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311 Gastrointestinal morphology of preweaned dairy calves fed whole milk powder or a high-fat milk replacer. S. C. Mellors*, A. C. Welboren, J. Wilms, L. N. Leal, J. Martin-Tereso, and M. A. Steele

The objective of this study was to evaluate effects of feeding a milk replacer (MR) of similar macronutrient composition to bovine whole milk and whole milk powder on growth, health and gastrointestinal (GIT) morphology. Male Holstein calves (n = 18, 1–3 d of age) were individually housed and blocked by day of arrival and age. Calves were not offered any solids to control nutrient intake and were fed 3L (135g/L) 3 times daily of either: 1) whole milk powder (WM, 26.0% fat, 24.5% protein, 38.0% lactose, n = 9); or 2) high fat MR (HF, 25% fat, 22.5% protein, 38.1% lactose, n = 9). BW (BW) was measured weekly and feed intake was recorded daily. Calves were euthanized at d 28 to obtain organ weights and intestinal samples to assess GIT morphology via histological analysis. Data were analyzed in SAS software using repeated measures GLIMMIX for weekly measures and Proc MIXED was used for dissection data. Weekly intake of MR (WM = 8.5L vs. HF = 8.6L; SE = 0.16L; P = 0.3) and BW at the time of dissection (WM = 56kg vs HF = 55kg; SE = 1.8; P = 0.8) did not differ between treatments throughout the experiment. Similarly, feed efficiency and metabolizable energy (ME) intake by week did not differ between treatment groups. In foregut digestate compartments, rumen (498g vs. 365g; SE = 39.6; P = 0.02), reticulum (100g vs. 73g; SE = 7.9g; P = 0.04), and omasum (215g vs. 146g; SE = 17.6g; P = 0.02), weights were found to be greater in WM than HF, respectively. Weights of the duodenum and ileum were similar between treatment groups but jejunum weight was greater in WM compared with HF (1462g vs. 1172g; SE = 63.7g; P = < 0.0001). Surface area of the duodenum and ileum did not vary between treatment groups; however, surface area of distal jejunum tended to be greater in WM than HF (1.1 vs. 0.99; SE = 0.08; P = 0.1). In visceral organs, no differences were found, albeit spleen weight was higher in HF than WM (270g vs. 2737g; SE = 10.2g; P = 0.01). Overall, the results suggest that the composition, other than macronutrient composition, of the liquid diet may influence GIT morphology during the preweaning period without affecting growth or feed efficiency.

Key Words: growth, histology, macronutrient

312 Effect of residual feed intake on nutrient digestion and milk production of lactating Holstein cows fed high and low starch diets. X. Dai and K. F. Kalscheur, U.S. Dairy Forage Research Center, USDA-ARS, Madison, WI

The objective of this study was to evaluate whether the difference in nutrient digestion and milk production could be explained by residual feed intake (RFI) in lactating cows. A total of 62 lactating Holstein cows (137 ± 3.8 DIM) were fed either high starch (HS; 27% starch, 29% NDF) or low starch (LS; 13% starch, 37% NDF) diets. The crossover designed experiment consisted of 2 56-d treatment periods with 11-d diet adaptation. Residual feed intake (RFI) is defined as the difference between observed and expected metabolizable energy intake (MEI). High RFI cows ate more than expected and were less efficient. Cows were classified as 1 of the following: highest 10% RFI (HRFI), lowest 10% (LRFI) and medium RFI (MRFI; the remaining 80%). Greater DM and OM total-tract digestibility (P < 0.01), but lesser NDF and ADF total-tract digestibility (P < 0.01) was observed in cows fed HS diet compared with LS diet. Greater molar proportion of propionate (P < 0.01), valerate (P < 0.01) and isovalerate (P = 0.05) were found in HS-fed cows compared with LS-fed cows. Greater DMI (P < 0.01), MEI (P < 0.01), and milk yield (P < 0.01) were observed in HS-fed cows compared with LS-fed cows. Cows fed the HS diet resulted in greater milk protein concentration and lesser milk fat concentration compared with cows fed the LS diet. LRFI cows consumed 5 kg less DMI but produced 5 kg more milk compared with HRFI cows fed the HS diet. However, when cows were fed the LS diet, the LRFI cows had 6 kg less DMI and produced 5 kg less milk compared with HRFI cows. Meanwhile, LRFI cows had more BW loss when fed the HS diet but more BW gains when fed the LS diet. Decreased total-tract digestibility and lower total VFA production resulted when LRFI cows were fed the HS diet compared with HRFI cows fed the HS diet. Our results suggest that the difference in nutrient digestion and milk production across different RFI groups are dependent on dietary starch levels. Dietary impacts need to be considered when using RFI as a feed efficiency selection tool for lactating cows.

Key Words: residual feed intake, starch, cow

313 The effects of nutritional management in early lactation and dairy cow genotype on milk production and metabolic status. E. L. Brady, M. B. Lynch, K. M. Pierce, A. G. Fahey, and F. J. Mulligan, School of Veterinary Medicine, University College Dublin, Belfield, Dublin, Ireland, School of Agriculture and Food Science, University College Dublin, Belfield, Dublin, Ireland.

High levels of milk production coupled with low feed intake causes negative energy balance in early lactation, especially in the first month post calving. Therefore, specific nutritional management at this time may improve nutritional and metabolic status with the possibility of genotypes responding differently. Thus, the objective of this study was to compare the effects of contrasting nutritional management strategies and dairy cow genotypes on milk production and metabolic status during early lactation for grazing cows. Sixty Holstein-Friesian cows were blocked on calving date, previous 305-d milk yield, BCS and genotype. Cows of high fertility low milk (HFLM) and low fertility high milk (LFHM) genotype (based on the 2019 Economic Breeding Index evaluation, ICBF Ireland) were randomly assigned to 1 of 2 treatments in a 2 × 2 factorial, randomized complete block design. The dietary treatments were (1) allocation of 21 kg of DM of a tailored TMR (TMR, n = 30); (2) ad libitum access to fresh pasture plus an allowance of 3 kg of concentrates (G, n = 30). These diets were offered for the first 30 DIM. Post 30 DIM, TMR cows joined the G treatment and were managed similarly until 100 DIM. Blood samples were taken weekly in the first month after calving and BCS recorded every 2 wk. BCS and BCS loss were analyzed using PROC MIXED of SAS (9.4; 2012) and blood metabolites using repeated measure MIXED procedure of SAS (9.4; 2012). Feeding TMR for the first 30 DIM significantly improved the metabolic status as NEFA (−0.12 mmol/L, P < 0.001) and BHB (−0.10 mmol/L, P < 0.001) were lower compared with the G treatment. Overall, there was no significant differences in BCS when comparing TMR (2.92) vs. G (2.88, P = 0.49) cows. However, TMR cows had a lower BCS loss (−0.23) from calving until 60 DIM compared with G cows (−0.41, P < 0.01). Genotype did not have an influence on metabolic status. In conclusion, specific NM in the first month after calving improves metabolic status and significantly reduces BCS loss up to 60 DIM regardless of genotype.

Key Words: early lactation, nutritional management, genotype

314 Feeding behavior of lactating dairy cows fed switchgrass (Panicum virgatum) as a replacement for wheat straw in a total mixed ration. R. L. Nagle, B. R. Lemay, M. Thimmanagari, T. J. DeVries, and A. J. Carpenter, Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph, ON, Canada, CSA Animal Nutrition, Dayton, OH.

The objective of this study was to evaluate the feeding behavior of lactating dairy cows fed switchgrass (Panicum virgatum; SG) as a replacement for wheat straw (WS) in TMR. Two experiments (Exp) were performed where SG replaced WS in TMR for lactating Holstein cattle (n = 24; parity
= 2 ± 1.2; DIM = 162 ± 19.3 and 215 ± 21.3, for Exp 1 and 2, respectively). Each Exp consisted of 2 periods in a crossover design, with 11d of adaptation and 10d of sample collection. In Exp 1, either WS or SG were fed in the TMR at 1.8% of diet DM (starch = 22.1 ± 1.74% or 20.6 ± 2.02% of diet DM, respectively). Cows were fed higher starch rations in Exp 2, with either WS or SG in the TMR at 3.6% of diet DM (starch = 29.6 ± 1.54% or 27.6 ± 2.45% of diet DM, respectively). Intake was monitored with automated feeders to determine DMI (kg/d), time spent feeding (min/d), total meal time (min/d), meal length (min/meal), meal size (kg/meal), feeding rate (kg/min), meal frequency (meals/d), and the interval between meals (IMI; min/d). Data were analyzed using a mixed-effect linear regression model, with day as a repeated measure. Two cows were excluded from analysis in Exp 1 for health and stealing feed, and 2 cows were excluded from Exp 2 for stealing. In Exp 1, DMI was greater for cows fed SG (25.1 ± 0.69 vs. 24.22 ± 0.69 kg/d; *P* ≤ 0.01) as was meal frequency (8.8 ± 0.36 vs. 8.1 ± 0.36; *P* ≤ 0.01), but there was no effect on meal size (*P* = 0.11). Cows on the SG diet had a shorter meal length (37.3 ± 2.06 vs. 39.6 ± 2.05 min/meal; *P* = 0.02) and IMI (145.5 ± 6.80 vs. 163.1 ± 6.69 min/d; *P* ≤ 0.01). Feeding rate, time spent feeding, and total meal time were not affected (*P* ≥ 0.14). In Exp 2, DMI (25.0 ± 0.65 vs. 25.6 ± 0.65 kg/d; *P* = 0.02) and feeding rate (0.135 ± 0.0086 vs. 0.143 ± 0.0086 kg/min; *P* ≤ 0.01) were lesser for cows fed SG. Time spent feeding for cows fed SG was greater (208.3 ± 9.11 vs. 201.7 ± 9.13 min/d; *P* = 0.01), but meal frequency, size, length, total meal time, and IMI were not affected (*P* ≥ 0.56). In conclusion, feeding behavior was affected by inclusion of SG in TMR, however, the response varied depending on dietary starch level and inclusion of SG.

**Key Words:** switchgrass, feeding behavior, starch