65 The effect of feeding rumen-bypass protein on milk yield and composition in Irish dairy cows. M. R. Sheehy*[1,2], F. J. Mulligan[1], P. A. McLaughlin[2], O. Brennan[2], S. Taylor[2], and A. G. Fahey[3], *[1]School of Veterinary Medicine, University College Dublin, Dublin, Ireland, [2]Devenish Nutrition Ltd., Belfast, UK, [3]School of Agriculture and Food Science, Dublin, Ireland.*

Inclusion of rumen-bypass proteins in dairy cow diets is a standard management practice in many areas around the world. However, supplementing diets with rumen-bypass protein is not standard practice with a typical perennial ryegrass based Irish diet. Therefore the objective of this study was to determine if supplementing rumen-bypass protein would alter milk yield and composition for cows fed this diet type. Holstein-Friesian dairy cows (n = 112) were balanced for DIM, pre-experimental milk yield, and milk composition and assigned to either a control (n = 58) or a rumen-bypass protein (n = 54) treatment. Cows were put into 2 large pens and after each milking the cows rotated into a new pen to account for environmental effects in the shed. Cows were fed rumen-bypass protein in individual stanchions. Therefore cow is considered the experimental unit. The trial was carried out over a 10 wk period and on weekly intervals yield was recorded and milk composition was determined (fat yield and %, protein yield and %, lactose yield and %). All data were analyzed in SAS with a repeated measures mixed model. The fixed effects included treatment, parity (1 to ≥5), week (1 to 10), and the interactions between treatment and parity, and treatment and week. Days in milk, genetic potential for milk production, and the covariates of production for milk yield and composition −2, −1, and +1 week of the trial were included in the model. Cow within treatment was included in the model as a random effect. Cows fed the bypass protein had significantly greater milk yield ($P < 0.01$), protein yield ($P < 0.05$), protein % ($P < 0.01$), and a tendency to have an increase in lactose yield ($P < 0.10$). There were significant differences between the rumen-bypass protein and control treatments for fat yield, fat percentage, or lactose percentage. In conclusion bypass protein supplementation in the diet resulted in increased milk yield, and protein yield and composition for cows fed typical Irish forages. Therefore supplementation of rumen-bypass protein in Irish dairy systems may improve milk yield and protein production.

Key Words: milk composition, milk yield, rumen-bypass protein

66 Rescue from diet-induced milk fat depression in monensin-supplemented dairy cows. D. E. Rico*[1], A. W. Holloway[2], and K. J. Harvatine[1], *[1]The Pennsylvania State University, University Park, [2]Elanco Animal Health, Greenfield, IN.*

Sixteen Holstein cows were used in a crossover design to investigate the effect of monensin (MN) on the recovery from milk fat depression (MFD). MFD was induced at the start of each period by feeding a low fiber, high oil diet with monensin (Rumensin 90, Elanco Animal Health) for 10 d. A recovery phase of 18 d followed where cows were fed a high forage, low oil diet (31.2% NDF and no oil). Treatments during recovery were (1) control (no MN supplementation) or (2) monensin administered as a topdress at a rate of 450 mg/cow/d. Dry matter intake was observed daily and milk yield and composition and milk fatty acid (FA) profile were measured every 3 d during recovery. Data were analyzed as repeated measures and tested control vs MN at each time point. There was no effect of monensin on DMI or yield of milk, protein, and lactose ($P > 0.05$). Milk fat concentration and yield increased progressively during recovery in both treatments. However, there was no treatment by time interaction for milk fat yield ($P > 0.10$). Monensin decreased milk fat yield from d 6 to 15 (12% on average; $P < 0.05$), but was the same as control on d 18. There was a treatment by time interaction for milk fat concentration ($P < 0.10$), which was decreased by MN only on d 3 and 6. The yield of milk de novo synthesized FA increased progressively in both treatments and was not affected by treatment. Similarly, yield of 16C FA increased progressively, but was decreased by MN on d 6 and 9. Preformed FA yield was lower in the MN group from d 6 to 15 (13.9%; $P < 0.05$), but was not different from control on d 18. Importantly, milk FA concentration of trans-10 C18:1 and trans-10, cis-12 CLA rapidly decreased in both groups, however, MN slightly increased trans-10 C18:1 concentration on d 15 and 18 (21% of FA; $P < 0.01$). Monensin feeding reduced the rate of recovery from MFD predominantly through a delayed recovery of preformed FA, although a similar level of recovery was achieved by d 18. Monensin supplementation has minimal effect on recovery of normal rumen biohydrogenation and de novo fatty acid synthesis during recovery from MFD by correction of dietary NDF and PUFA concentration.

Key Words: dairy cows, milk fat depression, monensin

67 Behavior of dairy cattle housed on differing freestall bed types compared with cattle kept at pasture. J. Lau[1], J. K. Margerison*[1], M. Hedley[1], D. Horne[1], J. Hanley[1], N. Powell[2], and A. Shilton[2], *[1]Institue of Agriculture and Environment, Massey University, Palmerston North, New Zealand, [2]School of Engineering & Advanced Technology, College of Sciences, Massey University, Palmerston North, New Zealand.*

This research aimed to compare differing types of free stall beds on the lying time of dairy cattle and compare this with animals grazed at pasture. Three groups of 12 adult dairy cattle, of similar age, live weight and condition score were offered access overnight to; pasture (P) or were housed in free stalls that were fitted with sand beds (S) or dual chamber water beds (W). All housed cows were offered each bed type in a changeover design, with a 5 d house acclimatization period, followed by a 3 d behavior measurement and a 5 d rest period on pasture. Each day cows were grazed for 4 h, waited to be milked for 2 × 2 h and were either housed or grazed for 16 h overnight. During the training period all cows adapted quickly to lying in deep litter sand beds (0.61 (±0.05) days). During the 3 d of 24 h behavior measurement, cows lay in water beds for significantly less time, and stood fully in and half in beds for significantly longer compared with sand beds, while there was no significant difference between sand beds and cows at pasture (Lying: 11.1; S: 11.1; W: 9.9 (0.71) h/d). More cows housed on water beds lay in the alley (3) compared with cows housed on sand beds (0). Cows quickly adapted to lying in sand beds, despite not having used freestall housing previously. Cows housed on sand beds lay down for similar amount of time as cows kept at pasture. Cows housed on water beds lay down for significantly less time than cows on sand beds and more lay in the ally, and stood for longer and often stood half in the beds.

Key Words: housing, pasture, dairy

68 Effects of amount of palmitic and stearic fed to mid-lactation dairy cows on intake, milk yield, and diet digestibility. D. N. Lobão da Silva*[1], R. S. Younker[2], and N. B. Litherland[1], *[1]University of Minnesota, Saint Paul, [2]Milk Specialties, Eden Prairie, MN.*

Dietary supplementation with stearic and palmitic acid can increase energy available for dairy cows when energy intake constrains milk yield. Questions still remain regarding the impact of carbon chain length (pure stearic or palmitic acid) of saturated fatty on DMI, milk production, and milk fat yield. The objectives of this study were to determine if pure stearic or palmitic acid fed at 2.5% and 5% of total diet DM would affect DMI, milk yield, milk components and DM digestibility. Forty (n = 8) multiparous cows at 219 ± 10 DIM, producing 33 ± 1.8 kg of milk/d were randomly assigned to 1 of 5 treatments for 6 wk with a 5-d adaptation period. Data were analyzed by PROC MIXED with model containing effect of treatment and random effect of cow within treatment. Treatments were: TMR with 0% fat of diet DM Control (C); 2.5% stearic (S2.5); 5% stearic (S5); 2.5% palmitic (P2.5); 5% palmitic (P5). Diets were 17% CP, 28% NDF, 22% starch, and varied only in ether extract (4.1, 6.5, 8.8, 6.5, 8.8 %) for C, S2.5, S5, P2.5 and P5, respectively. There were no treatment effects on DMI, energy intake, or milk yield. Due to high summer temperatures (35°C) during this study, cows were heat stressed (93 THI) with low DMI. Higher energy diets from fat source did not alleviate the effects of heat stress on production.

Table 1.

	Treatment						
Variable	C	S2.5	S5	P2.5	P5	SEM	*P*-value
Calculated supplemental FA intake, g/d	0.0	452.4	932.7	466.1	847.5	32.1	<0.001
DMI, kg/d	18.8	18.1	18.7	18.6	16.9	0.9	0.57
Energy intake, Mcal/d	29.3	30.3	33.5	30.9	30.7	1.5	0.50
3.5% FCM, kg/d	23.5	25.1	27.6	27.1	25.2	1.6	0.35
Fat yield, g/d	0.8	0.9	1.0	1.0	0.9	0.1	0.28
Apparent total-tract DM digestibility, %	64.3	67.8	64.8	69.3	68.6	1.6	0.10

Key Words: milk production, palmitic acid, stearic acid

69 Effects of dietary starch content and corn particle size on intake, digestion and milk production by dairy cows. S. M. Fredin*, S. J. Bertics, and R. D. Shaver, *University of Wisconsin, Madison.*

An experiment was conducted to evaluate the effects of dietary starch concentration and corn particle size on intake, ruminal fermentation, digestibility, and milk yield, composition and component yields. Eight ruminally-cannulated multiparous Holstein cows (96 ± 8 d in milk at trial initiation) were randomly assigned to a 2 × 2 factorial arrangement of treatments in a replicated 4 × 4 Latin square design with 21-d periods. Treatments were finely (F; mean particle size = 552 µm) and coarsely (C; 1270 µm) ground dry shelled corn in normal (NS) and reduced (RS) starch rations fed as TMR. The NS and RS rations contained 27 and 18% starch (DM basis), respectively, by partially replacing corn with soy hulls. Milk samples were collected at both milkings on d 16 and 17 and rumen fluid 4 times daily at 2-h intervals on d 18–20 such that the samples represented a 24-h feeding cycle. Fecal samples were collected 2 times daily on d 18–20. Apparent total tract DM digestibility (DMD) was estimated using indigestible NDF as a marker. Data were analyzed using the MIXED procedure of SAS. Mean DMI (23.2 kg/d) was unaffected by treatment. Cows fed NS produced 1.9 kg/d more milk (41.0 vs. 39.1 kg/d; $P = 0.03$) and 0.06 kg/d of milk protein (1.18 vs. 1.12 kg/d; $P < 0.01$) than cows fed RS. There tended ($P = 0.06$) to be an interaction for milk fat yield with greater yield for NSF and RSC. The DMD, ruminal VFA (mM) and ammonia (mg/dL) were unaffected by treatment. Cows fed F had greater ruminal propionate (20.0 vs. 18.9 mol/100 mol; $P < 0.001$) and lower acetate: propionate ratio (3.45 vs. 3.68; $P < 0.001$) and pH (6.27 vs. 6.33; $P = 0.04$). Average rumen pH was above 5.8 for all treatments. Feeding normal starch diets increased milk and protein yields and finely ground corn increased ruminal propionate concentration.

Key Words: digestion, particle size, starch

70 Effect of time of storage on ammonia nitrogen concentration and ruminal in vitro starch digestibility of high moisture corn—A field survey. L. F. Ferraretto*, R. D. Shaver, and P. C. Hoffman, *University of Wisconsin-Madison, Madison.*

The objectives of the study were to (1) determine relationships between HMC ammonia-N, DM, pH and soluble CP concentrations and 7-h ruminal in vitro starch digestibility (IVStarchD), and (2) evaluate the effects of storage time on HMC pH, ammonia-N, soluble CP and IVStarchD measurements. Month of submittal was assumed to be associated to length of time in storage. To achieve these objectives a data set comprised of 2,685 HMC samples, within 50 to 80% DM, from Dairyland Laboratories Inc. (Arcadia, WI) and Cumberland Valley Analytical Services Inc. (CVAS, Maugansville, MD). Ammonia-N and soluble CP were reported as % of CP. Data evaluating the effects of month of submittal were analyzed using Proc Mixed in SAS with month as a fixed effect and laboratory as a random effect. Regressions to determine linear relationships between IVStarchD and ammonia-N, soluble CP, pH and DM content were performed using Proc Reg in SAS. Statistical significance and trends were declared at $P \leq 0.05$ and $P > 0.05$ to $P < 0.10$, respectively. IVStarchD increased from October to September of the following year, with October/November values 6%-units lower than May through September values. Similar results were observed for ammonia-N and soluble CP with an increase from 3.5% or 30% in October to 6.6% or 48% in August, respectively. The pH of HMC decreased from 4.6 in October to 4.3 in August of the following year. Ammonia-N was positively related to soluble CP ($R^2 = 0.92$) and StarchD ($R^2 = 0.53$). The DM content of HMC was negatively related ($R^2 = 0.58$) to IVStarchD with a decrease of 0.4%-units in IVStarchD per 1%-unit increase in DM. Combined, ammonia-N and DM provided good predictions of IVStarchD (Adj. $R^2 = 0.66$). The pH of HMC was negatively related to ammonia-N ($R^2 = 0.61$), soluble CP ($R^2 = 0.56$) and IVStarchD ($R^2 = 0.43$). Increasing ammonia-N, soluble CP and IVStarchD values suggest that HMC may need up to 8 mo to achieve maximum starch digestibility. Furthermore, ammonia-N and DM content are good indicators of starch digestibility in high moisture corn.

Key Words: high moisture corn, ammonia, starch digestibility

71 Using a systems model approach to assess the potential effect of changes in gene expression in adipose tissue of dairy cattle on production and reproductive efficiency. S. Shields and J. McNamara*, *Washington State University, Pullman.*

Variation in efficiency is a function of genetic, physiological and nutritional control in several organs and systems, including adipose tissue. To identify key physiological control points of metabolic flux and reproductive functions in dairy cattle, an existing metabolic model was used and expanded to include reproductive cycling, follicular growth, and steroid clearance. Our objective was to relate transcription of mRNA in adipose and liver which control metabolism, and potentially, reproductive processes and efficiency. The model describes substrate sensitivity

and maximum velocity for lipogenesis, esterification and lipolysis in adipose and gluconeogenesis and protein synthesis in the liver. Data from late gestation through 56 DIM on nutrient intake, milk output, adipose lipid, visceral and body protein and lipid, adipose metabolism and gene transcription in adipose and liver were collected. Genes coding for lipogenic pathways, as well as rates of lipogenesis decreased, but rates of lipolysis increased without increased mRNA abundance. In the liver, several genes of glucose, fatty acid and amino acid metabolism increased. In the simulation study, we altered the Vmax and Ks for lipogenesis, lipolysis, gluconeogenesis and protein synthesis, and milk production and intake were allowed to vary in response. Milk production ranged from 38.3 to 38.9 kg/d, body fat change from −0.07 to 0.4 kg/d, maintenance energy 22.0 to 25.4 Mcal/d and efficiency of milk energy as a percent of ME from 44.3 to 49% (at 56 DIM). Changing rates of lipogenesis, lipolysis, gluconeogenesis and protein synthesis did not affect milk production or feed intake, but altered milk fat percentage and maintenance costs and varied postpartum interval to first ovulation approximately 3 d. Increases in metabolic rate increased rates of estrogen and progesterone degradation. This model may be used to help interpret genomic and transcriptomic data to pinpoint the most effective ways to select and manage for changes in productive and reproductive efficiency.

Key Words: efficiency, systems model, adipose tissue

72 Effects of feeding millet silage cultivars on performance of lactating dairy cows. T. Brunette*[1], B. Baurhoo[2], and A. Mustafa[1], *[1]McGill University, Ste-Anne-De-Bellevue, QC, Canada, [2]Belisle Solution Nutrition, St-Mathias, QC, Canada.*

Fifteen lactating Holstein cows were used in a replicated 3x3 Latin square experiment to determine the effects of feeding regular and high water soluble carbohydrate (WSC) millet silages on the performance of dairy cows. Dietary treatments (68:32 forage:concentrate ratio) were a corn silage diet (control, CS), a regular millet silage diet (RM), and a high WSC millet silage diet (SM). Experimental silages constituted 37% of each diet DM. Three ruminal-fistulated cows were used to determine the effect of dietary treatments on ruminal fermentation and total-tract nutrient utilization. Relative to corn silage, regular and high WSC millet silages contained 37% more CP, 66% more NDF, and 67% more ADL. Cows fed CS consumed more ($P < 0.05$) DM (24.4 kg/d) and starch (5.7 kg/d), and less ($P < 0.05$) NDF (7.9 kg/d) than cows fed RM or SM. Millet silage type had no effect on DM (22.8 kg/d), starch (3.7 kg/d) and NDF (8.7 kg/d) intakes. Feeding RM relative to CS reduced ($P < 0.05$) milk yield (32.7 vs. 35.2 kg/d), ECM (35.8 vs. 38.0 kg/d) and SCM (32.7 vs. 35.3 kg/d). However, cows fed SM had similar milk yield, ECM, and SCM relative to cows fed CS or RM. Milk efficiency was not affected by dietary treatments. Milk protein concentration was greatest for cows fed CS, intermediate for cows fed SM, and lowest for cows fed RM ($P < 0.05$). Milk concentration of SNF was reduced ($P < 0.05$) while MUN was greater ($P < 0.05$) for cows fed RM than for those fed CS. However, millet silage type had no effect on SNF and MUN concentrations. Furthermore, concentration of milk fat, lactose and TS were not affected by silage type. Ruminal pH was greatest for cows fed SM, intermediate for cows fed RM, and lowest for cows fed CS ($P < 0.05$), while ruminal NH_3-N was lower ($P < 0.05$) for cows fed CS than for those fed RM or SM. Total-tract digestibility of DM (67.9%), NDF (53.9%), CP (63.3%) and GE (67.9%) were not influenced by dietary treatments. It was concluded that cows fed CS performed better than those fed RM or SM likely due to the higher starch and lower NDF intakes. However, no major differences were noted between the 2 millet silages.

Key Words: millet silage, milk production, ruminal fermentation

73 Variability in the concentrations of free and esterified fatty acids in corn silage and byproduct feeds. C. M. Klein[1], J. C. Ploetz[1], T. C. Jenkins[2], and A. L. Lock*[1], *[1]Michigan State University, East Lansing, [2]Clemson University, Clemson, SC.*

This study examined the concentration of fatty acids (FA) as either free FA (FFA) or esterified FA from corn silages and byproduct feeds. Total lipids were extracted and lipid classes separated with solid-phase extraction cartridges. Esterified fractions were combined following separation, which resulted in a single esterified FA fraction and a FFA fraction. For corn silage samples (n = 75), DM (%), NDF, starch, and CP (all % DM) ranged from 35.3 ± 4.2, 36.5 ± 3.9, 36.4 ± 3.9, and 7.1 ± 0.7 (mean ± SD), respectively. Total FA ranged from 1.6 to 3.6% DM (mean 2.5 ± 0.3% DM). Esterified FA ranged from 1.2 to 2.8% DM (mean 2.0 ± 0.3% DM) and FFA ranged from 0.3 to 0.8% DM (mean 0.5 ± 0.1% DM). Esterified FA accounted for 69 to 86% (mean 80 ± 4%) and FFA 13 to 31% (mean 20 ± 4%) of total FA. Esterified FA (% DM) were positively correlated with starch concentration (r = 0.35, $P = 0.001$), whereas FFA (% DM) were positively correlated with lactic acid concentration and corn silage processing score (CSPS), and negatively correlated with in vitro starch digestibility. Multiple regression analysis identified 4 factors (CSPS, lactic acid, starch concentration, and in vitro starch digestibility; all $P < 0.05$) that explained 41% of the variation in the proportion of total FA as FFA. Concentration of esterified FA in distillers grains (n = 27), canola meal (n = 21), and cottonseed (n = 12) was 11.0 ± 1.7, 6.1 ± 5.1, and 18.4 ± 3.5% DM, respectively. Concentration of FFA was 1.2 ± 0.2, 0.9 ± 1.7, and 1.2 ± 1.7% DM, respectively. Ether extract (% DM) values for byproducts agreed with esterified FA plus FFA concentrations ($R^2 = 0.95$). Furthermore, in a dual-flow continuous fermenter study, soy FFA increased the accumulation of total *trans* 18:1 and *trans*-10 18:1 by 28 and 48% (both $P < 0.05$), respectively, when compared with soy oil (both at 1.5% DM). In conclusion, there is considerable variation in total FA concentration of corn silages and byproduct feeds and a variable proportion of these FA are present as FFA. Results suggest that FFA may negatively affect rumen biohydrogenation to a greater extent when compared with esterified FA.

Key Words: byproduct feed, corn silage, dietary fatty acid