fiber and 18% crude protein. Corn grain and silage supplied ∼23% and ∼38% of the diet DM, respectively. An interaction of treatments was detected for 3.5% FCM ($P = 0.10$). Floury endosperm decreased 3.5% FCM 1.2 kg/d compared to vitreous endosperm when fed with control corn silage (39.7 vs. 40.9 kg/d), but had the opposite effect, increasing 3.5% FCM 2.1 kg/d, when fed with *bm3* corn silage (42.2 vs. 40.1 kg/d). Corn grain with floury endosperm decreased DMI 1.8 kg/d compared to vitreous when fed with the control silage diets (23.6 vs. 25.4 kg/d) but increased DMI 0.5 kg/d when fed with *bm3* corn silage (25.2 vs. 24.7 kg/d; interaction: $P = 0.07$). The interaction of grain and silage treatments for DMI can be attributed to a decrease in meal size for floury vs. vitreous corn with control corn silage (2.18 vs. 2.47 kg DM) but an increase in meal size for floury vs. vitreous corn with the *bm3* corn silage (2.25 vs. 2.05 kg DM; interaction: $P = 0.03$). Diets containing *bm3* corn silage tended to increase number of meals compared to control corn silage (11.7 vs. 10.6; $P < 0.10$). Intermeal interval was not affected by treatment. It is unlikely that ruminal distension limited DMI because effects of treatment on meal size and ruminal pool sizes of DM and NDF (interactions $P < 0.05$) reflected effects of treatment on DMI. Treatment effects on meal size and DMI were likely from differences in temporal patterns of fuel production and absorption.

Key Words: Endosperm, Brown midrib, Feeding behavior

246 Dairy cattle performance, health, and milk composition when fed silage and grain from Bt (Cry1F) and near-isogenic control hybrids.

M. A. Faust*[1], B. Smith[2], M. Hinds[2], and G. Dana[2], [1]*Iowa State University, Ames,* [2]*Pioneer Hi-bred International, Inc., Johnston, IA.*

Objectives for this study were to evaluate the health and performance of dairy cows fed non-Bt maize and a new generation variety of Bt maize containing the Cry1F gene (Herculex^{TM} I). Twenty lactating Holstein cows were assigned to treatment groups and fed diets containing whole plant maize silage and maize grain from Bt and near-isogenic control hybrids. The study used a cross-over design with two 28-day treatment periods each preceded by 7-day adjustment periods. To minimize variability due to stage of lactation, two blocks of ten cows with 90-130 DIM at the start of the trial were used. Equal numbers of cows from each of two genetic selection lines (high and average fat + protein predicted transmitting ability) were assigned to treatments within blocks. Diets were formulated to be isocaloric and isonitrogenous. Daily production of milk, fat, protein, lactose, non-fat solids, and total solids did not differ for cows fed the Bt and non-Bt control diets ($P > 0.05$). Further,

groups did not differ for milk urea nitrogen and somatic cell count. For milk fat percentage, there was a significant treatment × genetic group interaction, however overall yields for milk and solids corrected milk did not differ and were 38.9 and 36.4 kg for Bt and 38.6 and 36.8 kg daily for non-Bt fed groups, respectively. Dry matter intakes were 27.1 and 27.9 kg per day and did not differ for the treatment and control diet groups ($P > 0.05$). Physical measures of cow health were collected weekly and included body weight, body condition score, temperature, and pulse and respiration rate; treatment group means for these parameters were not different. Blood chemistry and hematological analyses were conducted using blood samples collected from cows at two-week intervals. Overall, the Bt and non-Bt fed groups did not differ for these 21 indices of health. Further, hematological profiles for cows in the treatment groups were not different ($P > 0.05$). In summary, there were no differences in milk production, milk composition, or cow health as indicated by physical parameters, blood chemistry, and hematological analyses when dairy cows were fed diets containing maize grain and whole plant maize silage from Bt (Cry1F) or its near-isogenic counterpart hybrid.

Key Words: Genetically modified corn, Dairy cattle, Milk yield

247 Effects of feeding corn silage produced from corn containing MON810 and GA21 genes on feed intake, milk production and composition in lactating dairy cows.

S. Calsamiglia*[1], B. Hernandez[1], G. F. Hartnell[2], and R. H. Phipps[3], [1]*Universidad Autonoma de Barcelona, Spain,* [2]*Monsanto Company, St. Louis, MO,* [3]*University of Reading, UK.*

Eight multiparous (126 DIM) Holstein cows (mean live-weight 647 kg) were used in a single reversal study to assess effects of feeding genetically modified corn silage on feed intake and milk production. The potential for transgenic DNA and proteins to occur in milk was also evaluated. The trial consisted of two periods of 28 d (23 d adaptation and 5 d sampling). Cows were housed in a tie-stall barn, fed a TMR ration ad libitum and milked twice daily. Diets contained (DM basis) 45% corn silage, 10% alfalfa hay and 45% concentrate (1.66 Mcal NEl/kg DM, 15.8% CP, 35% NDF and 4.1% fat). Treatments were corn silage containing Roundup Ready event GA21 and MaisGard event MON 810 (RRMG) and a non-modified control line (CTR). Milk was analyzed for fat, protein, solids-non-fat, lactose and somatic cell counts, and transgenic DNA and CRY1A(b)-protein. Chemical composition (37.6% DM, 1.51 Mcal NEl/kg, 8.6% CP, 40% NDF, 19.6 ADF, and pH 3.76) and in vitro DM digestibility (62%) of corn silages were within normal ranges and similar between treatments. Silage type did not affect DM intake (22.1 kg/cow/d). Cows fed the RRMG produced milk with slightly higher ($P < 0.05$) milk protein (3.09 vs 3.00%), lactose (4.83 vs 4.72%) and solids-non-fat (8.60 vs 8.40%) compared with CTR. However, the total yield of milk (36.5 kg/d), 3.5% fat corrected milk (34.4 kg/d), fat (1151 g/d), protein (1106 g/d), lactose (1738 g/d) and solids-non-fat (3094 g/d), and somatic cell count (128000 cells/ml) were not affected by type of silage indicating no overall production difference. All milk samples were negative for the presence of transgenic DNA from either trait or fragments thereof and the CRY1A(b)-protein encoded in the RRMG (limit of detection of 0.1 ng/ml). Results from the chemical composition and production responses indicate that the use of the RRMG silage did not adversely affect animal performance.

Key Words: Corn silage, Genetically modified organism, Dairy cattle

248 Effects of replacing chopped alfalfa hay with alfalfa silage in total mixed rations fed to lactating dairy cows at two levels of concentrate inclusion.

M. S. Einarson*[1], J. M. Calberry[2], B. W. McBride[2], K. M. Wittenberg[1], and J. C. Plaizier[1], [1]*Department of Animal Science, University of Manitoba,* [2]*Department of Animal and Poultry Science, University of Guelph.*

Twenty four lactating dairy cows received one of three total mixed rations (TMR) in a higher concentrate range (Exp.1) or a lower concentrate range (Exp.2). Diets in the higher concentrate range (A, B and C) contained (DM basis) 38.5% barley grain based energy supplement, 30.5% corn silage, 17.0% protein supplement and 4.2% sunflower seeds. Diets in the lower concentrate range (D, E, and F) contained (DM basis) 31.7% barley grain based energy supplement, 40.5% corn silage, 13.9% protein supplement and 4.2% sunflower seeds. Diets also contained (DM basis) 0%, 4.9%, and 9.8% alfalfa silage and 9.8%, 4.9%, and 0% chopped hay for both diets A, B and C, respectively, and for diets D, E and F, respectively. Replacing chopped hay with alfalfa silage significantly decreased the proportion of dietary DM passing through the 8 mm bottom screen of the Penn State Particle Separator (PSPS) and dietary DM content, significantly increased the physical effective NDF (peNDF, NDF retained by the PSPS screens), but did not effect dietary CP, NDF and starch contents in both experiments. In the higher concentrate range, this replacement significantly increased rumen pH and significantly decreased total VFA, but did not affect DMI, milk yield and milk composition. This replacement did not significantly affect rumen pH, VFA concentrations, DMI, milk yield and milk composition in the lower concentrate range.

	Higher concentrate range					Lower concentrate range				
Diet	A	B	C	SE	P	D	E	F	SE	P
DMI (kg/d)	21.9	23.5	23.9	1.4	NS	22.2	22.3	22.0	1.4	NS
Rumen pH	6.27^{b}	6.35^{ab}	6.47^{a}	0.04	<0.05	6.28	6.27	6.31	0.04	NS
Total VFA (mM L^{-1})	95.3^{a}	88.3^{ab}	79.8^{b}	2.2	<0.05	91.9	92.1	89.8	1.8	NS
Milk Yield (kg d^{-1})	39.2	38.9	39.1	0.4	NS	37.0	36.8	36.2	1.4	NS
Fat (%)	2.39	2.53	2.63	0.1	NS	2.90	2.9	2.75	0.1	NS
Protein (%)	3.18	3.21	3.26	0.1	NS	3.03	3.03	3.14	0.1	NS
PSPS										
Top screen (% DM)	8.7	9.4	12.6	1.8	NS	12.1	12.4	11.3	0.8	NS
Bottom screen (% DM)	29.5	31.3	32.2	1.2	NS	35.4^{b}	37.5^{ab}	40.7^{a}	1.3	<0.05
Bottom pan (% DM)	61.9^{a}	59.3^{ab}	55.2^{b}	1.8	<0.05	52.4^{a}	50.1^{ab}	47.9^{b}	1.2	<0.05
NDF in retained fraction (%DM)										
Top screen	64.1	60.9	61.8	0.8	NS	63.7	64.5	61.5	1.3	NS
Bottom screen	48.3	46.0	47.4	1.4	NS	52.1	50.5	48.7	1.4	NS
Bottom pan	32.4	32.4	32.9	0.5	NS	35.2	34.1	33.8	1.0	NS
peNDF (% DM)	20.1^{b}	21.0^{ab}	23.3^{a}	1.2	<0.05	25.4^{c}	26.9^{b}	28.2^{a}	0.4	<0.05
DM (%)	54.0^{a}	52.4^{ab}	50.1^{b}	1.5	<0.05	48.9^{a}	46.7^{ab}	45.0^{b}	1.5	<0.05
CP (%DM)	16.8	16.4	16.8	0.1	NS	14.7	14.5	14.7	0.6	NS
NDF (%DM)	41.1	41.2	41.7	1.3	NS	43.8	44.0	45.3	0.8	NS
Starch (% DM)	24.7	25.0	24.2	1.6	NS	20.4	20.4	19.2	1.6	NS

Key Words: Physical effective NDF, Dairy cows, Rumen

249 Effects of different dietary ratios of alfalfa and corn silages on milk production and rumen metabolism in lactating dairy cows.

A. F. Brito*[1] and G. A. Broderick[2], [1]*University of Wisconsin-Madison,* [2]*US Dairy Forage Research Center.*

Diluting alfalfa silage with corn silage may be useful for improving N efficiency in dairy cattle. Twenty-eight lactating Holstein cows (8 ruminally fistulated) were randomly assigned to 7, 4 x 4 replicated Latin squares with 28-d periods to assess the effects of different ratios of alfalfa to corn silage on milk production, rumen metabolism, and N utilization. Diets contained (% of DM) the following proportions of alfalfa:corn silages, 50:0 (diet A), 37:13 (diet B), 23:27 (diet C), or 10:40 (diet D). All diets contained 26% NDF and contents of CP were 17.8% (diet A), 17.0% (diet B), 16.5% (diet C), and 15.7% (diet D). DMI decreased linearly (P<0.001) across diets with the lowest intake observed on diet D. Milk yield had both linear (P=0.02) and quadratic (P=0.04) effects and again diet D was lowest. Fat yield decreased linearly (P=0.001) with diet A differing from diets C and D. Protein yield was similar across diets but a quadratic effect (P=0.03) was observed. Total urinary N excretion, ruminal NH_3, and total AA decreased linearly (P=0.002, P<0.001, and P=0.004, respectively) and in all cases diet D was the lowest. Ruminal pH and propionate were not different. However, ruminal acetate and acetate:propionate decreased linearly from diet A to D (P<0.001). Overall, diet D was associated with the poorest production although it yielded better N utilization.

Item Alfalfa:corn silages	A 50:0	B 37:13	C 23:27	D 40:0	SE[1]
DMI, kg/d	26.5^{a}	25.9^{a}	25.0^{b}	23.2^{c}	0.44
BW gain, kg/d	0.92	0.90	1.07	1.03	0.18
Milk yield, kg/d	41.5^{a}	42.0^{a}	41.5^{a}	39.5^{b}	0.87
Milk fat, kg/d	1.57^{a}	1.52^{ab}	1.41^{bc}	1.35^{c}	0.07
Milk protein, kg/d	1.26	1.32	1.30	1.26	0.03
Urinary N excretion, g/d	418^{a}	429^{a}	401^{a}	367^{b}	17
Ruminal pH	6.29	6.31	6.30	6.31	0.06
Ruminal NH_3, mM	7.52^{a}	7.14^{a}	6.23^{a}	4.42^{b}	0.66
Ruminal total AA, mM	4.20^{a}	3.87^{a}	4.07^{a}	2.57^{b}	0.51
Ruminal Acetate, mM	88.6^{a}	84.8^{ab}	79.6^{bc}	74.0^{c}	3.5
Ruminal Propionate, mM	29.2	29.7	30.3	31.5	2.1
Ruminal Ac:Pr	3.22^{a}	2.95^{ab}	2.84^{b}	2.53^{c}	0.14

[1]Standard error of least square mean difference; ^{a,b,c}Means in rows without common superscripts are different (P<0.05)

Key Words: Milk production, Alfalfa:corn silages, N utilization

250 Comparison of sample preparation methods for in situ digestion of processed and unprocessed corn silage.

K. W. Cotanch*[1], C. S. Ballard[1], E. D. Thomas[1], S. M. Leach[1], M. P. Carter[1], P. Mandebvu[1], C. J. Sniffen[1], and T. Sato[2], [1]*W.H. Miner Agricultural Research Institute, Chazy, NY 12921,*, [2]*ZENNOH National Federation of Agricultural Co-operative Associations, Tokyo, Japan*.

Whole plant corn (Pioneer hybrid 38K06; RM 93 d) planted on May 4, 2001 on four plots, was harvested at 35% DM content and processed using one of three methods prior to ensiling: (1) chopped at 0.95-cm theoretical length of cut (TLC) and unprocessed; (2) chopped at 1.91-cm TLC and processed with 3 mm roll clearance; and (3) chopped at 1.91 cm TLC and processed with 1-mm roll clearance. Forage samples were ensiled in laboratory minisilos that were sealed for 130 days and stored at 20C. After opening, the minisilo contents were analyzed for chemical composition and remaining sample processed using one of four sample preparation methods prior to in situ digestion: (1) samples used "as is" without further processing; (2) samples separated into stover and kernels, with stover dried at 60C and ground to pass through 2 mm screen in a Wiley mill and then remixed with kernels; (3) samples pseudo-masticated with a traditional hand-cranked meat grinder; and (4) samples dried at 60C and ground to pass through a 2 mm screen. Forage samples (approx. 6 g on DM basis) were weighed into Dacron bags (10 x 20 cm) in triplicate and incubated into the rumen of a lactating dairy cow for 24 h to determine apparent DM (DMDa), NDF (NDFd), and apparent starch (Starch-d) disappearances. Repeatability of each method used to prepare the samples prior to in situ digestion was determined by measuring the coefficient of variation among the replicates. In summary, pseudo-mastication and grinding increased NDFd of corn silage from forage processed with 3-mm roll clearance at harvest.

Main Effects DM basis)	Unprocessed	3 mm	1 mm		SE	*P*-value
DMDa[1], %	58.3	57.8	57.0		0.71	0.845
NDFd[2], %	32.1a	28.8b	22.0c		1.13	0.001
Starch-d[3], %	93.4b	96.9a	96.8a		0.63	0.001
Main Effects DM basis)	As Is	Separated	Masticated	Ground	SE	*P*-value
DMDa, %	56.9b	55.9b	57.5b	60.4a	0.82	0.008
NDFd, %	26.8	29.0	27.7	27.1	1.31	0.654
Starch-d, %	93.1b	91.7b	99.4a	98.6a	0.73	0.001
Starch CV, %	1.0a	2.2a	0.4b	0.6b	0.4	0.020
Interactions DM basis)	As Is	Separated	Masticated	Ground	SE	*P*-value
NDFd, %						
Unprocessed	38.4	37.0	28.3	24.9	2.26	0.001
3 mm	24.3	29.5	31.3	30.1		
1 mm	17.7	20.4	23.3	26.5		
Starch-d, %						
Unprocessed	87.9	88.8	99.5	97.6	1.26	0.042
3 mm	95.3	94.1	99.3	99.0		
1 mm	96.0	92.4	99.4	99.2		

[1]Apparent DM disappearance at 24 h of incubation in the rumen of a lactating cow; [2]Neutral detergent fiber disappearance at 24 h of incubation in the rumen of a lactating cow; [3]Apparent starch disappearance at 24 h of incubation in the rumen of a lactating cow.

Key Words: Sample preparation method, In situ digestion, Processed and unprocessed corn silage

251 Effect of carbohydrate source on ruminal fermentation and nitrogen utilization in lactating dairy cows.

A. N. Hristov*, J. K. Ropp, K. L. Grandeen, S. Abedi, R. P. Etter, A. Melgar, and A. E. Foley, *Department of Animal and Veterinary Science, University of Idaho, Moscow, ID*.

The objective of this study was to investigate the effect of sugar, starch, NDF, and a carbohydrate (CHO) mix on utilization of ruminal ammonia in dairy cows. Four ruminally and duodenally cannulated Holstein cows were allocated to four dietary treatments in a 4 × 4 Latin square design trial. Cows were fed, at 12-h intervals, an all alfalfa hay diet. CHO [corn dextrose, GLU; corn starch, STA; fiber, NDF (white oat fiber); and a CHO mix (25% of each): apple pectin, GLU, STA, and NDF, PEC] were introduced intraruminally during feeding at 20% of dietary DMI. Ruminal ammonia was labeled with ^{15}N. GLU resulted in reduced ($P < 0.05$) DMI compared to NDF (21.7 *vs* 22.6 kg/d, respectively). NDF had the highest (6.41, $P < 0.05$) average ruminal pH (13 samples in 30 h) followed by STA, PEC, and GLU (6.19, 6.05, and 5.96). Ruminal ammonia concentration was higher ($P < 0.05$) in NDF and PEC than in GLU and STA (16.4, 12.4, 8.5, and 9.6 mmol/L). Compared to the other CHO, GLU reduced ($P < 0.05$) acetate and total VFA concentrations in the rumen. Milk yield and milk fat content were not different ($P > 0.05$) between treatments but NDF had lower ($P < 0.05$) milk protein concentration compared to the other CHO. STA resulted in lower ($P < 0.05$) MUN concentration than NDF (16.9 *vs* 22.4 mg/dl). The area under the milk protein ^{15}N excretion curve (22 samples in 120 h) tended to be larger ($P = 0.052$) for STA than for NDF and PEC. As percent of the dose given, cumulative excretion of ^{15}N in milk protein was greater for STA (6.64%) than for GLU (5.87%, trend at $P < 0.1$) or NDF (5.58%, $P < 0.05$). Estimated time to reach 50% of maximum ^{15}N excretion tended to be shorter ($P = 0.101$) for STA than for GLU (36 *vs* 48 h, respectively). Overall, excretion of ^{15}N in milk protein was greater ($P < 0.05$) for STA than for GLU and NDF. Compared to glucose and fiber, starch enhanced utilization of ruminal ammonia for milk protein synthesis in dairy cows.

Key Words: Dietary carbohydrates, Rumen ammonia, Milk protein

252 Linted and delinted cottonseed as feeds for lactating dairy cows.

V. R. Moreira*[2], L. D. Satter[1,2], and B. Harding[3], [1]*U.S. Dairy Forage Research Center, Madison, USDA - Agricultural Research Service,* [2]*Department of Dairy Science, University of Wisconsin - Madison,* [3]*Buckeye Technologies, Memphis, TN*.

Performance of lactating dairy cows fed diets containing either mechanically delinted whole cottonseed (**DWCS**; 3.7% lint) or linted whole cottonseed (**LWCS**; 11.7% lint) was measured. Forty one primiparous (86±39 DIM) and 39 multiparous (88±30 DIM) cows were fed TMR containing 13% (DM basis) **DWCS** or **LWCS** in two blocks of 112d (n=53, and n=27). Other TMR ingredients were corn silage (28.1%DM), alfalfa silage (23%), high moisture shelled corn (27.8%), soybean meal (1.8%), Soy-plus® (1.8%), blood meal (2%), and mineral-vitamin supplements (2.5%). Dry matter intake and milk yield were measured daily, and milk composition bi-weekly. Fecal grab samples were taken on weeks 3 and 13 of each block to estimate excretion of intact whole seeds. Body condition score tended ($P \leq .11$) to increase with **DWCS** (.22 vs. .11) for primiparous cows, although this was not reflected in body weight change. Assuming a DM digestibility of 67% for all TMR, only 3.37 and 1.91% of ingested seeds (lint excluded) were excreted undigested with **DWCS** and **LWCS**, respectively. Although significant, treatment differences in excreted seeds would have little nutritional consequence. **DWCS** performed as well as **LWCS** for all of the key cow performance and milk composition variables measured.

MULTIPAROUS				$P\leq$	
	DWCS[1]	LWCS[1]	SEM	Lint	Lint*week
Milk Yield, kg/d	37.4	37.5	0.83	0.91	0.68
DMI, kg/d	23.8	23.1	1.60	0.14	0.001
Fat, %	3.16	3.16	0.23	0.95	0.51
True protein, %	2.90	2.88	0.03	0.64	0.59
3.5%FCM, kg/d	35.0	34.8	2.01	0.92	0.82
BW change, kg/d	30.2	26.0	9.87	0.76	-
BCS change	0.27	0.31	0.05	0.54	-
Intact WCS, % fecal DM	1.53	0.72	0.15	0.001	0.01

PRIMIPAROUS				$P\leq$	
	DWCS[1]	LWCS[1]	SEM	Lint	Lint*week
Milk Yield, kg/d	32.7	32.8	0.78	0.88	0.96
DMI, kg/d	20.5	20.4	0.59	0.83	0.001
Fat, %	3.23	3.19	0.11	0.77	0.37
True protein, %	2.99	2.95	0.03	0.35	0.32
3.5%FCM, kg/d	31.3	30.9	1.12	0.70	0.11
BW change, kg/d	2.0	-9.6	133.0	0.60	-
BCS change	0.22	0.11	0.45	0.11	-
Intact WCS, % fecal DM	1.02	0.61	0.10	0.01	0.65

[1] **DWCS** or **LWCS**: TMR containing Delinted or Linted WCS

Key Words: Cottonseed, Dairy cows

253 Physical effectiveness of whole cottonseed as affected by lint and particle size. M.L.M. Lima*, J. L. Firkins, J. T. Sylvester, S.K.R. Karnati, and W. Mattos, [1]*Escola de Veterinaria - UFG, Goiania, GO - Brazil,* [2]*The Ohio State University, Columbus - OH,* [3]*Universidade de Sao Paulo, ESALQ, Piracicaba - SP - Brazil.*

The objectives of this study were to evaluate fermentation and physical effectiveness of whole cottonseed as influenced by particle size and availability of linters. Six ruminally cannulated Holstein cows averaging 155 DIM and 33.0 kg/d of milk were used in a 6 x 6 Latin square design with 15 d periods Whole cottonseeds (WCS), starch-coated WCS (Easiflo, EAS), mechanically delinted cottonseed (DEL) and pelleted WCS (PEL) were included in four diets with 16% forage NDF (FNDF). There were a low forage diet (LFD) with 16% FDNF and a high forage diet with 21% FDNF. The DMI did not differ among cottonseed diets (P>0.05), but it was higher (P <0.01) for cows fed the cottonseed diets than HFD. Milk yield was higher for cows fed LFD (P<0.01) and did not differ among cottonseed diets and HFD. Milk fat percentage (3.76%) was not affected (P>0.05) by treatments. Ruminating and chewing activity (min/kg of DMI) were unaffected by cottonseed diets (P>0.05), but they were lower (P <0.05)for cows fed the cottonseed diets than HFD. Rumen pool sizes of DM and NDF and DM turnover rate were unaffected by cottonseed diets, but they were higher (P=0.01) and lower (P=0.03), respectively, for cows fed the cottonseed diets than HFD, apparently explaining the similar ruminal mat consistency among treatments. Rumen mean pH, and the passage rates of ruminal fluid and indigestible NDF were unaffected (P>0.05) by treatments. The presence of linters had minimal effect on chewing effectiveness under our conditions.

Key Words: Whole cottonseed, Linters, Particle size

254 Effect of changes in peNDF and starch source on intake, milk production and milk composition of dairy cows. P. Berzaghi*[1,2] and D. R. Mertens[2], [1]*University of Padova, Italy,* [2]*US Dairy Forage Research Center, Madison, WI.*

The study evaluated the effects of changes in ration physically effective NDF (peNDF) and starch source on dairy cow performance. The negative control (NC) diet was formulated to induce milk fat depression and contained 19% peNDF using finely chopped (TLC = 6.4 mm) corn silage as the main forage source. Three diets were formulated to increase peNDF to 22% by adding corn silage (CS) or chopped alfalfa hay (AH) or chopped grass hay (GH) to NC. Each of the four diets was formulated with dry ground corn (DGC) or finely ground high moisture corn (HMC) to obtain eight diets that varied in starch source and peNDF source and concentration. Twenty-four cows were blocked for milk production and half were assigned to either DGC or HMC diets in replicated 4x4 Latin squares with 21d periods. Intake, milk production, milk composition were recorded during the last week of each period. A mixed model was used for ANOVA. Increasing dietary peNDF raised milk fat percentage by 0.38% (P<0.01) and milk fat yield by about 60g/d (P<0.04), regardless of starch source. On average, HMC depressed (P<0.03) milk fat percentage by 0.47% compared to DGC and milk fat was lowest (2.87%) for the HMC-NC. Among peNDF sources, AH was most effective (P<0.07) in increasing 3.5%FCM production. Milk production tended (P<0.11) to be greater for NC diets and was lower (P<0.02) for CS than AH and GH diets regardless of starch source. Although daily DMI was about 1.6 kg less (P<0.03) for HMC diets compared to DGC, milk production was not different. Regardless of starch source, AH increased (P<0.05) DMI compared to NC, whereas CS did not. Additional peNDF from GH increased DMI for DGC, but not for HMC diets resulting in a significant (P<0.01) peNDF source x starch interaction. Larger particles in feed refusals suggest that GH may not have increased the particle size of consumed diets. In conclusion, changes in dietary peNDF and starch source were most effective alleviating milk fat test depression when used together.

Key Words: Physically effective fiber, Starch, Milk fat

255 Effect of dietary calcium concentration on solubility of phosphorus in feces. M. J. Aguerre*[2] and L. D. Satter[1,2], [1]*U.S. Dairy Forage Research Center, USDA-Agricultural Research Service,* [2]*University of Wisconsin, Madison.*

Excess dietary P is excreted in the feces, largely in water-soluble form, thus increasing the risk of P loss to the environment. The effect of dietary Ca concentration on the solubility of feed P in feces of lactating cows was determined by feeding diets containing either 0.6 (LCa) or 1.10 % (HCa) of Ca and 0.5 % of P. Diets contained (% DM) 35 % corn silage, 20 % alfalfa silage, 25.35 % high moisture shelled corn (HMSC), 8 % soybean meal, 10 % roasted soybeans, 0.6 % monosodium phosphate, 0.55 % $CaCO_3$ and 0.5 % of a salt and vitamin mix.To achieve the higher dietary Ca concentration a small amount of HMSC was replaced by limestone ($CaCO_3$). The diets were fed to 11 mid-lactation cows in a crossover design using 2-wk periods. Fecal grab samples were collected from the rectum at four different times during the last two days of each period (two samples per day) and refrigerated for later analysis. Feed intake and lactation performance were also measured during the trial. The increase in Ca concentration in the diet from 0.6 to 1.10 % had a significant effect (P<0.01) on the amount of soluble P in feces (LCa= 0.36 and HCa=0.31 %), but had no effect (P=0.26) when it was expressed as a percentage of total P (soluble P/ total P) excreted in the feces. Milk yield (32.7 vs. 32.6 kg/d), DMI (22.0 vs. 22.1 kg/d), total P in the feces (0.87 vs. 0.81 %) and fecal Ca (2.4 vs. 2.6 %) for the LCa and HCa trts were not affected by treatment (P>0.10). Animal performance measurements were consistent with those from other studies, although a lower fecal Ca excretion was expected with cows on the LCa diet. High levels of Ca in the diet do not appear to affect the proportion of soluble P: total P in the feces.

Key Words: Calcium, Soluble phosphorus, Milk production