331 Residual feed intake is repeatable when high and low starch diets are fed to lactating Holstein dairy cows. S. E. Burczynski*, J. S. Liesman, R. J. Tempelman, J. C. Ploetz, M. S. Allen, A. L. Lock, and M. J. VandeHaar, *Michigan State University, East Lansing.*

Residual feed intake (RFI) is a tool to quantify feed efficiency in livestock and is commonly used to assess efficiency independent of production level, BW, or BW change. Seventeen primiparous and 40 multiparous lactating Holstein cows, averaging 674 ± 77 kg of BW, 39 ± 9 kg of milk/d, and 125 ± 33 d postpartum at experiment start, were fed diets of high or low starch content in 2 crossover experiments with 4-wk periods. Soyhulls replaced a portion of ground corn and soybean meal (experiment 1) or a portion of ground corn, soybean meal, and wheat straw (experiment 2) to formulate the low starch diets. High starch diets were approximately 27% NDF and 30% starch and low starch diets were either 44% NDF, 12% starch (experiment 1) or 39% NDF, 16% starch (experiment 2). All diets were approximately 17% CP. Individual dry matter intake (DMI) of a cow was modeled as a function of her cohort group, milk energy output, metabolic BW ($BW^{0.75}$), and BW change within each period; RFI for each cow was the residual error term. For the model, each unit increase in milk energy output, metabolic BW, or BW change was associated with 0.38, 0.14, or 0.17 kg increase in DMI, respectively. High starch diets increased milk energy output by 7%, DMI by 3%, and percentage of gross energy captured as milk and body tissue (GEcap) by 9% ($P < 0.01$) across experiments and parity. Primiparous cows had lower milk energy output, DMI, and GEcap than multiparous cows for both experiments ($P < 0.01$). The difference in RFI between treatments across experiments ranged from −2.5 to 2.8 kg, with a mean absolute change of 0.9 kg (SD = 0.7). The correlation between RFI when cows were fed the high starch diets and RFI when cows were fed the low starch diets was 0.79 ($P < 0.01$) and was similar within each parity and experiment. We conclude that RFI is reasonably repeatable for a wide range of dietary starch concentrations so that cows that are most efficient when fed high corn diets are likely also most efficient when fed diets high in non-forage fiber sources.

Key Words: dairy cow, feed efficiency, residual feed intake

332 The effect of offering differing combinations of forages and cereals on feed intake, total diet composition and the growth and development rates of dairy heifers. Z. Ullah*[1], J. K. Margerison[1], D. Simcock[2], and N. Lopez Villolobos[3], *[1]Institue of Agriculture and Environment, Massey University, Palmerston North, New Zealand, [2]Institute of Food Nutrition and Human Health, Massey University, Palmerston North, New Zealand, [3]Institute of Veterinary and Biological Sciences, Massey University, Palmerston North, New Zealand.*

The experimental objective was to assess the effect of offering milk fed calves starter supplement with one of 3 forage options: moist Lucerne haylage (LH), pasture hay (PH) or no forage (NF), on individual animal feed intake, total diet composition, growth and development rate, and feed conversion efficiency. Sixty Holstein-Jersey crossbred calves were collected from their dams (<6 h of age), weighed and placed in individual pens and fed colostrum. Calves were selected at random and allocated simultaneously to one of the 3 diet treatments (20 calves per treatment) according to live weight and age, such that the treatments were similar for these factors. Whole milk was fed twice daily (10.4% birth weight) till weaning at 49 d of age. Individual animal feed intake was monitored daily, whereas live weight and stature (hip width and height, last rib girth) was measured weekly. Starter intake (g/day) was greater for calves offered PH followed by LH and lowest in NF both pre weaning (PH: 741[a], LH: 582[b], NF: 368[c], SEM, 24.5) and 7 d post weaning (PH: 2152[a], LH: 1677[b], NF: 1253[c], SEM, 47.4). Calves offered PH and LH had greater liveweight gains (g/day) compared with calves offered NF, both pre weaning (PH: 560[a], LH: 540[a], NF: 431[b], SEM, 0.6) and 7 d post weaning (PH: 771[a], LH: 710[a], NF: 600[b], SEM, 11.1). Calf stature did not differ between treatments. In conclusion, calves offered forages had greater starter and total feed intakes, and greater growth rates, but no difference in stature compared with calves not offered forage.

Key Words: dairy, heifer, nutrition

333 Determination of the optimum dietary forage concentration when using canola meal as a primary protein source in lactating dairy cow diets. A. M. Schuler*, K. F. Kalscheur, D. P. Casper, and J. L. Anderson, *South Dakota State University, Brookings.*

Canola meal (CM) is a high quality protein supplement that can be fed to lactating dairy cows. Presently there is little research evaluating the optimum dietary forage concentration when CM is included as the primary protein source in lactating dairy cow diets. Twelve multiparous and 4 primiparous Holstein cows (96 ± 54 DIM) were used in a 4 × 4 Latin square design with 3-wk periods to determine the optimum dietary concentration of forage when using CM as the primary protein source. Diets were formulated to include 42% forage (42F), 50% forage (50F), 58% forage (58F), and 66% forage (66F) concentrations on a DM basis. All diets included 11% canola meal (DM basis). The corn silage: alfalfa haylage ratio (70:30) was maintained across treatment regardless of dietary forage concentration. Diets were similar in crude protein and metabolizable protein. Dry matter intake (DMI) linearly decreased with increasing forage concentration ($P = 0.001$). Milk production was similar ($P > 0.10$) among treatments. Milk fat percentage and yield linearly increased with increasing dietary forage concentration ($P < 0.05$). Milk protein percentage tended to decrease with increasing forage concentration ($P = 0.06$). Milk protein yield and energy-corrected milk were not affected by forage concentration. Feed efficiency (FE) increased linearly with increasing forage levels ($P = 0.001$). Mid-lactation Holstein dairy cows fed an increasing forage to concentrate ratio in conjunction with CM as the primary protein source did not alter milk yield while decreasing DMI resulting in improved feed efficiency.

Table 1.

	Treatment					
Item	42F	50F	58F	66F	SEM	*P*-value[1]
DMI, kg/d	28.0	27.0	25.8	24.8	0.69	L
Milk, kg/d	40.1	40.4	40.8	39.1	1.12	NS
Fat, %	3.17	3.22	3.37	3.52	0.17	L
Fat, kg/d	1.26	1.28	1.35	1.37	0.07	L
Protein, %	2.98	3.00	2.96	2.94	0.05	LT
Protein, kg/d	1.19	1.21	1.20	1.14	0.04	NS
ECM, kg/d	38.0	38.4	39.5	38.7	1.23	NS
FE (ECM/DMI)	1.36	1.44	1.54	1.57	0.05	L

[1]L = linear effect ($P < 0.05$); LT = linear trend ($P < 0.10$); NS = $P > 0.10$.

Key Words: canola meal, dairy cow, forage concentration

334 Moment and allocation of corn silage on dry matter intake and milk production of grazing dairy cows. D. A. Mattiauda*[1], M. Carriquiry[1], S. Tamminga[2], F. Elizondo[1], and P. Chilibroste[1], *[1]Departamento de Produccion y Pasturas, Facultad de Agronomia, UdelaR, Paysandu, Uruguay, [2]Department of Animal Science, Wageningen University, Wageningen, the Netherlands.*

Thirty-three multiparous Holstein cows were used in a randomized block design to study the effects of feeding strategies (corn silage allocation during the day) in early lactation (48 ± 17.8 d). All cows (separated by treatment) had access to an ungrazed daily strip of pasture (1535 ± 289 kg DM/ha; forage allowance: 15 kg DM/cow) from 0900 to 1500 h and received 2.7 kg DM of concentrate at each milking (0430 and 1530 h). Corn silage (3.9 kg DM/d) was offered 100% at 1700 h (T1), at 0800 h (T2) or equally distributed at 1700 and 0800 h (T3). Experimental period lasted 7 wk with 1 wk of adaptation and 6 wk of measurements. Milk yield was recorded daily and milk samples were collected weekly (2 consecutive days) for fat, protein, and lactose composition. Cow BCS was recorded every 2 wk. Individual herbage DMI was determined during 4 d at wk 7 in 12 cows (4 complete blocks), using n-alkanes. Data were analyzed with a mixed model including treatment, week of treatment and their interaction (if corresponded) as fixed effects and block as a random effect. Herbage DMI was greater ($P < 0.04$) for T1 and T3 than T2 cows (10.3, 8.5, and 11.0 ± 0.68 kg/d for T1, T2, and T3, respectively) which defined a difference between treatments in total DMI (19.5, 17.7, 20.0 ± 0.68 kg/d for T1, T2, and T3, respectively). There was no difference in milk yield among treatments (25.2 ± 0.62 kg/d) but fat percentage was greater ($P < 0.04$) for T3 than T2, being intermediate in T1 cows (3.85, 3.66 and 3.89 ± 0.072% for T1, T2, and T3, respectively), resulting in a trend ($P = 0.10$) for greater 4% fat-corrected milk yield (24.6, 23.7 and 25.3 ± 0.84 kg/d for T1, T2, and T3, respectively). Protein (2.97 ± 0.048%) and lactose (4.74 ± 0.045) percentages did not differ among treatments. Cow BCS was greater ($P < 0.03$) for T3 than T2, being intermediate in T1 cows (2.42, 2.37, 2.52 ± 0.063 for T1, T2, and T3, respectively). Corn silage allocation related to grazing session had an effect on DMI and productive performance, probably due to the integration of the animal grazing strategy and rumen fermentation.

Key Words: feeding strategy, corn silage, grazing

335 Predicting dry matter intake of Holstein calves. J. C. M. Lima[1], J. P. P. Rodrigues[1], M. I. Marcondes*[1], M. M. Campos[2], T. E. Silva[1], A. S. Treece[1], N. C. S. Gonzaga[1], and A. F. W. Oliveira[1], *[1]Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil, [2]Embrapa Gado de Leite, Juiz de Fora, Minas Gerais, Brazil.*

This study aimed to develop a model to predict dry matter intake (DMI) in dairy calves. Thirty-two male Holstein calves, with 3 d of age and average live weight of 35.56 ± 5.86 kg, were used. The animals were distributed into a completely randomized design and allocated in individual houses. The treatments consisted of different amounts of raw milk (12.43% DM; 3.19% fat; 2.68% CP on natural matter basis), which were: 2, 4, 6 and 8 L/day, fed twice a day, in 8 replications. All calves were fed starter (19.75% CP) ad libitum and feed intake was registered daily from 3 to 59 d old. Total dry matter intake (TDMI; kg/day) was obtained summing milk dry matter intake (MDMI) and starter dry matter intake (SDMI; kg/day). TDMI equations were regressed for each treatment by days according to the model: $TDMI = \beta_0 + e^{(\beta 1 \times d)}$. SDMI was regressed by milk intake (MI; liters/day) and day according to the model: $SDMI = \beta_0 \times MI + \beta 1 \times e^{((\beta 2 \times MI + \beta 3) \times d)}$. The TDMI equations obtained for each treatment was: $TDMI = 0.2405(\pm 0.0165) \times e^{0.0279(\pm 0.0010) \times d}$; $TDMI = 0.3156(\pm 0.0135) \times e^{0.0262(\pm 0.0007) \times d}$; $TDMI = 0.4957(\pm 0.0227) \times e^{0.0173(\pm 0.0007) \times d}$ and $TDMI = 0.7068(\pm 0.0215) \times e^{0.0125(\pm 0.0005) \times d}$ for 2, 4, 6 and 8 L/day, respectively. The β_0 values indicate that initial intake was greater with greater milk amounts, while β_1 suggests that the rate of increasing in dry matter intake was more expressive for calves fed lower milk amount. Afterward, β_0 and β_1 of each equation were linear regressed on milk intake to compose a single equation to predict TDMI in calves. The equations to predict TDMI and SDMI according to milk intake and age were, respectively: $TDMI = (0.079 \times MI + 0.0449) \times e^{((-0.0028 \times MI + 0.0348) \times d)}$ and $SDMI = -0.013 \times MI + 0.125 \times e^{((-0.003 \times MI + 0.034) \times d)}$. Negative value obtained for parameters linked to milk intake (β_0; β_2) suggests that initial starter intake was lower for greater milk intake. Considering that when using 2 prediction equations the sum of random errors might be greater, it is suggested to estimate SDMI by the equation: SDMI = DMI – MDMI. It can be concluded that TDMI and SDMI can be explained by calf age and milk intake. Supported by CNPq/Fapemig.

Key Words: calf, milk, starter

336 Abrupt changes in forage dry matter of one to three days affect intake and milk yield in lactating dairy cows. J. Boyd*[1] and D. R. Mertens[2], *[1]US Dairy Forage Center, Madison, WI, [2]Mertens Innovation & Research LLC, Belleville, WI.*

Our objective was to determine the effects of 1, 2, and 3d changes in forage DM on lactating cow performance across stage of lactation or parity. Data was compiled from 2 studies: Study A (fall 2009) early lactation cows averaging 65 DIM and 43.3 kg milk/d and Study B (fall 2012) late lactation cows averaging 192 DIM and 40.7 kg milk/d (total of 44 primiparous and 44 multiparous Holstein cows) housed in a tie stall barn. Within parity, cows were assigned to 1 of 11 blocks based on production and days in lactation. Study design was replicated 2 × 2 Latin Squares for each set of 1-, 2-, or 3-d treatments. Each period consisted of a 3-d pre-treatment, 1- to 3-d treatment, and a 3-d post-treatment phase. Diets were control (Ctrl) with no water added and treatment (Trt) with water added to decrease forage DM by 8%-units, to mimic rainfall events on a bunker silo and feeding an imprecise ration based on as-fed ratios of ingredients. Ctrl rations were adjusted daily to maintain DM ratios of ingredients. Feed offered was adjusted daily for both Ctrl and Trt based on the previous day's refusal. Milk yield was recorded daily and samples were taken 2× daily. Forages, TMR, and refusals were sampled daily and concentrates sampled 2× weekly. Chemical composition (DM, CP, aNDF) of samples were determined by NIR. Data was analyzed using Proc MIXED of SAS with cow within parity-block as a random variable. On d 1, DMI was reduced 2.3 ($P < 0.0001$), 1.5 ($P < 0.0001$), and 0.91 kg ($P < 0.0001$), for the 1-, 2-, and 3-d treatments, respectively, but DMI recovered during the following 1 to 3 d even during Trt phases. Although daily milk decreased slightly on d 1 of each Trt, the decrease was largest on d 2: −1.06 ($P = 0.003$), −1.48 ($P = 0.0003$) and −0.79 kg ($P = 0.03$), for the 1, 2, and 3d treatments, respectively. No parity effect was observed, but late lactation cows were not as susceptible to diet DM change as early lactation animals. We concluded that abrupt changes in forage DM causes economically significant reductions in daily milk yield, but the duration of the change does not worsen the losses if offered ration amounts are adjusted daily.

Key Words: DM changes, silage, feeding

337 Dry matter intake in crossbred dairy calves. A. L. Silva[1], M. I. Marcondes*[1], M. M. Campos[2], T. E. Silva[1], A. S. Trece[1], J. S. A. A. Santos[1], S. G. S. Moraes[1], and J. P. P. Rodrigues[1], *[1]Universidade*

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The liquid-feeding phase is extremely important in animal production systems. Therefore, it becomes necessary to establish measures to maximize animal performance during this phase. Dry matter intake (DMI) affect directly the animal performance, because it's the main determinant of entry of nutrients to meet animal requirements. The objective was to determine the DMI for crossbred Holstein-Zebu calves aged between 0 and 60 d. The experiment was conducted at Department of Animal Science, at Universidade Federal de Viçosa, Brazil. Eighteen male calves, crossbreed Holstein-Zebu, with initial BW of 36 ± 5.5 kg, were used. The animals were allotted to 3 treatments, with 6 replications. Treatments consisted of 3 different levels of milk intake, which were 2, 4 and 8 L/d. The animals had free access to water and concentrate (starter), which was formulated in accordance with the requirements presented in NRC (2001). The animals were fed twice a day, at 6:00 and 15:00, and starter intake was measured every day at 6:00h. Environmental variables were also considered: relative humidity (RH), temperature and humidity index (THI) and black globe temperature and humidity index (BGTHI). Environmental effects, milk intake and age were used in a multiple regression model, considering both linear and quadratic effects, to estimate calves DMI. The test was conducted using the MIXED procedure, at the level of significance of 5%. The DMI was affected by milk intake ($P < 0.001$), THI ($P = 0.0453$) and age of the animals ($P < 0.001$). However, no significant quadratic effects were observed ($P > 0.05$), thus the final regression can be expressed by equation. DMI = 0.4272 + 0.6741 × M – 0.0059 × THI + 0.0122 × D; where: DMI = Dry matter intake (kg/day), M = Milk intake (kg/day of DM), THI = Temperature and humidity index (without dimensional), D = Age of animal (days). The SI can be estimated by the difference between the total DMI and the DMI from milk. It can be concluded that the DMI in calves can be estimated using parameters as milk intake, THI and age of animals.

Key Words: environmental effect, feed, milk

338 The study of ruminal degradation of canola meal in dairy cows. Y. J. Tian[1,2], Y. Zeng[1,2], Z. J. Cao[1,2], and S. L. Li*[1,2], *[1]College of Animal Science and Technology, China Agricultural University, Beijing, China, [2]State Key Laboratory of Animal Nutrition, Beijing, China.*

The objective of this paper was to determine the rumen degradability of Canola. Two types of diets were formulated at a 4:6 (DM basis) concentrate: forage ratio according to 1.3× maintenance or 2.5× maintenance nutrients levels, respectively. Ruminal degradation rates of dry matter (DM) and crude protein (CP) of 2 kinds of canola meals (CM1, CM2) and 2 other kinds of domestic regular rapeseed meals (DRM1, DRM2) were determined using in situ method in the cows fed the above 2 types of diets. The results suggested that ruminal degradation kinetics of DM and CP of the 4 kinds of rapeseed meals had the similar variation trend. The effective degradation of DM and CP were higher for all the rapeseed meals measured in the cows fed the diets with 1.3× maintenance compared with the 2.5× maintenance level. With the same nutrients levels, DM and CP digestion rates of CM was generally higher than that of DRM. The total digestion rates of CP of CM were no differences between 2 maintenance nutrients levels. However, the total digestion rate of CP of DRM on the 1.3× maintenance nutrients level was higher than that on the 2.5× maintenance nutrients level.

Table 1. Rumen effective degradation of DM (top) and CP (bottom) in cows fed diets at 1.3 and 2.5× maintenance level

Sample	1.3×	2.5×	SEM	P-value[1]
CM 1	48.45	45.30	1.09	0.158
CM 2	49.22	47.11	1.28	0.453
DRM 1	45.12	39.18	1.23	0.002
DRM 2	51.05	43.16	1.88	0.019
CM 1	59.86	52.61	1.77	0.024
CM 2	61.58	57.61	1.22	0.104
DRM 1	57.11	49.30	1.54	<0.001
DRM 2	66.93	55.76	2.25	0.001

[1]$P < 0.05$ = significant difference, $P < 0.01$ = very significant difference.

Key Words: canola meal, rumen degradation, dairy cow

339 Meta-analysis: Effect of corn silage hybrid type on intake, digestion, and milk production by dairy cows. L. F. Ferraretto* and R. D. Shaver, *University of Wisconsin–Madison, Madison.*

A meta-analysis was performed to evaluate the effects of corn silage hybrid type on digestion, rumen fermentation and lactation performance by dairy cows using a data set of 139 treatment means from 45 peer-reviewed articles published 1990–2013. Categories for hybrids differing in grain and stalk characteristics, respectively, were: conventional (CONG), nutridense (ND), high oil (OIL), and waxy (WAXY); conventional, dual-purpose, isogenic or low-normal fiber digestibility (CONS), brown midrib (BMR), high fiber digestibility (HFD), and leafy (LFY). Genetically-modified (GM) hybrids were compared with their genetically similar non-biotech counterpart (ISO). Data were analyzed using Proc Mixed in SAS with hybrid as fixed and trial as random effects. Silage nutrient composition was similar ($P > 0.10$), except for lower ($P < 0.01$) CP% and EE% for CONG than ND and OIL. Milk fat content and yield and protein% were lowest ($P < 0.05$) for OIL. Intake, milk production and total tract nutrient digestibilities were unaffected ($P > 0.10$) by grain hybrid type. Except for lower ($P < 0.001$) lignin% for BMR, lower ($P < 0.05$) starch% for HFD than CONS, and a trend ($P < 0.10$) for higher NDF% for HFD, silage nutrient composition was similar ($P > 0.05$) among hybrids of different stalk type. Intake, milk, and protein yield were 1.6, 1.3, and 0.05 kg/cow/d, respectively, greater ($P < 0.01$) for BMR than CONS and LFY on average. Likewise, DMI and milk yield were 0.6 and 0.9 kg/cow/d greater ($P < 0.01$) for HFD than CONS. Total tract NDF digestibility was greater ($P < 0.001$) and starch digestibility reduced ($P < 0.01$) for BMR and HFD than CONS or LFY. Rumen pH tended ($P < 0.10$) to be lower for BMR than CONS. No differences in lactation performance were observed for GM compared with ISO ($P > 0.10$). Except for negative effects of OIL on milk fat and protein percentages, differences were minimal among corn silage hybrids differing in grain type. Except for positive effects of BMR and HFD on intake and milk yield, differences were minimal among corn silage hybrids differing in stalk type. However, reduced total tract starch digestibility for BMR merits further study.

Key Words: corn silage, hybrid, dairy cow

340 Responses of late lactation cows to forage substitutes in diets supplemented with byproducts. M. B. Hall*[1] and L. E. Chase[2], *[1]US Dairy Forage Research Center, USDA-ARS, Madison, WI, [2]Department of Animal Science, Cornell University, Ithaca, NY.*

In a drought year with forage shortages and high grain prices, a study was performed to evaluate cow lactation response to lower forage diets supplemented with forage substitutes and byproduct feeds. No corn grain or soybean meal was used. The design was a randomized complete block with a 2 wk covariate period. Forty-eight lactating cows were offered a high forage TMR in the covariate period and 1 of 4 diets in a 4-wk feeding period. Experimental diets contained wheat straw (WS)/ sugar beet pulp (SBP) at 0%/12%, 3%/9%, 6%/6%, or 9%/3% of diet DM. The rest of the diet DM was comprised of 20% corn silage, 20% alfalfa silage, 25.5% corn gluten feed, 8% distillers grains, 5% whole cottonseed, 7% cane molasses/whey blend, and 2.5% vitamin and mineral mix with monensin. Diet DM averaged 16.5% CP, 35% NDF, and 11% starch. DMI declined linearly ($P = 0.03$) and milk kg tended to decline linearly ($P = 0.08$) as WS increased. As WS increased, actual milk fat kg did not change ($P > 0.57$), but protein kg declined linearly ($P = 0.02$). Experimental diets did not differ in 3.5% fat-and protein-corrected milk kg (FPCM; $P > 0.19$). Average FPCM in the experimental period (34.6 kg) did not differ from the covariate period (34.2 kg; $P = 0.48$), but FPCM/DMI was greater with the covariate diet than with the experimental diets (1.50 vs. 1.28, $P < 0.01$). MUN tended to be greater for 9%WS than for other diets ($P = 0.12$). Time spent ruminating increased linearly from 566 to 703 min/d with increasing WS ($P < 0.01$). There was a tendency for ruminal pH to increase from 0 to 4 h post-feeding (5.91 to 6.16; $P = 0.11$), and pH was lower with 0% WS than the other diets ($P = 0.01$). Use of forage substitutes in low starch/ high byproduct diets can maintain good milk production and components in late lactation cows. Future research should evaluate long-term effects on body condition changes.

Table 1.

	Straw % of DM				
Item	0%	3%	6%	9%	SED
DM intake, kg	26.9	25.9	25.9	25.4	0.64
Milk, kg	32.2	32.7	31.5	30.8	0.88
Fat, kg	1.38	1.38	1.32	1.37	0.06
Protein, kg	1.06	1.07	1.03	0.98	0.03
MUN, mg/dL	10.0	10.9	10.6	12.0	0.46

Key Words: byproduct, dairy cow, forage

341 Performance of dairy cows as affected by dietary starch level and supplementation with monensin during early lactation. M. M. McCarthy*[1], T. Yasui[1], C. M. Ryan[1], G. D. Mechor[2], and T. R. Overton[1], *[1]Cornell University, Ithaca, NY, [2]Elanco Animal Health, Greenfield, IN.*

The objective of this study was to evaluate the effect of dietary starch level and monensin (M) supplementation on performance of dairy cows during early lactation. Primiparous (n = 21) and multiparous (n = 49) Holstein cows were fed high starch (HS) or low starch (LS) diets beginning at parturition with a topdress pellet containing 0 or 450 mg/d of M in completely randomized design with a 2 × 2 factorial arrangement of treatments. Prior to parturition all cows were fed a common controlled energy diet with daily topdress of either 0 or 400 mg/d M consistent with postpartum treatments. From d 1 to 21, cows were fed HS TMR (26.2% starch, 34.3% NDF, 22.7% ADF, 15.5% CP) or LS TMR (21.5% starch, 36.9% NDF, 25.2% ADF, 15.4% CP) with a daily topdress of either 0 or 450 mg/d M. From d 22 through 63 cows were fed HS with their assigned daily topdress. Interactions of starch content × M supplementation were not significant. Cows fed HS from wk 1 to 3 postcalving had greater increases in milk yield during wk 2 and 3 postcalving compared with LS cows ($P = 0.002$), but HS cows also had lower percentages of milk fat ($P = 0.01$), true protein ($P = 0.05$), lactose ($P = 0.05$), and total solids ($P = 0.009$) during the same period. This resulted in similar yields of 3.5% FCM and ECM between starch treatments. Cows fed HS diets had higher DMI in wk 2 and 3 postcalving ($P = 0.04$) and lost less BCS during wk 1 to 3 ($P = 0.04$), contributing to lower ECM/DMI during this period for HS cows ($P = 0.002$). Cows fed M had higher DMI from calving through wk 9 of lactation (20.0 vs. 18.9 kg/d; $P < 0.02$). Cows fed M had higher milk yields during the first 9 wk of lactation (37.3 vs. 35.1 kg/d; $P = 0.05$), but had similar yields of both 3.5% FCM and ECM because of trends for lower milk fat content during early lactation ($P = 0.10$). In part because of similar yields of ECM between these treatments and higher DMI for cows fed M, ECM/DMI during the first 9 wk of lactation was not affected by M treatment. Overall, cows fed HS had faster increases in milk and DMI and lost less BCS postpartum and cows fed M had higher milk and DMI during the first 9 wk of lactation.

Key Words: early lactation, starch, monensin

342 Effects of alfalfa hay particle size in diets supplemented with unsaturated fat: Feeding behavior and performance of dairy cows. A. Kahyani[1], G. R. Ghorbani[1], M. Khorvash[1], S. M. Nasrollahi[1], K. A. Beauchemin[2], and S. Ding*[2], *[1]Isfahan University of Technology, Department of Animal Sciences, Isfahan, Iran, [2]Lethbridge, Agriculture and Agri-Food Canada, Research Centre, Lethbridge, AB, Canada.*

The objective was to evaluate the effects of increasing the physically effective fiber (peNDF) intake of lactating dairy cows fed diets supplemented with unsaturated fat on feeding behavior and performance. The peNDF content of the diets was increased by incorporating 24% (DM basis) alfalfa hay (AH), which varied in particle size (PS). Nine multiparous cows averaging 87.8 ± 14.8 DIM and weighing 653 ± 53 kg were randomly assigned to a triplicate 3 × 3 Latin square. During each of 3 21-d periods, animals were offered one of 3 total mixed rations that were chemically similar but varied in PS of AH: fine, medium, and long, with a geometric mean particle length of 2.1, 3.6, and 5.0 mm, respectively. All diets were supplemented with yellow grease at 2% of dietary dry matter (DM). Data were analyzed using the mixed model procedure of SAS to account for effects of square, cow within square, and treatment. The treatment was considered a fixed effect; square, period and cow within square were considered random effects. Increasing PS quadratically affected DM intake (DMI) (24.68, 25.38, and 23.70 kg/d, for fine, medium, and long, respectively; $P < 0.05$). Increased peNDF intake decreased eating rate ($P < 0.05$), did not affect feed sorting ($P > 0.05$), and increased eating and total chewing per kg DMI ($P < 0.05$). Daily rumination time exhibited a quadratic response ($P < 0.05$), with highest rumination time for the medium diet. There was a quadratic response in actual (41.5, 43.3, and 40.4 kg/d) and 4% fat-corrected milk production as well as milk protein yield ($P < 0.05$). There was a linear increase in milk fat content with increasing PS ($P < 0.05$), but milk fat content and fat to protein ratio were low for all treatments likely due to adding yellow grease to a diet containing a high level of non-forage carbohydrates (42.2% DM). The study indicates that increasing PS of AH in diets containing unsaturated fat can help to elevate peNDF intake results in the improvement of chewing activity, DMI, and milk yield and milk fat production.

Key Words: alfalfa hay particle size, feed sorting, unsaturated fat