698 Effect of a phytogenic feed additive on feed intake and milk production in dairy cows. Carina Schieder*[1], Annamaria Boczonadi[1], and Bryan Miller[2], *[1]BIOMIN Holding GmbH, Herzogenburg, Austria, [2]BIOMIN USA Inc., San Antonio, TX.*

Fifty-five Holstein Friesian cows were assigned according to previous milk performance and days-in-milk into control (n = 27) or experimental group (n = 28) on a commercial farm in Czech Republic. Animals were housed in groups including one milking robot in each building. Experimental cows received a partly mixed ration (PMR) with a phytogenic feed additive (PFA) including herbs, spices, essential oils and plant extracts [Digestarom Dairy (3 g/head/day), Biomin Phytogenics GmbH, Germany]. Control cows received PMR without any supplementation during the trial period of 90 d. Both groups received additional concentrates based on wheat, barley, corn and soybean extraction meal according to their milk performance in the milking robots. Feed intake was recorded per group. Feed refusals were evaluated once daily. Milk performance was recorded each time visiting the milking robot, while milk solids were determined 3 times during the trial period. Health status and medical treatments were recorded throughout the trial. Data of daily milk performance were statistically analyzed using the independent *t*-test (IBM SPSS 21.0). PFA addition in the PMR of dairy cows resulted in a slightly higher dry matter intake (44.23 vs. 43.88 kg/d). The PFA supplemented group produced higher quantities of milk fat (1.27 vs. 1.19 kg/d; $P > 0.05$), milk protein (1.20 vs. 1.18 kg/d; $P > 0.05$) and lactose (1.75 vs. 1.67 kg/d; $P > 0.05$). Animals receiving the PFA showed a significantly higher milk production (35.37 vs. 33.67 kg/d; $P < 0.001$). Increased daily milk yield and enhanced quantity of milk solids resulted in a superior amount of energy-corrected milk (33.01 vs. 31.89 kg/d; $P > 0.05$). In conclusion, the tested PFA was able to improve feed intake and milk performance, hence resulting in an increased farm benefit.

Key Words: dairy cow, performance, phytogenic feed additive

699 Fractionated harvest and alkali treatment of whole-plant corn silage fed to lactating dairy cattle can increase intake and production. David E. Cook, Robb W. Bender*, Kevin J. Shinners, and David K. Combs, *Department of Dairy Science, University of Wisconsin-Madison, Madison, WI.*

The objective of this study was to evaluate alkali treatment of whole plant corn and stalks fractionated from the whole plant at harvest as feeds for lactating dairy cows. A forage harvester with a 6-row modified ear-snapping head was setup to snap the corn ear from 2 rows and cut 4 rows at a height of 82 ± 5cm, resulting in a feed product called toplage. The toplage used in this study was 82% of the DM yield from the field and contained 44% starch. The remaining stalks were harvested with a forage harvester at a height of 12 ± 2 cm on a second pass. Stalks were treated with calcium hydroxide at a rate of 70 g·kg^{-1} DM and ensiled. A second treatment was comprised of whole plant corn harvested at 28 ± 3cm and treated with calcium hydroxide at a rate of 70 g·kg^{-1} DM, then ensiled. Conventional corn for the negative control diet (CON) was harvested at 26 ± 3cm from the same fields. BMR corn for the positive control diet was harvested from an adjacent field at a height of 26 ± 5cm. One hundred twenty-eight Holstein cows were stratified among 4 treatments in a randomized complete block design. Data were analyzed using the MIXED procedure of SAS, with treatment, week, and relevant interactions as fixed effects. Diets were TMR containing 40% corn silage, 20% alfalfa silage, and 40% concentrate. Treatments were complete substitution of corn silage with a negative control (CON), positive control (BMR), treated whole plant (TRTCS), and a combination of toplage (82% of corn silage) and stalklage (18% of corn silage) (TOP). The TOP and BMR diet resulted in a similarly increased ECM over the CON diet ($P < 0.01$), and the TRTCS resulted in the highest ECM.

Table 1 (Abstr. 699). Effects of treatment on DMI, production, and rumination

Item	CON	BMR	TOP	TRTCS	SED	*P*-value
DMI	23.6^{c}	24.2^{bc}	24.8^{ab}	25.5^{a}	0.5	0.02
Milk, kg·d^{-1}	43.1^{b}	47.1^{a}	45.6^{a}	48.0^{a}	1.0	<0.01
Fat, %	3.40	3.30	3.32	3.37	0.13	0.84
Fat, kg·d^{-1}	1.47^{b}	1.55^{b}	1.54^{b}	1.66^{a}	0.05	<0.01
Protein, %	2.97^{a}	2.96^{a}	2.94^{a}	2.84^{b}	0.04	0.02
Protein, kg·d^{-1}	1.29^{b}	1.40^{a}	1.38^{a}	1.39^{a}	0.03	<0.01
ECM	41.9^{c}	45.0^{b}	44.7^{b}	47.0^{a}	0.8	<0.01
ECM DMI^{-1}	1.79	1.85	1.77	1.83	0.04	0.31
BW change, kg·wk^{-1}	0.30	0.29	0.36	0.35	0.23	0.99
BCS	2.79	2.80	2.86	2.84	0.03	0.26
Rumination, min·d^{-1}	510^{a}	474^{bc}	487^{ab}	459^{c}	10	0.01

Key Words: corn silage, alkali, fractionated

700 Effect of abomasal infusions of saturated fatty acids differing in chain length on milk production, composition, and fatty acid profile in Holstein dairy cows. Daniel E. Rico*[1], Jair E. Parales[2], Ben A. Corl[3], Andrea Lengi[3], P. Yvan Chouinard[1], and Rachel Gervais[1], *[1]Université Laval, Quebec, QC, Canada, [2]Universidad Nacional de Colombia, Bogotà, DC, Colombia, [3]Virginia Polytechnic Institute and State University, Blacksburg, VA.*

Fat supplements are commonly fed to increase dietary energy density and improve animal performance. However, metabolic effects may vary depending on fatty acid (FA) chain length. Eleven multiparous Holstein dairy cows (150 ± 52 DIM; Mean ± SD) were randomly assigned to treatment sequence in a replicated 3 × 3 Latin Square design testing the effect of saturated fat supplements differing in chain length on milk production and composition, and on milk FA profile. Treatment periods were 7 d in length and were separated by 7 d of washout. Treatments were administered as abomasal infusions of emulsions providing 280 g/d of FA from: 1) free FA enriched in palmitic acid (>85% 16:0; PA), 2) free FA enriched in stearic acid (98% 18:0; SA), or 3) medium chain triglycerides (50% 8:0 and 50% 10:0; MCT),. Milk yield was recorded and samples taken on the last 3 d of each period. The statistical model included the random effects of period, cow and sequence, and the fixed effect of treatment. Preplanned contrasts tested were PA vs. SA, and PA vs. MCT. Fat- and energy-corrected milk were not affected by treatments, and averaged 36.0 ± 2.0 kg/d and 35.1 ± 2.0 kg/d, respectively ($P > 0.11$). Milk fat content was higher in PA (4.49%) than in SA (4.18%, $P < 0.001$), but was not different between PA and MCT (4.37, $P = 0.17$). Similarly, milk fat yield was increased by PA (1.56 kg/d) relative to SA (1.46 kg/d, $P = 0.01$) and tended to be higher in PA than in MCT (1.48 kg/d; $P = 0.06$). De novo synthesized FA were higher in both SA and MCT (27.3 and 30.5% of FA, respectively) compared with PA (24.5% of FA; $P < 0.001$). The sum of 16:0 and cis-9 16:1 was higher in PA (43.7% of FA) relative to MCT and SA (38.0 and 35.6, respectively; $P < 0.001$). Lastly, the concentration of 18:0 plus cis-9 18:1 was increased by SA (31.2% of FA) relative to PA (26.6% of FA; $P < 0.001$), but

was not different between PA and MCT (25.8%, $P = 0.42$). The chain length of fat supplements infused into the abomasum affected milk fat and fatty acid profile.

Key Words: dairy cow, chain length, fat supplement

701 Effect of *Bacillus pumilus* on early lactation performance of dairy cows fed low or high starch diets postpartum. D. N. Lobão da Silva*[1], Z. Sawall[1], K. Froehlich[1], E. Galbraith[2], T. Parrott[3], M. Endres[1], and N. B. Litherland[1], *[1]University of Minnesota, Saint Paul, MN, [2]DuPont Nutrition and Health, Waukesha, WI, [3]DuPont Industrial Biosciences, Waukesha, WI.*

Strains of *Bacillus pumilus,* a spore-forming gram-positive bacterial species can be highly resistant to environmental stresses and have the potential to produces xylanase. Xylanase increases fiber digestion and feed efficiency which might benefit cows during early lactation. This study aimed to investigate the effects of low (20%, LS) or high (27%, HS) dietary starch concentration and *Bacillus pumilus* 8G-134 (BP) supplementation during early lactation. We hypothesized that BP would increase DMI and milk yield of cows fed LS or HS diets postpartum. Forty-four (n = 11/treatment) multiparous cows dried-off 42d before expected calving date were assigned to a common prepartum diet. At calving, cows were fed a LS or HS lactation diet and BP carrier or BP was top dressed on the TMR once daily to provide $5x10^9$ cfu/cow/day until 112 DIM. Factors combined produced 4 treatments: LS+carrier (LSCO); LS+BP (LSBP); HS+carrier (HSCO); HS+BP (HSBP). Blood samples collected on d 7, 14, 21 and 28 after calving were analyzed for NEFA and BHBA concentrations. Data were analyzed using the MIXED procedure of SAS. No changes were observed on postpartum DMI and 3.5%FCM yield; however, NEFA was lower and BHBA tended to be lower in serum of BP vs. Control. Results indicated that BP supplementation during early lactation decreased body lipid mobilization. We hypothesize that greater amounts of digestible energy available from fiber digestion might have caused lower lipid mobilization in cows fed BP. Future research should further investigate the use of BP as a feed additive because it appears to modify blood metabolite concentrations in early lactation.

Table 1 (Abstr. 701). Body condition, lactation performance, and blood metabolites in early lactation

	Treatment							
	LS		HS			*P*-value		
Item	CO	BP	CO	BP	SEM	S	BP	S × BP
DMI, kg/d	18.34	18.68	17.18	19.86	0.80	0.16	0.25	0.98
EB, Mcal/d	−10.66	−10.18	−9.29	−7.52	1.83	0.25	0.51	0.71
3.5% FCM, kg/d	39.98	39.87	40.72	42.25	1.78	0.35	0.67	0.62
NEFA, µEq/L	363.95	311.66	475.85	314.84	68.80	0.29	0.05	0.33
BHBA, mg/dl	12.76	10.27	14.52	8.02	2.57	0.92	0.07	0.41

Key Words: *Bacillus pumilus*, dietary starch, early lactation

702 Effects of direct-fed *Bacillus pumilus* 8G-134 fed pre- and postpartum on feed intake, milk yield, milk composition, and feed efficiency of Holstein cows. Shaoyu Luan[1], Elizabeth Galbraith[2], Megan Duersteler[2], and Felipe C. Cardoso*[1], *[1]University of Illinois, Urbana, IL, [2]Dupont Nutrition and Health, Waukesha, WI.*

The usage of direct-fed microbials (DFM) has become common in the dairy industry, but questions regarding their value and mode of action on dairy cows performance remain prevalent. The objective of this study was to evaluate the effects of DFM (*Bacillus pumilus* 8G-134) on pre- and postpartum performance. Forty-three multiparous Holstein cows were fed a total mixed ration (TMR) according to NRC (2001) recommendations and assigned to 2 treatments in a randomized completely block design. Cows in the direct-fed microbial treatment (DFMt, n = 21) received 5.0×10^9 cfu of *B. pumilus* 8G-134 direct-fed microbial in 28g of maltodextrin carrier, whereas cows in the control treatment (CON, n = 22) received 28g of maltodextrin carrier alone. Treatments were top-dressed on the TMR daily. Treatments were applied from 21 d before expected calving date to 154 d after calving. Intake from each cow was measured and dry matter intake was recorded daily. Milk weights were recorded daily, and milk samples were obtained weekly. Composite milk samples were analyzed for fat, protein, lactose, urea N (MUN), total solid and somatic cell count (SCC). Statistical analysis was performed using the MIXED procedures of SAS. Cows on DFMt had higher milk yield (41.2 ± 1.34 vs. 37.8 ± 1.33 kg; $P = 0.02$), fat corrected milk (48.5 ± 1.48 vs. 42.0 ± 1.49 kg; $P = 0.01$), energy-corrected milk (46.6 ± 1.40 vs. 40.9 ± 1.38 kg; $P = 0.01$), fat production (1.85 ± 0.06 vs. 1.57 ± 0.06 kg; $P = 0.03$), and protein production (1.27 ± 0.04 vs. 1.18 ± 0.04 kg; $P = 0.02$) on the second week of lactation than CON. There were no differences ($P > 0.27$) between treatments for milk yield, fat, protein, lactose, total solids, MUN or SCC overall. Dry matter intake, BW, body condition score (BCS) were not affected ($P > 0.35$) by DFMt supplementation. Cows on DFMt tended ($P = 0.06$) to have higher feed conversion (ECM/DMI; 2.02 ± 0.04) than cows fed CON (1.92 ± 0.04). In conclusion, cows fed DFMt tended to have higher feed conversion than CON with no detrimental consequences (i.e., BCS).

Key Words: direct-fed microbial, feed efficiency, *Bacillus pumilus*

703 Effects of fecal contents of aluminum (Al), iron (Fe), and manganese (Mn) on the apparent digestibility of phosphorus in dairy cows. Jan Plaizier*, Emma McGeough, and Kim Ominski, *University of Manitoba, Winnipeg, MB, Canada.*

To test if the apparent absorption of phosphorous (P) is reduced by aluminum (Al), iron (Fe), and manganese (Mn), relationships between the fecal contents of these minerals and the apparent digestibility (ADC) of P in dairy cows were determined. The study involved 10 commercial dairy farms in Manitoba, and 10 early and peak lactation, 10 mid lactation and 10 late lactation cows on each farm. Farms were visited once to collect diet, feed and fecal grab samples of individual cows. Feed, diet, and feces samples were analyzed by ICP for P and for the internal marker acid insoluble ash (AIA). Feces samples also were analyzed for Al, Fe, and Mn by ICP. Apparent digestibility coefficients (ADC) of P for individual cows were determined from the contents of P and AIA in the diet and the feces. Fecal Al contents of individual cows ranged from 2.7 to 36.8 ppm, with an average of 9.8 ppm (DM basis). Fecal Fe contents of individual cows ranged from 5.5 to 34.5 ppm, with an average of 11.6 ppm (DM basis). Fecal Mn contents of individual cows ranged from 0.6 to 5.6 ppm, with an average of 2.3 ppm (DM basis). These concentrations do fecal mineral contents do not indicate that the fecal Al, Fe, and Mn contents were excessive. The ADC of P ranged from 15.9 to 59.7% among individual cows with an average of 35.1%. The fecal Al and Fe contents were correlated ($r = 0.60$, $P < 0.0001$), but the fecal contents of Mn were not correlated with those of Al ($P = 0.91$) and Fe ($P = 0.65$). The regression equation between the ADC of P and the fecal contents of Al, Fe, and Mn (in ppm) determined by SAS Mixed Procedure was ADC P = 27.51(± 2.79, estimate + SE) + 1.18 (± 0.15) × Al – 1.11(± 0.19) × Fe +1.73(± 0.93) × Mn ($R^2 = 0.31$). This shows that, as expected, the increases in fecal Fe contents were associated with decreases in the ADC of P, but that for the fecal Al and Mn contents the opposite occurred. These discrepancies may be

the result of the confounding of these fecal contents with other factors that affect the ADC of P and variation in the form that the dietary Al, Fe, and Mn contents were in. Nevertheless, results suggest that at the levels observed in our study the fecal contents of Al, Fe, and Mn may affect the digestibility of P.

Key Words: aluminum, phosphorus, iron

704 Effects of feeding diets differing in dietary cation-anion difference (DCAD) and source of vitamin D on Ca status, health, and lactation performance in Holstein cows. N. Martinez*[1], R. Rodney[2], R. M. Santos[1], L. F. Greco[1], R. S. Bisinotto[1], E. S. Ribeiro[1], L. L. Hernandez[3], C. D. Nelson[1], E. Block[4], I. J. Lean[2], and J. E. P. Santos[1], *[1]University of Florida, Gainesville, FL, [2]SBScibus, Camden, NSW, Australia, [3]University of Wisconsin, Madison, WI, [4]Arm and Hammer Animal Nutrition, Princeton, NJ.*

Objectives were to evaluate the effects of feeding diets differing in DCAD (PD = +130 vs. ND = −130 mEq/kg) and source of vitamin D3 prepartum (CH; cholecalciferol vs. CA; calcidiol; both fed at 0.27 mg/kg of diet DM) on Ca status, health, and lactation performance in dairy cows during the transition period. Seventy-nine Holstein cows, 51 parous and 28 nulliparous, at 255 d gestation were blocked by parity, and randomly assigned to 1 of 4 dietary treatments arranged as a 2 × 2 factorial that were fed for the last 21 d prepartum. Dry matter intake (DMI) was measured from 21 d pre- to 42 d in milk (DIM). Prevalence of subclinical hypocalcemia (SCH) was evaluated in the first 3 DIM and defined as blood ionized Ca <1.06 m*M*. Incidence of diseases was monitored daily for the first 30 DIM. Milk yield and composition were recorded for the first 49 DIM. Data were analyzed using PROC MIXED and PROC GENMOD of SAS. Feeding CA compared with CH increased ($P < 0.01$) prepartum plasma concentrations of 25OH-D_3 (237.0 vs. 59.5 ± 6.4 ng/mL), 24,25$(OH)_2$-D_3 (19.2 vs. 1.6 ± 1.0 ng/mL), and 1,25$(OH)_2$-D_3 (55.3 vs. 48.4 ± 1.7 pg/mL), but decreased that of cholecalciferol (1.7 vs. 15.3 ± 0.5 ng/mL). Feeding ND increased prepartum concentration 1,25$(OH)_2D_3$ (57.2 vs. 46.9 ± 1.7 pg/mL). The ND diet reduced ($P < 0.01$) prepartum DMI in multiparous (11.5 vs. 13.7 ± 0.4 kg/d) but not in primiparous cows (11.3 vs. 11.0 ± 0.5 kg/d). Feeding the ND diet reduced ($P < 0.05$) the prevalence of SCH at 0 and 1 DIM (20.0% and 34.3%) compared with PD (69.3% and 76.5%). Incidence of clinical hypocalcemia (milk fever) was 0% in ND compared with 23.1% in PD cows ($P < 0.05$). Feeding CA compared with CH reduced ($P < 0.05$) the incidences of retained placenta (2.5 vs. 30.8%) and metritis (23.1 vs. 46.2%). Cows fed prepartum ND and CA had reduced ($P = 0.04$) morbidity compared with all other 3 treatments. Cows fed CA produced 3.70 ± 1.2 kg/d more ($P < 0.04$) 3.5% fat- and energy-corrected milk than those fed CH. The use of prepartum ND in combination with CA improved Ca status, health, and lactation performance in dairy cows.

Key Words: dairy cow, vitamin D, DCAD

705 Effects of the interaction between photoperiod and nutritional management on milk yield for dairy cows. Oswaldo S. Espinoza* and Masahito Oba, *University of Alberta, Edmonton, Alberta, Canada.*

The objective of this study was to evaluate the interaction effects of photoperiod management and nutritional management on milk production of lactating dairy cows. We hypothesized that feeding a high grain diet increases milk yield of cows exposed to long photoperiod to a greater extent compared with those exposed to short photoperiod. The study was conducted at a tie-stall barn with metal halide light fixtures. Thirty mid-lactating cows (109 ± 37 d in milk; mean ± SD) were exposed to long photoperiod (LP; 16 h/d light; n = 15) or short photoperiod (SP; 8 h/d light; n = 15). After 30 d of light adaptation, cows within each photoperiod treatment were fed 3 diets containing steam rolled barley grain at 15, 25 and 35% of dietary dry matter (LG, MG, and HG, respectively) in a 3 × 3 Latin square design. Dry matter intake was greater for cows fed the HG diet compared with those fed the LG diet (22.7 vs. 20.4 kg/d; $P < 0.001$) whereas it was not affected by photoperiod treatment. The interaction effects between photoperiod and dietary treatments were significant for yields of milk ($P = 0.03$), milk fat ($P < 0.01$), and milk protein ($P = 0.02$). Feeding the HG diet increased milk yield by 4.0 kg/d compared with the LG diet for cows exposed to SP treatment (30.5 vs. 26.5 kg/d, $P < 0.05$) whereas the increase was 2.2 kg/d for cows on the LP treatment (30.4 vs. 28.2 kg/d, $P < 0.05$). Likewise, the HG diet increased milk protein yield compared with the LG diet to a greater extent for cows on the SP treatment (1.03 vs. 0.84 kg/d, $P < 0.05$) than those on the LP treatment (0.99 vs. 0.90 kg/d, $P < 0.05$). However, dietary grain content did not affect milk fat yield for cows on the LP treatment while the HG diet increased milk fat yield compared with the LG diet for cows on the SP treatment (1.25 vs. 1.10 kg/d, $P < 0.05$). These results indicate that milk production responses to high grain diets may be greater for cows exposed to short photoperiod, and that dietary grain content can be reduced without negatively affecting milk fat yield if lactating dairy cows are exposed to long photoperiod.

Key Words: photoperiod, grain, interaction.