Increasing the milking frequency of dairy cows to 4 times a day (4×) in early lactation increases milk yield both during the increased milking frequency (IMF) treatment and after the cows are returned to 2× milking. Modifications of this approach have been examined to maximize production and determine the most efficient practice for producers. The aim of this study was to investigate the effect of duration of early lactation IMF on milk yield (MY). Twenty-one primiparous and multiparous Holstein cows were assigned to have the right udder half milked 4× (0300, 0600 1500 and 1800) for 10, 20, or 40 d (n = 7), and the left udder half 2× (0300 and 0150). Udder-half milk yields were measured at 10, 20, 40, 60, 120, 150, 180, 210, 240, and 270 d of treatment, and yield differences per day between halves were calculated. Data were processed through the GLIMMIX procedure of SAS (SAS 9.4; SAS Institute, Inc., Cary NC). For 10-, 20-, and 40-d treatments, mean udder half differences (4× − 2×) through 270 d of treatment were calculated for MY (0.87, 1.75 and 4.09 kg), fat yield (13, 61, and 136 g) and protein yield (28, 52, and 117 g). Only the 40-d treatment differed from zero for each yield, including solids-nonfat, lactose, and somatic cell count (P < 0.05). Interactions of treatment by DIM and treatment by parity were not significant for udder half differences of any measures (P = 0.36). The MY difference was different from zero on d 20 for the 20-d treatment, and on d 10, 20, 40, 180, 210, 240 and 270 for the 40-d treatment (P < 0.05). Fat yield difference was different from zero on d 10 for the 20-d treatment and d 10, 20, 60, 120, 180, 210, 240 and 270 for the 40-d treatment (P < 0.05). Protein yield difference was different from zero on d 10 for the 10-d treatment, on d 20 for the 20-d treatment, and on d 10, 20, 40, 180, 210, 240, and 270 for the 40-d treatment. Overall, the 40-d treatment resulted in greater milk and component yields. Supported by Agriculture and Food Research Initiative Competitive Grant no. 2017–67015–26538 from the USDA NIFA and project 683 of the VA Agricultural Council.

**Key Words:** milking frequency, early lactation, milk yield
tion. In calves, supplemental butyrate had detrimental effects on serum IgG concentration, adversely affecting passive transfer of immunity.

**Key Words:** passive transfer, immunoglobulins, butyrate

136 Double-blind, block-randomized, placebo-controlled clinical trial on effectiveness of zinc supplementation on diarrhea and average daily gain in pre-weaned dairy calves. H. R. Feldmann*1, D. R. Williams1, J. D. Champagne1, T. W. Lehenbauer1,2, and S. S. Aly1,2, 1Veterinary Medicine Teaching and Research Center, School of Veterinary Medicine, University of California, Davis, Tulare, CA, 2Department of Population Health and Reproduction, School of Veterinary Medicine, University of California, Davis, CA.

The objective of this clinical trial was to evaluate the effectiveness of zinc supplementation on diarrhea and average daily weight gain (ADG) in pre-weaned dairy calves. A total of 1,482 healthy Holstein heifer and bull calves from a large California dairy were studied between December 2015 and June 2016. Each calf was enrolled at 24 to 48 h of age until exit from the hutches at approximately 90 d of age. Calves were block-randomized by time to 1 of 3 treatments: (1) placebo, (2) zinc methionine (ZM), or (3) zinc sulfate (ZS) administered in milk once daily for the first 14 d. Serum total protein at enrollment and body weight at birth, end of treatment, and hutch exit were obtained. Fecal consistency was assessed daily for 28 d post-enrollment. For a random sample of 127 calves, serum zinc concentrations before and after treatment and a fecal antigen ELISA at diarrhea start and resolution using a commercial kit (Pathasure Enteritis 4; Biovet, Quebec, Canada) for *Escherichia coli* K99, rotavirus, coronavirus, *Cryptosporidium parvum* were performed. Linear regression demonstrated that bull calves treated with ZM had 22g and 27g increased ADG compared with placebo-treated (*P = 0.042*) and ZS-treated bulls (*P = 0.014*), respectively. Conversely, ZM-treated heifers had 12g decreased ADG compared with placebo-treated heifers (*P = 0.019*). There were no other significant differences in ADG. Cox Proportional Hazard regression showed that ZM and ZS-treated calves had a 14.7% (*P = 0.015*) and 13.9% (*P = 0.022*) reduced hazard of diarrhea, respectively, compared with placebo-treated calves. Additionally, 8-d-old calves treated at least the first 5 d of diarrhea with ZM and ZS had a 15.6% (*P = 0.028*) and 8.4% (*P = 0.039*) increased hazard of clinical cure, respectively, compared with placebo-treated calves. Logistic regression showed that the odds of microbiological cure at diarrhea resolution for any single fecal pathogen was not different between treatments. The current trial showed a potential role of zinc supplementation for improved weight gain and diarrhea prevention in pre-weaned dairy calves with the need for further research on sex-specific or weight-based dosing.

**Key Words:** zinc, dairy calf, diarrhea


Serotonin (5-HT) is a monoamine that play a role in the regulation of energy balance through the modulation of glucose and lipid metabolism. Here, we examined whether manipulating 5-HT pathway by administering Fluoxetine (FLX, a 5-HT reuptake inhibitor) or 5 hydroxy-L-tryptophan (5-HTP, a 5-HT precursor), would impact hepatic glucose metabolism in pre-weaned dairy calves. Bull Holstein calves (21 ± 2 d old) were fed milk replacer (8 L/d) with saline (CON, 8 mL/d n = 8), FLX (40 mg/d, n = 8) or 5-HTP (90 mg/d, n = 8) for 10 consecutive d in a complete randomized block design. Blood samples were collected before (d-1), during treatment (d1–10) and after treatment withdrawal (d12, 13, 14, 16, 24) to measure glucose concentrations. Two subset of calves (n = 4/group) were euthanized on d10 or d24. Liver tissue was harvested to measure gene expression of 5-HT receptor 2 (5-HTR2A, 2B, 2C), 5-HT transporter (SERT), tryptophan hydroxylase (TPH1), glucose transporters (GLUT-1 to 12) and gluconeogenic enzymes (PDK4, PC, G6P) by real-time PCR. Data were analyzed using mixed models in SAS. Calves fed FLX and 5-HTP had higher circulating glucose compared with CON (110 and 105.5 vs 96 ± 3.8 mg/dl, respectively; *P < 0.001*). On d10, TPH1 tended to be downregulated in 5-HTP treatment (*P < 0.10*) and SERT was downregulated in both treatments compared with CON (*P < 0.01*). On d24, SERT and TPH1 were not different among treatments. On d10, 5-HTR-2A was and 2B tended to be upregulated in the 5-HTP treatment (*P < 0.09*) while 2C was downregulated in the FLX treatment compared with CON (*P < 0.02*). On d24, 5-HTR-2A and 2C were not expressed and 2B was not different among treatments. Gluconeogenic enzymes were not different among treatments on d10, but PDK4 was and G6P tended to be downregulated and PC was upregulated in 5-HTP treatment compared with CON (*P < 0.07*) on d24. On d10, glucose transporters were not different among treatments, while on d24 GLUT-9 tended to be upregulated in 5-HTP treatment and GLUT-12 was downregulated in both treatments compared with CON (*P < 0.09*). Feeding FLX and 5-HTP increased circulating glucose and altered hepatic expression of gluconeogenic enzymes in dairy calves.

**Key Words:** glucose, serotonin, calves