

Ruminant Nutrition: Dairy: Feeds and Co-Products

W296 Productive response of lactating cows fed low-fat dried distillers grains with solubles in combination with rumen-inert fat.

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Twenty Holstein cows, 12 primiparous and 8 multiparous, with (mean \pm SD) 91 \pm 19 DIM and 594 \pm 81 kg were used in replicated 4 \times 4 Latin squares to compare the effects of feeding conventional dried distillers grains with solubles (DDGS) and low-fat DDGS (LF-DDGS) in combination with rumen-inert fat (RIF, as calcium salts of long chain fatty acids). In each 21-d period cows were randomly assigned to one of 4 dietary treatments (values expressed on a DM basis): control diet (CONT) that contained 0% DDGS; a second diet (DG) that contained 30% DDGS; a third diet (LF-DG) that contained 30% LF-DDGS in substitution of DDGS; and a fourth diet (COMBO) that was similar to LF-DG with the addition of 1.9% RIF. Dry matter intake was similar across treatments containing any form of DDGS, 26.0 \pm 0.6 kg/d, and greater ($P < 0.01$) than CONT, 21.6 \pm 0.6 kg/d. Milk yield was similar across treatments averaging 33.4 \pm 0.94 kg/d. The COMBO treatment resulted in the greatest ($P = 0.05$) fat corrected milk (3.5% FCM), 35.0 \pm 0.98 kg/d, and no differences were observed among the remaining treatments averaging 33.4 \pm 0.98 kg/d. A reduction in milk fat percentage and yield was observed ($P < 0.01$) when cows consumed the DG diet, 3.27 \pm 0.10% and 1.11 \pm 0.04 kg/d, whereas these parameters were similar among CONT, LF-DG and COMBO which averaged 3.68 \pm 0.10% and 1.22 \pm 0.04 kg/d. Concentration of milk protein was highest ($P < 0.01$) for the DG and LF-DG treatments, intermediate for the COMBO treatment and lowest for the CONT diet, namely 3.21, 3.12 and 3.07 \pm 0.05%. Milk protein yield for the CONT diet was 1.0 \pm 0.03 kg/d and was lower ($P < 0.01$) compared with DG, LF-DG and COMBO which averaged 1.08 \pm 0.03 kg/d. These results demonstrate that compared with typical dairy diets, feeding high proportions of LF-DDGS to lactating dairy cows results in greater DMI with no risk for milk fat depression and that the addition of RIF supports greater yield of fat corrected milk.

Key Words: milk fat depression, corn milling

W297 Production performance and ruminal fermentation of dairy cows fed diets replacing starch from corn with non-forage fiber from distillers grains.

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The objective was to evaluate replacing starch from corn with non-forage fiber from dried distillers grains with solubles (DG) on the intake, lactation performance, and ruminal fermentation of lactating dairy cows. Six Holstein cows with ruminal fistula were assigned to a multiple 3 \times 3 Latin square design. Three diets were formulated: 1) high starch (33% starch, 0% DG), 2) medium starch (25% starch, 12% DG), and 3) low starch (17% starch, 24% DG). Ground corn, soybean feeds were replaced by DG at 2 inclusion amounts to formulate diets containing medium and low starch concentrations. Diets contained 27.5% corn silage, and 22.5% alfalfa hay, and were formulated to contain 17% CP, 4.4% fat, and 21% forage NDF. Intake of DM was not affected by the diets. As dietary starch concentrations were decreased across diets, milk yield ($P = 0.04$), milk fat percentages ($P = 0.04$), milk fat yield (P

= 0.03), total solids (TS) yield ($P = 0.03$), and energy-corrected milk ($P = 0.02$) were increased linearly, whereas protein percentages ($P = 0.01$) were decreased linearly. Diets were similar for milk lactose, and TS percentages, protein yield, and feed efficiency. Ruminal pH (6.23) and total VFA concentrations (102 mM/L) were similar for all diets. Quadratic responses were observed for the concentrations of acetate and propionate when starch concentrates were decreased across diets. Decreasing starch concentrations in the diet by replacing corn with DG increased milk production and milk fat percentages, while altering ruminal VFA concentrations.

Table 1.

Item	High Starch	Medium Starch	Low Starch	SEM	<i>P</i> -value ¹
DMI, kg/d	22.3	21.9	22.9	1.50	NS
Milk, kg/d	30.7	31.2	32.4	2.75	L
Fat, %	3.03	3.37	3.40	0.30	L
Protein, %	3.10	3.05	3.00	0.15	L
Total VFA, mM/L	103	101	101	3.33	NS
VFA, mol/100 mol					
Acetate	61.5	63.3	62.5	1.63	L,Q
Propionate	24.5	22.6	23.3	1.71	L,Q
Butyrate	10.1	10.9	10.9	0.41	L
A:P ratio	2.74	2.83	2.75	0.24	NS

¹L= linear effect ($P < 0.05$); Q = quadratic effect ($P < 0.05$); NS = nonsignificant.

Key Words: distillers grains, starch, non-forage fiber

W298 Effect of supplementing dairy cow diets with different forms of palm oil-based supplements on the fatty acid profile of milk fat.

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Calcium salts of palm fatty acids (FA) and high palmitic acid-based products, are commonly used as rumen-protected energy supplements for high yielding dairy cows. The objective of this study was to determine the effects of including these 2 types of palm oil-based fat supplement in dairy cow diets on milk FA profile, particularly total saturated FA (SFA) and C16:0, given current interest in the effects of these on long-term human health. Forty-two cows were randomly allocated to diets from calving until wk 12 of lactation, in a completely randomized block design. Diets were total mixed rations with a forage:concentrate ratio of 50:50, with the forage portion comprising 50:50 corn silage:grass silage, wt/wt (DM). A control diet (Control) contained 32 g/kg DM molasses in the concentrate portion, and this was replaced by either calcium salts of palm FA distillate (Megalac; CPO) or a high-C16:0 (>85%) product (H16), each contributing 19 g lipid per kg ration DM. All diets were isonitrogenous. Milk FA profile (g/100 g total FA) was analyzed during wk 6 and 12. Data were analyzed as repeated measures using mixed model procedures of SAS (see Table 1). It is concluded that CPO supplementation had no effect on 16:0 but reduced total SFA concentration in milk fat, while H16 increased milk 16:0 but had no effect on SFA when compared with the Control diet.

Table 1.

g/100 g fatty acids	Control	CPO ¹	H16 ¹	SEM	Diet effect (<i>P</i>)
4:0-10:0	9.29 ^a	7.91 ^b	7.68 ^b	0.171	0.001
12:0-14:0	17.5 ^a	14.2 ^b	13.6 ^b	0.38	0.001
16:0	38.1 ^b	37.4 ^b	43.5 ^a	0.66	0.001
18:1 cis-9	17.9 ^b	21.6 ^a	19.3 ^b	0.72	0.004
Total SFA ²	75.3 ^a	70.9 ^b	73.8 ^a	0.80	0.002
Total cis-MUFA ²	21.4 ^b	25.2 ^a	23.1 ^b	0.71	0.003

^{a,b}Means within rows with different superscripts are significantly different ($P < 0.05$).

¹CPO = calcium salts of palm fatty acid distillate; H16 = High C16 supplement.

²SFA = saturated fatty acids; MUFA = monounsaturated fatty acids.

Key Words: milk fatty acids, palm oil, saturated fatty acids

W299 Influence of corn silage hybrid on lactation performance by dairy cows. M. S. Akins* and R. D. Shaver, *Department of Dairy Science, University of Wisconsin-Madison, Madison.*

The objective of this study was to determine lactation performance by dairy cows fed diets containing different corn silage hybrids; dual-purpose (DP; Pioneer 34A89), brown midrib (BMR; Mycogen F2F665) or NutriDense (ND; NutriDense 905823). One hundred and 28 Holstein and Holstein × Jersey cows were stratified by breed and parity and randomly assigned to 1 of 16 pens, each with 8 cows. Pens were randomly assigned 1 of 4 TMR treatments containing DP, BMR, or ND. Three treatments (DP40, BMR40 and ND40) contained 60% forage DM with 2/3rd (40% of TMR DM) from the respective corn silage and 1/3rd alfalfa silage on DM basis. The fourth treatment contained 65% forage DM entirely from ND corn silage (ND65). All diets were formulated to be isonitrogenous. A 2-wk covariate period with all pens receiving a TMR containing equal DM proportions of DP40, BMR40 and ND40 was followed by an 11-wk treatment period with pens fed their assigned treatment TMR. Contrasts were used to compare ND40 vs. DP40, ND40 vs. BMR40, and ND40 vs. ND65. Data are presented in Table 1. Dry matter intake, actual milk and 3.5% fat-corrected milk (FCM) yields, milk fat%, and yields of protein and lactose were greater ($P < 0.05$) for cows fed ND40 compared with ND65. Cows fed ND40 tended ($P = 0.08$) to produce more milk and had greater ($P < 0.05$) protein and lactose yields than DP40. Cows fed ND40 and BMR40 had similar ($P > 0.10$) actual milk and FCM yields, FCM/DMI, and milk fat% and component yields, with reduced ($P = 0.04$) MUN for BMR40. Overall, cows fed ND40 had improved lactation performance compared with DP40 and ND65, and similar performance to BMR40.

Table 1.

Item	DP40	BMR40	ND40	ND65	SEM
DMI, kg/d	23.9	24.4	24.5	22.7	0.3
Milk, kg/d	38.8	40.7	40.2	38.0	0.5
3.5% FCM, kg/d	42.0	42.5	43.6	37.1	0.9
FCM/DMI, kg/kg	1.73	1.74	1.74	1.65	0.03
Fat, %	3.91	3.76	3.78	3.33	0.11
Protein, kg/d	1.23	1.28	1.29	1.20	0.01
Lactose, kg/d	1.94	2.05	2.03	1.92	0.02
MUN, mg/dL	14.6	13.0	14.0	15.7	0.3

Key Words: corn hybrid, corn silage, lactating cow

W300 Sugar cane silage for lactating dairy cows. M. I. Marcondes*¹, F. L. Andrade¹, R. A. V. Vergara¹, A. S. Trece¹, T. E. Silva¹, W. L. Cardoso¹, and A. B. Fonseca², ¹Universidade Federal de Viçosa, Viçosa, MG, Brazil, ²University of New Hampshire, Durham.

Sugar cane has strong potential to replace corn as a silage source due to its higher productivity (80–120 tons/ha), lower costs, and maintenance of nutritive value during the dry season in tropical conditions. However, previous research showed that sugar cane silage has high concentration of ethanol and significant DM losses when ensiled. This study was conducted to evaluate the effects of sugar cane silage alone or ensiled with different additives on milk production and performance of lactating Holstein cows. Thirty 5 cows averaging 110 DIM were blocked by milk production and, within each block ($n = 5$), randomly assigned to one of 7 treatments: 1) corn silage (CS), 2) chopped sugar cane (SC), 3) sugar cane silage (SCS), 4) SCS + 0.5% of CaO (SCCaO), 5) SCS + *Lactobacillus buchneri* (2.5×10^{10} cfu/g; SCLB), 6) SCS + *Lactobacillus plantarum* (2.5×10^{10} cfu/g) and *Pediococcus pentosaceus* (2.5×10^{10} cfu/g; SCLPPP), or 7) SCS + *Propionibacterium acidipropionici* (5×10^9 cfu/g; SCPA). Data was analyzed as completely randomized block design using a mixed model with repeated measures over time where block and treatment were considered as fixed variables and period and animal as random variables; each experimental period ($n = 5$) lasted 21 d. Diets were formulated to be isonitrogenous and isocaloric with a 60:40 (CS diet) or 40:60 (sugar cane silage-based diets) forage to concentrate ratios. There were no differences ($P > 0.05$) among treatments for milk production (18.5, 22.4, 19.4, 19.7, 18.8, 19.5, and 19.5 kg/d, respectively) and milk lactose content (4.16, 4.11, 4.08, 4.18, 4.03, 4.19, and 4.18%, respectively), FCM (4% fat) (20.0, 23.0, 21.4, 21.1, 20.2, 18.7, and 20.8, respectively), DMI (16.7, 19.3, 18.1, 17.2, 17.1, 17.4, and 20.2 kg/d, respectively), feed efficiency (1.12, 1.15, 1.05, 1.11, 1.09, 1.12, and 0.97 kg of milk/kg of DMI, respectively), and average daily weight gain (0.64, 0.81, 0.55, 0.56, 0.23, 0.37, and 0.77 kg/d, respectively). Cows fed CS (4.02%), SC (4.50%), SCCAO (3.99%), and SCPA (3.92%) had the highest ($P < 0.05$) concentration of milk fat, whereas those fed CS (3.16%), SC (3.19%), SCS (3.30%), SCLB (3.28%), and SCPA (3.32%) showed the greatest ($P < 0.05$) milk protein content. Cows receiving sugar cane silage-based diets produced 20 kg/d of milk and maintained body condition throughout the study, thus suggesting that nutrient requirements were met for this low milk output. Further research is needed to investigate the effect of sugar cane silage-based diets on milk production of high-producing dairy cows. Because ensiling sugar cane with additives did not improve milk yield when compared with the SCS diet, it can be concluded that silage made from sugar cane alone can maintain reasonable milk outputs in tropical conditions. Supported by INCT-CA/FUNARBE/CNPq.

Key Words: dairy cattle, lactobacilli, sugar cane

W301 Influence of dietary starch and forage NDF concentrations on digestion and lactation performance by dairy cows. L. F. Ferraretto* and R. D. Shaver, *University of Wisconsin-Madison, Madison.*

A meta-analysis was performed to evaluate the effect of starch and forage NDF concentrations in corn grain based diets on intake, digestion and milk production by dairy cows, and assess site of starch digestion using a data set comprised of 414 treatment means from 100 peer-review articles published during 2000 - 2011. Categories for dietary starch and forage NDF concentrations were: $\leq 18\%$ (VLS), $>18\%$ to 24% (LS), $>24\%$ to 27% (MS), $>27\%$ to 30% (MHS), $>30\%$ to 33% (HS), and $>33\%$ (VHS) starch (DM basis); $\leq 17\%$ (LFNDF), $>17\%$ to 20% (MFNDF), and $>20\%$ (HFNDF) forage NDF (DM basis). Data

were analyzed using Proc Mixed of SAS with treatment as Fixed and trial as Random effects. Digestibility of dietary starch was greater ($P = 0.03$) ruminally, but not ($P = 0.61$) total tract (TT), for HS and VHS compared with VLS, LS and MS. Conversely, increased dietary starch concentration decreased ruminal ($P = 0.02$) and TT ($P = 0.001$) dietary NDF digestibilities. The TT digestibilities of dietary DM and OM were greatest ($P = 0.001$) for VHS and lowest for VLS. A quadratic effect ($P = 0.001$) was observed for DMI, which was lowest for VLS and VHS. Actual milk yield and protein content were unaffected by dietary starch concentration ($P > 0.10$). Fat-corrected milk (FCM) yield was 2.0 kg/d lower ($P = 0.01$) for VHS than the other dietary starch concentrations. A similar response was observed for milk fat content ($P = 0.001$). Ruminal and TT nutrient digestibilities were unaffected ($P > 0.10$) by dietary forage NDF concentration. Milk fat, protein and urea-nitrogen concentrations did not differ ($P > 0.10$) either. The DMI was 0.8 kg/d greater ($P = 0.01$) and milk yield tended ($P = 0.09$) to be 2.1 kg/d greater for LFNDF. Ruminal and TT starch digestibilities were positively related ($R^2 = 0.84$), with an increase of 0.23%-units TT per %-unit increase ruminally. Digestibility of dietary NDF decreased 0.60% units ruminally ($R^2 = 0.58$) and 0.52% units TT ($R^2 = 0.45$) per unit increase in dietary starch concentration.

Key Words: dairy cow, milk production, starch digestibility

W302 Processed corn stover as a corn silage replacement feed for lactating dairy cattle. S. S. Donkin^{*1}, A. C. Headley¹, H. A. Tucker¹, P. H. Doane², and M. J. Cecava², ¹Purdue University, West Lafayette, IN, ²Archer Daniels Midland Company, Decatur, IL.

Corn silage represents almost half of the forage used in rations for dairy cattle in the Midwest region and increased value for corn grain has increased the costs of corn silage production. Our overall goal is to determine the potential for treated corn crop residues as replacement feeds for corn silage and corn grain. The objective of this initial study was to determine the short-term impact of feeding increasing amounts of processed and chemically treated corn stover on feed intake, milk production and milk composition. Baled stover was tub-ground, hydrated to approximately 50% moisture and treated with either 5% CaO or a mixture of 3% CaO and 2% NaOH (DM basis) in a twin-screw extruder. Separately, baled stover from the same lot, was chopped through a 10.2 cm screen using a HayBuster, mixed with water to 50% moisture and CaO to 5% of DM. All stovers were stored in AgBags. Fifty-six Holstein cows were assigned to 1 of 7 diets in which corn silage was replaced by treated stover. Diets were: CaOH extruded stover at 12.5 and 25% of ration DM, CaOH +NaOH extruded stover at 12.5 and 25% of ration DM, on-farm prepared stover containing 5% CaOH and fed at 12.5 or 25% of ration DM and a control diet consisting of 37.5% corn silage. Cows were fed diets for 21 d to assess initial acceptance of treated stover and impact on production parameters. Milk production averaged 28.9 ± 2.22 kg/d and DM intake was 22.3 ± 1.26 kg/d and did not differ ($P > 0.05$) between treatments. There were no differences ($P > 0.05$) in milk composition, body weight changes during the 21-d feeding period. There were treatment \times day of experiment effects ($P < 0.05$) for feed intake and milk production with the greatest difference with day observed for extruded stover containing NaOH. The data indicate that chemically treated corn stover can replace corn silage in diets for lactating dairy cows to at least 25% of the ration DM and potentially more for some compositions.

Key Words: biofuels, stover, corn replacement

W303 Effects of feeding camelina meal on milk production and composition in lactating Holstein cows. B. C. Casperson,* J. E. Williams, K. M. Hunt, K. M. Steinkamp, and M. A. McGuire, *Department of Animal and Veterinary Science, University of Idaho, Moscow.*

Meal from *Camelina sativa* is potentially available from the biofuel industry as a protein source rich in α linolenic acid for the dairy cow. The objective of this work was to determine the effects of feeding camelina meal to Holstein cows on milk production and composition. Cows ($n = 15$) were randomly assigned to diet after blocking for parity and milk production. Camelina meal replaced canola meal at 0, 50, and 100% so rations contained 0, 7 and 14% of the diet DM as camelina meal. Total mixed rations were formulated to meet NRC requirements for cows producing 35 kg of milk per day. Cows were fed individually in tie stalls for 6 wk. Milk production was recorded daily and composition was tested on d 41 and 42 of feeding. Results were compared using Tukey's test. Milk production (30.4, 32.0 and 29.3 kg/d for 0, 7 and 14% camelina, respectively; SEM = 1.6) for d 35–42 and milk protein percentage (3.2, 3.0 and 2.8% for 0, 7 and 14% camelina, respectively; SEM = 0.07) from d 41 and 42 were unaffected ($P > 0.05$) by diet. Milk fat percent was lower ($P < 0.05$) in milk from cows on 14% camelina meal compared with the other diets (3.8, 3.6 and 3.3% for 0, 7, and 14% camelina, respectively; SEM = 0.09). Camelina meal at 14% of diet DM reduced ($P < 0.05$) milk fat concentrations of 18:0 (10.8, 12.0 and 7.9% total fatty acids for 0, 7 and 14% camelina, respectively; SEM = 1.6), but increased ($P < 0.05$) α linolenic acid (0.1, 0.5 and 0.8% total fatty acids for 0, 7 and 14% camelina, respectively; SEM = 0.01), 18:1 trans isomers (2.6, 3.5 and 6.8% total fatty acids for 0, 7 and 14% camelina, respectively; SEM = 1.3) and c9t11 CLA (0.9, 1.1 and 2.3% total fatty acids for 0, 7 and 14% camelina, respectively; SEM = 0.18), relative to other diets. Camelina meal had no effect ($P > 0.05$) on 12:0, 14:0, 18:1c9 and linoleic acid concentrations in milk fat. In conclusion, camelina meal supported milk production similar to canola meal and enhanced the unsaturated portion of the fatty acid profile.

Key Words: camelina, milk fat, milk yield

W304 Comparison of the NRC (2001) model and the DVE/OEB system in the prediction of protein supply to dairy cows from hullless barley (*Hordeum vulgare* L.) with altered carbohydrate traits. L. Yang^{*1,3}, D. Christensen^{1,3}, J. McKinnon^{1,3}, B. Rossnagel^{2,3}, A. Beattie^{2,3}, and P. Yu^{1,3}, ¹Department of Animal and Poultry Science, ²Crop Development Centre, ³University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

The objective of this study was to predict protein supply to dairy cows from 4 hullless barley varieties (zero-amylose waxy, CDC Fibar; waxy, CDC Rattan; normal-amylose, CDC McGwire and high-amylose, HB08302) by using NRC 2001 model and DVE/OEB system. CDC Copeland was induced as a hulled control. The hullless barley breeding lines differed ($P < 0.05$) in amylose (1 to 20%DM), amylopectin (34 to 51%DM), amylose to amylopectin ratio (Ay:Ap) (0.02 to 0.59) and β -glucan contents (5 to 10% DM). In DVE/OEB system, CDC McGwire was higher ($P < 0.05$) in rumen fermented organic matter (FOM: 683 vs. 545 g/kg DM), metabolizable protein (MP: 102 vs. 82 g/kg DM), truly absorbed microbial protein in the small intestine (AMCP: 65 vs. 52 g/kg DM) and digested organic matter (DOM: 921 vs. 871 g/kg DM) but lower ($P < 0.05$) in endogenous protein in the small intestine (ENDP: 5 vs. 9 g/kg DM), truly absorbed bypass protein in the small intestine (ABCP: 48 vs. 61 g/kg DM) and degraded protein balance (OEB: -35 vs. -24 g/kg DM) compared with HB08302. Highest OEB among all barley varieties was found in CDC Fibar (-14 g/kg DM, $P < 0.01$). Hulled barley was lower ($P < 0.01$) in true protein supplied to the small intestine (TPSI: 127

g/kg DM) and truly digested protein in the small intestine (DVE: 95 g/kg DM) than hullless barley lines but higher ($P < 0.01$) in undigested inorganic matter (9 g/kg DM). From NRC Dairy 2001 model, CDC Fibar was higher ($P < 0.05$) in OEB (-30 g/kg DM), microbial protein synthesized in the rumen (MCP: 76 g/kg DM), AMCP (49 g/kg DM) than the other hullless barley lines. Compared with hullless barley, hulled control was relatively lower ($P < 0.01$) in truly absorbed rumen undegraded protein in the small intestine (44 g/kg DM) and total MP (83 g/kg DM). In conclusion, altered carbohydrate traits in hullless barley varieties significantly improved the truly absorbed protein supply to dairy cattle compared with hulled barley.

Key Words: NRC dairy 2001 model, DVE/OEB system, amylose to amylopectin ratio

W305 Effect of different forage and dried distillers grains with solubles concentrations on sorting behavior of lactating dairy cows. S. D. Ranathunga,* K. F. Kalscheur, and D. P. Casper, *Dairy Science Department, South Dakota State University, Brookings.*

The objective was to evaluate the effect of different forage and dried distillers grains with solubles concentrations on sorting behavior of lactating dairy cows. Four Holstein cows were assigned to a 4×4 Latin square in a 2×2 factorial arrangement of treatments with 4-week periods. Diets contained low forage (LF; 41% of diet DM) or high forage (HF; 60% of diet DM) and DG at 0 or 18% of diet DM. Ground corn and soybean feeds were partially replaced by DG from 0% DG diets to formulate 18% DG diets. Fresh TMR and Orts were sampled for particle size analysis on the first 3 d of wk 3 and 4 of each period. Particle size distribution of samples of TMR and Orts were determined using the 4-box Penn State particle size separator. The particle size separator had 3 screens (19, 8, and 1.18 mm) and a bottom pan, resulting in 4 fractions (long, medium, short, and fine). Feed sorting was calculated as the actual intake of each particle size fraction expressed as a percentage of the predicted intake of that fraction. Average DMI was similar ($P > 0.05$) across diets (23.8 kg/d). Cows fed HF diets sorted against long (91.2 vs. 97.6%) and medium (96.6 vs. 97.8%) particles compared with LF diets. Feeding HF diets increased selective consumption of short (103 vs. 101%) and fine (104 vs. 100%) particles compared with the LF diets. These results suggest that, despite geometric mean diameter of the diet being affected by forage (LF vs. HF: 1.55 vs. 1.95 mm) and DG (0DG vs. 18DG: 1.81 vs. 1.69) concentrations, only forage concentration affected the sorting behavior of lactating dairy cows.

Table 1. Effect of forage and DDGS concentration on sorting (%)

Item	LF		HF		SEM	P-value ¹
	0DG	18DG	0DG	18DG		
Particles						
Long	96.8	98.4	91.3	91.1	1.93	F
Medium	96.9	98.7	97.1	96.1	0.54	F
Short	102	101	103	104	0.59	F
Fine	101	99.5	104	104	0.43	F
Geometric mean diameter (mm)						
TMR	1.58	1.52	2.04	1.87	0.02	F, D, F×D
Orts	2.12	1.63	2.70	2.99	0.04	F, F×D
Geometric SD (mm)						
TMR	1.56	1.51	2.16	2.00	0.03	F, D
Orts	2.37	1.74	3.05	3.31	0.18	F, F×D

¹F or D = forage or DG effect; F × D = forage and DG interaction ($P < 0.05$).

Key Words: distillers grains, forage, sorting behavior

W306 Effects of sudden additions of condensed distillers solubles to diets of lactating dairy cows on milk production and milk components. S. E. Fraley,* J. R. Townsend, and T. D. Nennich, *Purdue University, West Lafayette, IN.*

Variability in the fat content of dried distillers grains with solubles (DDGS) in dairy diets make dairy producers hesitant to utilize this coproduct. The objective of this study was to determine the effect of sudden additions of condensed distillers solubles (CDS) on milk production, milk components and rumen parameters. Eight ruminally cannulated Holstein cows (166 ± 12 DIM) were randomly assigned to treatments in a replicated 4×4 Latin square design with 21-d periods. The dietary treatments, on a DM basis, were CON (10% DDGS); DDGS (20% DDGS); CDS2.5 (17.5% DDGS plus 2.5% CDS); and CDS5 (15% DDGS plus 5% CDS). Cows were fed CON diets for a 14-d adaptation period and treatments diets for a 7-d treatment period with the last 3 d used for data collection. Milk samples were collected daily to determine milk components. Rumen samples were collected via rumen cannula for determination of pH, volatile fatty acids (VFA) and NH₃. Data were analyzed using PROC MIXED of SAS. Milk yield and fat percentage were similar between treatments ($P = 0.66$ and 0.82 , respectively). Cows fed CON had greater ($P < 0.01$) and DDGS tended ($P = 0.06$) to have greater milk protein concentrations than CDS2.5 and CDS5 (2.89, 2.83, 2.77, 2.81%, respectively). Dry matter intake was greater ($P < 0.05$) for CON than CDS2.5 or CDS5 (21.6, 20.1, 20.5 kg/d, respectively), but was similar ($P = 0.11$) to DDGS (20.7 kg/d). Rumen pH was lesser for CON than CDS5 (6.05 and 6.13, respectively; $P = 0.03$) and lesser for DDGS than for CDS2.5 and CDS5 (6.03, 6.10, 6.13, respectively; $P \leq 0.05$). Total VFA concentrations were similar among treatments ($P = 0.84$); however, CDS5 had greater butyrate concentrations than CON (11.1 and 9.7 μmol/mL; $P = 0.05$) and tended to have greater concentrations than DDGS (9.7 μmol/ml; $P = 0.08$). Rumen NH₃ was greater for CON and DDGS ($P < 0.03$) and tended ($P = 0.08$) to be greater for CDS2.5 than for CDS5 (18.4, 17.5, 17.1, 15.0 mg/dL, respectively). Sudden additions of up to 5% added CDS in dairy cow diets decreased milk protein concentration and DMI without affecting milk yield or milk fat.

Key Words: condensed distillers solubles, dairy cow, milk fat

W307 Occurrence and concentration of mycotoxins, molds and yeasts on corn co-products from South Dakota and Minnesota dairy farms. F. Diaz-Royon*¹, A. Garcia¹, K. F. Kalscheur¹, K. A. Rosentrater², J. S. Jennings³, and K. Mjoun³, ¹Dairy Science Department, South Dakota State University, Brookings, ²Department of Agricultural and Biosystems Engineering, Iowa State University, Ames, ³Alltech South Dakota, Brookings.

Twenty-nine large dairies in SD and MN were visited during summer and fall 2011 to provide a comprehensive assessment of the prevalence of mycotoxins, molds, and yeasts on corn co-products. Samples were collected from every corn co-product used on these farms. Feed samples analyzed included: distillers grains (n = 13 wet, 6 dried), wet corn gluten feed (n = 11), high moisture corn (n = 2) and germ meal (n = 1). Ten subsamples (0.5 kg each) were taken from each corn co-product, pooled together and composited. This composite was split in two 0.8- to 1.0-kg samples. After vacuum sealing, one sample was stored at -20 °C for later mycotoxin analyses and the second was stored at 4 °C for mold and yeasts analyses. A total of 32 different mycotoxins were analyzed by triplicate using UPLC-MS/MS (tandem mass spectrometer coupled to liquid chromatography). Molds and yeasts counts were determined by direct plate dilution. In addition, mold isolates were identified in samples with mold growth equal to or greater than 1,000 cfu/g using the conventional microscopic tape method. Two distillers dried grains samples contained aflatoxin B2 levels (32.0 and 36.7 ppb) greater than

the U. S. Food and Drug Administration (FDA) guidelines for use in feeds for dairy cows or immature animals (20 ppb). But these samples contained aflatoxin levels lower than the FDA recommendation for feeding mature beef cattle (300 ppb), swine (200 ppb) and poultry (100 ppb). The rest of the samples contained aflatoxins, deoxynivalenol, and fumonisins levels lower than the detection limit or the FDA guidelines for use in animal feeds. Mold growth was lower than 1,000 cfu/g in 25 corn co-product samples (75.7%) and greater than 2,000 cfu/g in 4 samples (12.1%). *Aspergillus* and *Mucor* were the fungi genera most frequently isolated. There were only 7 corn co-products (21.2%) with yeast counts lower than 1,000 cfu/g, with most of them containing levels greater than 105 cfu/g (63.6%). The majority of the samples analyzed in this experiment had high yeast counts not associated with the presence of detrimental mycotoxin concentration.

Key Words: corn co-products, dairy cows, mycotoxins

W308 Surveying the constraints of ethanol co-products utilization on dairy farms. F. Diaz-Royon^{*1}, A. Garcia¹, K. F. Kalscheur¹, K. A. Rosentrater², J. S. Jennings³, and K. Mjoun³, ¹*Dairy Science Department, South Dakota State University, Brookings*, ²*Department of Agricultural and Biosystems Engineering, Iowa State University, Ames*, ³*Alltech South Dakota, Brookings*.

Distillers grains (DG) originating from the corn-based fuel ethanol industry are an excellent source of energy and rumen undegradable protein, which complement well with other feedstuffs used in dairy cattle diets. However, despite the competitive pricing when compared with other protein sources and their availability in the market, DG are not always sought as dietary ingredient by nutritionists and dairy producers. A survey was mailed to every South Dakota grade A dairy farm (303) to determine current use and constraints to ethanol co-products usage in dairy cattle diets and whether dairy producers found the different co-products available in the market useful. The self-administered survey with an original cover letter and self-addressed stamped envelope were delivered to dairy farms through the US Postal Service in April of 2011. Forty-nine dairy producers (16.2%) filled out and returned the survey. The average number of years producers had been feeding corn co-products was 8, with a range between 0.5 and 21. Thirty-six producers (73% of respondents) were using ethanol co-products in their rations. Among those that did not feed them, the primary reason was price (31%). Modified distillers grains (MDG) was the ethanol co-product included at the highest percentage in lactating dairy cows and heifer rations (13.8 and 10.7% on a dry matter basis, respectively); however, distillers dried grains with solubles were mostly used in dry cow rations. In addition, MDG was the corn co-product most frequently fed in farms during 2010, with an average use of 1,048 ton/yr (as-fed basis). Outside piles were the most common storage method for wet or modified distillers grains while commodity sheds for distillers dried grains. When dairy producers were asked to rank the degree of importance of several DG issues (1 = none; 2 = low; 3 = average; and 4 = high), the majority (73%) ranked "variability between batches" highest, followed by price (60%), and mycotoxin content (58%). These results provide a snapshot of percent inclusion, storage methods, major concerns, amount fed and type of corn co-products used on South Dakota dairy farms.

Key Words: dairy farms, ethanol co-products, survey

W309 Effects of molasses products on productivity and milk fatty acid profile of cows fed high-DDGS diets. A. V. Siverson^{*} and B. J. Bradford, *Kansas State University, Manhattan*.

Previous research has shown that replacing up to 5% corn with cane molasses can partially alleviate milk fat depression when cows are

fed high-concentrate, low-fiber rations containing distillers grains with solubles (DGS). Our objective was to determine whether dietary molasses would alter milk fatty acid profile or improve solids-corrected milk yield in the context of a more typical lactation diet. Our secondary objective was to assess production responses to increasing RDP supply when molasses was fed. Twelve primiparous and 28 multiparous Holstein cows (196 ± 39 DIM) were randomly assigned to 8 pens. Pens were randomly allocated to treatment sequence in a 4 × 4 Latin square design balanced for carryover effects. Treatments were a control diet including 20% dried DGS, 35% NDF, 30% starch, and 5% EE (CON), a diet with 5% cane molasses (DM basis) replacing a portion of the corn grain (MOL), a diet with 3.25% (DM basis) QLF (Quality Liquid Feeds) 20% CP supplement (QLF3), and a diet with ~6.5% (DM basis) QLF 20% CP supplement (QLF6). Data were analyzed using mixed models including the fixed effects of treatment and the random effects of period, pen, period × pen interaction, and cow within pen. Diets had no significant effects on dry matter intake, milk production, milk component concentration or yield, crude feed efficiency, BW change, or somatic cell count in milk (all $P > 0.12$). Milk stearic acid content was increased by QLF6 compared with CON and QLF3 ($P < 0.05$), but the magnitude of the effect was small (12.27, 11.75 and 11.69 ± 0.29 g/100 g fatty acids). Production data revealed a dramatic effect of period on milk fat content and yield. Milk fat content dropped during the course of the experiment (3.16, 2.81, 2.93, and 2.64 ± 0.09% for periods 1–4, respectively) as did milk fat yield (1.20, 1.03, 0.98, and 0.79 ± 0.05 kg/d). Exchanging molasses-based products for corn at 3 to 6% of dietary DM did not influence productivity and had minute effects on milk fatty acid profile. The limited responses in this study may have been influenced by dietary unsaturated fatty acid content or advancing DIM of cows on the study.

Key Words: biohydrogenation, milk fat depression, sugar

W310 Effects of feeding brown midrib corn silage with a high dietary concentration of alfalfa hay during early and mid lactation on milk production of Holstein dairy cows. M. S. Holt^{*1}, A. J. Young¹, X. Dai², K. E. Nestor³, and J.-S. Eun¹, ¹*Department of Animal, Dairy, and Veterinary Sciences, Utah State University, Logan*, ²*Utah Agricultural Experiment Station, Utah State University, Logan*, ³*Mycogen Seeds, Indianapolis, IN*.

This experiment was conducted to determine the long-term effects of feeding brown midrib corn silage (BMRCS) fed with a high dietary concentration (25% DM) of good quality alfalfa hay in high-forage lactation diets on productive performance of dairy cows. Twenty 4 multiparous Holstein cows were used starting at the onset of lactation through 200 d-in-milk (DIM). Two dietary treatments were tested in a completely randomized design: TMR based on conventional corn silage (CCST) and TMR based on BMRCS (BMRCS). Intake of DM was not affected by dietary treatments throughout the experiment. During early lactation (0–60 DIM), milk yield was not different between dietary treatments, whereas milk yield during mid lactation (61–200 DIM) increased by feeding the BMRCS compared with the CCST (39.8 vs. 36.2 kg/d; $P = 0.05$), resulting in increased overall milk yield by feeding the BMRCS throughout the experiment (40.9 vs. 37.6 kg/d; $P = 0.05$). While milk fat concentration did not differ during early lactation, it tended to decrease by feeding the BMRCS compared with the CCST during mid lactation (3.51 vs. 3.82%; $P = 0.08$). During mid lactation, yield of 3.5% fat-corrected milk tended to increase for cows fed the BMRCS compared with those fed the CCST (42.5 vs. 39.3 kg/d; $P = 0.10$), but it remained similar during 200 DIM. Overall milk protein concentration was similar between dietary treatments throughout the experiment

(2.95% on average), but overall milk protein yield was higher for the BMRCST than the CCST (1.27 vs. 1.14 kg/d; $P = 0.01$). Milk protein concentration and yield were similar between dietary treatments during early lactation; however, during mid lactation, milk protein yield was greater for cows fed the BMRCST than those fed the CCST (1.27 vs. 1.10 kg/d; $P < 0.01$). Feeding BMRCST with a high dietary concentration of alfalfa hay did not affect milk production during early lactation; however, cows fed the BMRCST maintained longer peak milk yield, which resulted in increased milk production during mid lactation, leading to greater overall milk production and milk protein yield.

Key Words: brown midrib corn silage, alfalfa hay, early and mid lactation

W311 Effects of harvest date and a BMR hybrid on yield and nutrient composition of corn plants harvested for silage. P. Walker¹, M. J. Faulkner¹, T. D. Kaufman^{*1}, L. Brown², and F. N. Owens², ¹Illinois State University, Normal, ²Pioneer Hi-Bred International, a DuPont Business, Bloomington, IL.

Maturity at harvest and the brown midrib (BMR) trait influence concentration and availability of nutrients from plants harvested for corn silage. To quantify these effects, 9 commercial elite Pioneer corn silage hybrids were planted in 12-row plots in a field near Lexington, IL on May 9, 2010 at 69K and 84K/hectare. Duplicate sets of 5 plants each were harvested 10 times (at 3 to 6 d intervals) spanning the silage harvest window (28 to 42% DM). Nutrient content and availability were estimated by calibrated NIR procedures. Averaged across hybrids, yield of DM reached a plateau at 33% plant DM, but starch content (% of DM and g/plant) continued to increase to over 40% plant DM. NDF digestibility was not altered by DM content. Per plant, grams of starch increased while grams of NDF, ADF, and sugars decreased as plant DM increased. Nutrient values for the Pioneer BMR hybrid (P1376XR) were compared with those from the non-BMR hybrids. Differences were not significant ($P > 0.05$) for starch, total sugars, hemicellulose, ash, dry matter yield per hectare (18.9 for BMR vs. 19.0 t/ha), or kg of grain per hectare estimated from starch content (8.1 vs. 7.8 t/ha). At equal moisture contents, the BMR hybrid had less ($P < 0.01$) NDF (41.4 vs. 43.7%) and ADF (23.8 vs. 25.9%) but more ($P < 0.01$) crude protein (7.9 vs. 7.4%) and greater ($P < 0.01$) digestion of NDF at 24 h (50.5 vs. 46.7%). Although it did not alter grain yield, the 21% higher planting density increased yield of DM per hectare only by 5% ($P < 0.01$) because individual plants weighed 13% less. When adjusted for DM content, the higher plant density decreased the percentage of starch and digestion of NDF at 24 h ($P < 0.05$). Harvest of modern corn hybrids below 33% DM sacrifices DM yield while harvest below 40% sacrifices yield of starch. The BMR tested had grain and NDF yields equal to elite non-BMR hybrids but greater NDF digestibility at 24 h.

Key Words: corn silage, harvest maturity, BMR

W312 Chemical and nutrient availability of hulless barley (*Hordeum vulgare* L.) with altered carbohydrate characteristics. L. Yang^{*1,3}, J. McKinnon^{1,3}, D. Christensen^{1,3}, B. Rossnagel^{2,3}, A. Beattie^{2,3}, and P. Yu^{1,3}, ¹Department of Animal and Poultry Science, ²Crop Development Centre, ³University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

Four hulless barley varieties and breeding lines with altered carbohydrate composition were developed at the Crop Development Centre, University of Saskatchewan based on amylose (1 to 20% DM), amylopectin (34 to 51% DM), amylose to amylopectin ratio (0.02 to 0.59) and β -glucan (5 to 10% DM) content. The objective of this study was to compare differences

in chemical and nutrient profiles among the 4 newly developed hulless barley lines (zero-amylose waxy, CDC Fibar; 5%-amylose waxy, CDC Rattan; normal-amylose, CDC McGwire and high-amylose, HB08302). CDC Copeland hulled barley was included as a hulled control. Among the hulless barley lines, CDC Fibar showed greater ($P < 0.01$) crude protein (16.2% DM), soluble crude protein (7.8% of DM) and β -glucan (10.0% DM) but reduced ($P < 0.01$) amylose (1.3% DM), intermediately degradable CHO (51.9% CHO) and slowly degradable CHO (9.9% CHO). CDC McGwire had greater ($P < 0.01$) starch (61.5% DM) but reduced β -glucan (4.7% DM) while HB08302 had greater neutral detergent fiber (13.8% DM, $P < 0.01$) than the other hulless barley lines, but reduced intermediately degradable protein than CDC Fibar (30.5 vs. 40.9% CP, $P < 0.05$). The hulled control showed greater CHO ($P < 0.01$) but a reduced rapidly degradable CHO content and Mcal/kg of NEL (1.68 vs. 1.74, $P < 0.01$) versus the hulless barley lines. Altered carbohydrate composition improved chemical, protein and carbohydrate subfractions and energy values which affected nutrient availability for ruminants.

Key Words: amylose to amylopectin ratio, β -glucan, hulless barley

W313 Effects of dietary protein content and source of grain on milk production and nitrogen efficiency in early lactating primiparous Holstein cows. H. Mirzaei Alamouti^{*} and A. Mohammad, *University of Zanjan, Zanjan, Iran.*

Nitrogen excretion from dairy farming systems is a major environmental challenge and formulating dairy ration to decreasing nitrogen excretion without compromising milk production and composition can be one of strategies. An experiment was conducted to determine the effects of dietary crude protein (CP) levels, source of grain and their interactions on performance and nitrogen efficiency of early lactating Holstein cows. Eight primiparous cows (BW = 560 \pm 65 kg and DIM = 50 \pm 15 d) were allocated to one of 4 diets in replicated 4 \times 4 Latin square design. The diets containing: 1) 20% CP and barley grains as a cereal grain source (HPB), 2) 20% CP and a 50:50 ratio of barley and corn grain (HPBC), 3) 16% CP and barley grain (LPB), and 4) 16% CP and a 50:50 ratio barley and corn grain (LPBC). In 21 d periods, data collection was conducted in second and third weeks. Data were analyzed as repeated measure by using proc mixed of SAS software. The results showed that cows fed with LPBC diet had higher Dry matter intake ($P < 0.01$), dry matter digestibility ($P < 0.05$), organic matter digestibility ($P < 0.05$) and neutral detergent fiber digestibility ($P < 0.01$). Rumen fluid concentrations of total volatile fatty acids ($P < 0.05$), acetate ($P < 0.01$), propionate ($P < 0.05$), and rumen pH ($P < 0.01$) of cows fed with different source of grain was significant. Cows fed higher level of CP had greater ($P < 0.05$) urine and rumen ammonia nitrogen, blood and milk urea nitrogen, and lower nitrogen efficiency than those fed lower level of CP. There were no differences between milk production and contents. In conclusion, the results from this study showed lowered dietary nitrogen content and using a mix of barley and corn grain in dairy ration can improve nitrogen efficiency.

Key Words: cereal grains, crude protein, Holstein cow

W314 Lactational performance, chewing behavior, and ruminal fermentation of dairy cows fed diets differing in amount and digestibility of NDF from two sources of corn silage. C. Kokko,^{*} H. M. Dann, K. W. Cotanch, J. W. Darrah, and R. J. Grant, *William H. Miner Agricultural Research Institute, Chazy, NY.*

Ruminally cannulated Holstein cows (n = 8, 91 \pm 11 d in milk) were used in a replicated 4 \times 4 Latin square design study with 21-d periods

(8-d collection periods) to evaluate intake, milk yield and components, chewing behavior, and ruminal fermentation in response to diets differing in amount and 24-h digestibility of aNDF (NDFD_{24h}) from 2 sources of corn silage. Treatments were 1) 53% forage, conventional corn silage (CCS)-based diet with 32% aNDF, 28% starch, 56% NDFD_{24h} (Low CCS); 2) 68% forage, CCS-based diet with 36% aNDF, 21% starch, 54% NDFD_{24h} (High CCS); 3) 50% forage, BMR-corn silage-based (BMR) diet with 32% aNDF, 28% starch, 62% NDFD_{24h} (Low BMR); and 4) 64% forage, BMR-based diet with 35% aNDF, 24% starch, 60% NDFD_{24h} (High BMR). Data were analyzed as a replicated Latin square with the MIXED procedure of SAS with fixed effects of diet, period, and replicate. Cow within square was the random effect. Intake, milk yield, and solids corrected milk (SCM) were lower on the High CCS diet. Efficiency of milk production (milk/DMI, 1.63 ± 0.04; SCM/DMI, 1.57 ± 0.03) was not affected ($P > 0.1$) by treatment. Differences in milk composition and chewing behavior reflected dietary inclusion of NDF. Chewing time per kg of NDF intake was greater for CCS diets. Mean ruminal pH was lower on the Low BMR diet, though time (min/d) below a pH of 5.8 (328 ± 89) or 5.5 (98 ± 43) did not differ ($P > 0.1$) among diets. Greater inclusion of highly digestible NDF forage promoted DMI and milk yield without compromising the ruminal environment.

Table 1.

Item	Low CCS	High CCS	Low BMR	High BMR	SE
DMI, kg/d	29.0 ^a	26.5 ^b	29.3 ^a	29.2 ^a	0.7
Milk, kg/d	47.0 ^a	43.1 ^b	48.6 ^a	47.2 ^a	1.6
SCM, kg/d	45.2 ^{ab}	41.8 ^b	46.4 ^a	45.7 ^a	1.2
Fat, %	3.82 ^{ab}	4.02 ^a	3.76 ^b	3.94 ^{ab}	0.14
Fat, kg/d	1.83	1.71	1.87	1.85	0.05
True protein, %	3.06 ^{ab}	2.92 ^c	3.10 ^a	3.02 ^b	0.05
True protein, kg/d	1.48 ^{ab}	1.25 ^c	1.55 ^a	1.43 ^b	0.04
Ruminating, min/d	514 ^{ab}	543 ^a	463 ^b	536 ^a	17
Chewing, min/kg NDF	84.6 ^{ab}	88.7 ^a	77.9 ^b	80.5 ^b	3.6
Rumen pH	6.09 ^{ab}	6.17 ^a	6.00 ^b	6.07 ^{ab}	0.08
Rumen NH ₃ -N, mg/dL	10.49	11.60	9.88	10.42	0.79
Rumen VFA, mM	105 ^{ab}	102 ^b	110 ^a	111 ^a	8

^{abc} $P \leq 0.05$.

Key Words: BMR corn silage, chewing behavior, NDF digestibility

W315 Reduced protein for late-lactation dairy cows fed ryegrass haylage-based diets. V. R. Moreira¹, A. B. D. Pereira^{*2}, L. K. Zeringue¹, C. Leonardi³, B. F. Jenny², C. C. Williams², and M. E. McCormick¹, ¹LSU AgCenter SE Research Sta., Franklinton, LA, ²LSU AgCenter School of Animal Sciences, Baton Rouge, LA, ³LSU Health Sciences Center, New Orleans, LA.

Ryegrass is a reliable high-quality forage resource in Southeast Louisiana. In this study, 2 protein levels were compared in ryegrass-based diets fed to late lactation dairy cows. Twenty 4 lactating Holstein cows (244 ± 55 DIM and 30.7 ± 4.81 kg milk yield) were randomly distributed among 4 pens in a freestall barn equipped with Calan gates for individual TMR feeding. Higher protein TMR (HP) contained 15.4 ± 0.20% CP using soybean meal as the main protein supplement and

rumen-protected Met (Metaspart, Adisseo; 0.10% DM basis). Lower protein TMR (LP) contained 13.8 ± 0.4% CP and was prepared using dry distillers' grains plus solubles (DDGS), soybean hulls, and rumen protected Lys (AminoShure-L, Balchem, 0.25% DM basis) and Met (0.18% DM basis) to offset dietary AA deficiencies. Cottonseed, corn, and minerals remained similar in both rations. Forage (ryegrass haylage) represented 41% of the rations (DM basis). Metabolizable protein (MP) balance (NRC, 2001) was estimated to be marginal (30 g/cow/d for HP) or deficient (-180 g/cow/d for LP). The experiment was analyzed as a crossover design using SAS MIXED procedure with pen as experimental unit. Cows in both treatments had similar intake (21.4 kg/cow/d for HP and 20.9 kg/cow/d for LP; $P = 0.51$) and maintained body condition score (0.03 unit/period for HP and 0.04 unit/period for LP; $P = 0.77$), but most lost weight (-18.1 kg/cow/period for HP and -14.0 kg/cow/period for LP; $P = 0.71$) mainly in the second period. Milk yield (27.5 kg/cow/d for HP and 25.9 kg/cow/d for LP; $P = 0.36$) and water intake (118 kg/cow/d for HP and 112 kg/cow/d for LP; $P = 0.47$) did not differ statistically. Cows ingested 4.3 kg of water per kg of milk output in both treatments. Milk components averaged 3.48%, 3.30%, and 4.71% respectively for fat, protein and lactose ($P = 0.12$). Milk urea nitrogen decreased ($P = 0.01$) from 9.85 mg/dL with HP to 6.40 mg/dL with LP. Results suggest late-lactation dairy cow performance can be maintained, at least in the short term (21 d-period), when fed an MP deficient diet based on ryegrass haylage and supplemented with DDGS and soybean hulls, adjusted with rumen-protected Met and Lys.

Key Words: dairy cows, protein, dry distillers grains plus solubles

W316 Energy intake of dairy cows grazing native rangeland in México. R. Améndola-Massiotti^{*1}, H. Crespo-Lira¹, J. Burgueño-Ferreira², and M. Huerta-Bravo¹, ¹Universidad Autónoma Chapingo, Chapingo, Estado de México, México, ²CIMMYT, Texcoco, Estado de México, México.

Energy requirements of cows for grazing on native rangeland are high; therefore determination of energy intake from grazed herbage (EIGH) is important. The aim was to estimate EIGH of dairy cows grazing native rangeland at Marcos Castellanos, Michoacán (19°59' N, 103°01' W, 2000 masl). The experiment took place in the dry (DS) and rainy (RS) seasons; DS measurements were taken in 2 farms and during the RS a third farm was added. Intake was measured on 6 cows during 2 (DS) and 3 (RS) cycles of 24 h. Offered and residual amounts of supplementary feed were measured and samples were taken to estimate the content of net energy of lactation (NEL) based on Acid Detergent Fiber contents. Hand-plucked samples of grazed herbage were taken for estimation of NEL content. Herbage dry matter intake (DMI) was estimated by means of fecal output (chromium oxide and acid insoluble ash). Calculation of EIGH was based on DMI and NEL content. A mixed model was used, with fixed effects of season, farm nested within season, cycle nested within farm and season, lactation stage and their interactions; the random effect of cows nested within farm was included. In Table 1 is shown that mean total energy intake was lower in DS than in RS due to lower EIGH. Total energy intake and EIGH in DS did not differ among farms and neither did EIGH in RS. Differences in RS were due to supplementary feeding. It is concluded that due to very low EIGH, accurate use of supplementary feeding is crucial in the dry season.

Table 1. Energy intake (Mcal NE_i) of dairy cows grazing native rangeland

Season	Farm			Mean
	A	B	C	
Total				
Dry		18.5 ^{x,b}	19.5 ^{x,a}	19.0 ^B
Rainy	26.4 ^x	23.2 ^{xy,a}	19.3 ^{y,a}	23.0 ^A
Herbage				
Dry		5.1 ^{x,b}	4.3 ^{x,b}	4.7 ^B
Rainy	10.8 ^x	10.8 ^{x,a}	11.0 ^{x,a}	10.8 ^A

^{x,y}Means not sharing letters within rows and within each variable are different ($P \leq 0.05$).

^{a,b}Means not sharing letters within columns and within each variable are different ($P \leq 0.05$).

^{A,B}Means not sharing letters within columns and within each variable are different ($P \leq 0.05$).

Key Words: dry and rainy seasons, grazed herbage, net energy of lactation

W317 Feeding canola meal to dairy cows: A meta-analysis on lactational responses suggests underestimation of metabolizable protein supply by NRC (2001). R. Martineau, D. R. Ouellet, and H. Lapierre.* *Dairy and Swine R&D Centre Agriculture and Agri-Food Canada, Sherbrooke, Quebec, Canada.*

The objective of this meta-analysis was to determine the effects of the substitution of a protein source by canola meal (CM) on lactational responses (Δ = CM minus control) in dairy cows. The study included 83 comparisons of isoproteic ($\pm 1.5\%$ CP) treatments published since 1975 (42 experiments). The CM intake ranged from 0.9 to 4.0 kg/d (SD 0.75). The level of inclusion of CM (Δ CM) was expressed as 100 g/kg of diet (DM basis); therefore, the coefficient associated with Δ CM represents the response observed with a 10% increment in the dietary proportion of CM (e.g., 2 kg of CM for 20 kg DMI = Δ CM of 10%). Dietary composition was estimated using NRC (2001). Regressions were forced through the origin, weighted by sample size and controlled for differences in DMI and diet concentrations of NDF, CP and ether extract. Milk yield (MY, kg/d) and milk protein yield (MPY, g/d) responded linearly to increasing Δ CM: Δ MY = 0.4^{***} (± 0.08) \times Δ CM, R^2 adj = 0.55, $n = 80$; and Δ MPY = 25^{***} (± 2.6) \times Δ CM, R^2 adj = 0.53, $n = 80$. The MPY response was different ($P = 0.04$) depending on the type of protein source that was substituted. The Δ CM coefficients were 14^{***} (± 3.8) and 26^{***} (± 3.5) with substitutions involving only soybean meal (R^2 adj = 0.44; $n = 37$) or other protein sources (R^2 adj = 0.61; $n = 35$), respectively. The greater effect with other protein sources was due to an additional positive effect of Δ CM on milk protein percentage. The efficiency of N utilization (milk N yield/N intake; g/kg) also responded linearly to increasing Δ CM: 7.5^{***} (± 0.96) \times Δ CM, R^2 adj = 0.48, $n =$

82. The estimated supply of metabolizable protein (MP) was examined to explain the responses to Δ CM. Surprisingly, there was a negative effect of CM inclusion on Δ MP: -85^{***} (± 9.2) \times Δ CM, R^2 adj = 0.53, $n = 80$, contrarily to the usual positive relationship between MP supply and MY or MPY. In conclusion, current results suggest that a protein supplement can be substituted by CM with positive effects on lactational performances. It also appears that there is a systematic underestimation of MP supply associated with CM inclusion in dairy rations using the NRC (2001) model.

Key Words: canola meal, meta-analysis, metabolizable protein

W318 Milk production, milk composition and blood parameters of cows fed whole flaxseed or whole linola. H. V. Petit*¹, R. N. do Prado^{1,2}, M. F. Palin¹, and C. Benchaar¹, ¹*Dairy and Swine Research and Development Centre, Sherbrooke, QC, Canada,* ²*Universidade Estadual de Maringá, Maringá, PR, Brazil.*

A total of 28 Holstein cows were stratified by groups of 3 within parity for similar expected calving dates, and cows within group were randomly assigned to one of 3 isonitrogenous and isoenergetic diets to determine the effects of feeding different sources of fatty acids (FA) on milk production, milk composition, and blood parameters related to fatty liver. The 3 TMR contained either calcium salts of palm oil (MEG), unsaturated lipids supplied as 4.8% whole linola (WLO) rich in $n-6$ FA, or unsaturated lipids supplied as 4.8% whole flaxseed (WFL) rich in $n-3$ FA. The experiment was carried out from wk 4 before parturition to wk 12 of lactation. All cows were fed for ad libitum intake. Milk production and DMI were recorded at every milking and daily, respectively. Cows were weighed weekly and body score was recorded at the same time. Milk composition was determined on wk 1, 2, 3, 4, 6, 10 and 12. Blood was collected on wk 1 and 2 prepartum and on wk 1, 2, 4, 6 and 8 postpartum to determine NEFA, glucose and β -hydroxybutyrate. Data were analyzed as repeated measures using the PROC MIXED procedure of SAS (SAS Institute, 2000). There was an interaction ($P = 0.01$) between wk and treatment as a result of a greater increase over time in DMI, expressed as a percentage of BW, for cows fed WFL compared with those fed MEG. Cows fed MEG tended ($P = 0.07$) to produce more milk (41.7 kg/d) than those fed WFL and WLO (38.3 and 38.2 kg/d, respectively). Concentrations of protein, fat and lactose in milk were similar among diets. Treatment had no effect on BW, body condition score, blood concentration of NEFA and β -hydroxybutyrate. Cows fed WFL tended ($P = 0.09$) to maintain higher blood concentrations of glucose than those fed WLO and MEG as shown by the interaction between treatment and wk. These data suggest that feeding oilseeds that differ only for their type of FA ($n-6$ in linola and $n-3$ in flaxseed) result in similar productivity of early-lactating dairy cows.

Key Words: dairy cattle, flaxseed, linola