Physiology and Endocrinology

169 Physically effective neutral detergent fiber content modulates chewing activity, rumen fermentation, plasma metabolites, and performance. Y. Cao*1,2, X. Chen2, L. Wang2,3, and J. Yao2,1 Northwest A&F University, Yangling, Shaanxi, China,2Harvard Medical School, Boston, MA.

Subacute ruminal acidosis (SARA) continues to be a common and costly metabolic disorder in high-producing cows worldwide. To evaluate if increasing physically effective neutral detergent fiber (peNDF) in diet can prevent SARA in cows fed high concentrate diets. Thirty second-parity Holstein cows were randomly allocated to 3 treatment groups: H-peNDF8.0, M-peNDF8.0, and L-peNDF8.0 which were prepared by mixing the same total mixed ration for 10, 18, or 60 min, respectively. The peNDF intake was positively correlated with the peNDF contents in the diets. Total chewing and ruminating time was lower for the L-peNDF8.0 diet than for the H-peNDF8.0 and M-peNDF8.0 diets (P < 0.05). Rumen pH was higher in the H-peNDF8.0-fed cows than in the other 2 groups (P < 0.05). The H-peNDF8.0 and M-peNDF8.0 diets corresponded with higher acetate concentration, acetate:propionate ratio than the L-peNDF8.0 diet (P < 0.05), while H-peNDF8.0 and M-peNDF8.0 resulted in lower propionate and valerate concentrations than L-peNDF8.0 (P < 0.05). Lowering the peNDF content decreased the activities of ruminal carboxymethyl cellulase, avicelase, and β-glucanase (P < 0.05). H-peNDF8.0 resulted in lower total plasma antioxidant capacity, γ-glutamyl transpeptidase, albumin, and creatinine compared with M-peNDF8.0 and L-peNDF8.0 (P < 0.05). Somatic cell counts in milk were positively correlated with the dietary peNDF content. The feed and milk energy efficiencies were unaffected by the treatments. In conclusion, increasing the content of peNDF in diet could help alleviate SARA and improve animal health among early lactation cows fed a high concentrate diet by increasing peNDF intake, chewing activity, and rumen pH.

Key Words: physically effective NDF (peNDF), subacute ruminal acidosis (SARA), chewing activity

170 Hepatic lipid-associated protein abundances vary by day relative to calving and are associated with hepatic triglyceride content in transition dairy cows. H. T. HoldorPer, R. S. Pralle, S. J. Erb, and H. M. White, University of Wisconsin-Madison, Madison, WI.

The objectives of this study were to determine protein abundance of hepatic lipid-associated proteins (HLAP) in liver homogenates and interroscopy samples during early lactation (LVTG) content. Multiparous Holstein cows (n = 25) were blocked by expected calving date and randomly assigned to control or a fatty liver induction (FLI) treatment (TRT). Liver samples were collected via biopsy at −28, −14, +1, +14, +28, +42, and +56 d relative to calving (DRTC). Content of LVTG was determined and expressed on a % dry matter basis. Western blotting was used to analyze the abundance of LHT: abhydrolase domain containing 5 (ABHD5), hormone sensitive lipase (HSL), phosphorylated HSL (PHSIL), adipose triglyceride lipase (ATGL), perilipin 1 (PLIN) and phosphorylated PLIN (PPLIN). Data was analyzed using PROC MIXED in SAS 9.4. Evidence was considered significant if P ≤ 0.05, and a tendency if 0.05 < P ≤ 0.1. When P ≤ 0.1 for the main effects, means were separated by Bonferroni adjustment and presented as least squares means ± SEM with comparison P-values. No evidence was observed for effects of TRT or TRT × DRTC (P > 0.1) on LVTG content or HAP abundance. Mean LVTG content was greater (P < 0.05) postpartum compared with prepartum and peaked at +14 DRTC (P < 0.0004). Greater ATGL abundance was observed (P < 0.04) at +14 and +28 DRTC (μ = 1.89 ± 0.02 arbitrary units [AU]) compared with +1 (1.83 ± 0.03 AU) DRTC. Abundance of PLIN tended to be greater (P = 0.08) at +14 (0.79 ± 0.02 AU) compared with +1 DRTC (0.72 ± 0.03 AU). Conversely, PPLIN was decreased (P = 0.003) at +1, +14, +28, and +42 (μ = 1.67 ± 0.02 AU) compared with −14 DRTC (1.74 ± 0.01 AU). As linear regressors, PPLIN predicted (P = 0.05; β = −0.44) and ATGL tended to predict (P = 0.09; β = −0.33) LVTG content across all DRTC. Variation in HAP abundance by DRTC and their associations with LVTG suggest a potential role in the accumulation and subsequent remobilization of LVTG. The impact of coordinated regulation of HAP on the etiology of fatty liver onset and recovery peripartum warrants further exploration.

Key Words: lipase, fatty liver, peripartum


Following parturition cows experience an increased starch load to the large intestine, and we hypothesize that the negative consequences of hindgut acidosis are exacerbated by prior periparturient immunoinactivation. Therefore, objectives were to evaluate the effects of hindgut acidosis on metabolism and inflammation in cows previously infused i.v. with lipopolysaccharide (LPS). Twelve rumen cannulated cows were enrolled in a study with 3 experimental periods (P). Baseline data were collected during P1 (5d). Beginning on d1 of P2 (2d), all cows received an i.v. LPS bolus (0.2 μg LPS/kg BW). During P3 (4d), cows were randomly assigned to 1 of 2 abomasal infusion treatments: 1) control (LPSCON; 1.5 L H2O/infusion; n = 6) or 2) starch infused (LPSST; 1 kg corn starch + 1.5 L H2O/infusion; n = 6) 4 times daily. Additionally, both treatments received an LPS bolus on d1 and 3 of P3 (0.8 and 1.6 μg LPS/kg BW, respectively). Effects of treatment, time, and treatment × time were assessed using PROC MIXED. During P3, starch infusion markedly decreased fecal pH relative to controls (0.82 pH units; P < 0.01). Relative to P1, administering LPS decreased production metrics during both periods, and the most pronounced effects were observed on d1 of P2 and d1 and 3 of P3 for milk yield (54, 45, and 37%) and DMI (49, 43, and 40%) respectively (all P < 0.01); however, starch infusion did not exacerbate effects of LPS on either parameter. Regardless of starch infusion, administering LPS markedly altered milk components and somatic cell counts. During P3, hindgut acidosis had no effect on circulating glucose, insulin, NEFA, or BHBA (P > 0.35), but decreased BUN (17%; P = 0.07) relative to LPSCON cows. Relative to P1, LPS administration markedly increased SAA and LBP during P2 (3.3-fold and 51%) and P3 (2.7-fold and 48%; all P < 0.01), however there were no additional effects of starch administration during P3 on acute phase proteins. By design, LPS administration initiated marked changes in metabolism and inflammation, however, hindgut acidosis did not exacerbate the inflammatory response.

Key Words: inflammation, starch infusion, LPS


Cows experience an increased starch load to the large intestine following parturition, and we hypothesize that the negative consequences of hindgut acidosis (HGA) may be exacerbated by prior periparturient stressors (i.e., reduced feed intake, inflammation). Therefore, objectives were to evaluate the effects of HGA on metabolism and inflammatory biomarkers in feed restricted (FR) cows. Twelve rumen cannulated cows were enrolled in a study with 3 experimental periods (P). During P1 (5d), baseline data were collected. During P2 (2d), all cows were FR to 40% of their ad libitum P1 feed intake. During P3 (4d) cows remained FR and were randomly assigned to 1 of 2 abomasal infusion treatments: 1) control (FRCON; 1.5 L H2O/infusion; n = 6) or 2) starch (FRST; 1 kg corn starch +
1.5 L H2O/infusion; n = 6). Respective treatments were infused 4 × daily. Effects of treatment, time, and treatment × time were assessed using PROC MIXED. Starch infusions markedly decreased fecal pH relative to FRCON during P3 (0.96 pH units; \( P < 0.01 \)). By design, DMI decreased 60% relative to baseline for both treatments during P2 and P3 (\( P < 0.01 \)). Milk yield was markedly decreased by FR during P2 and 3 relative to P1 (39%; \( P < 0.01 \)), but was unaffected by HGA (\( P > 0.91 \)). Feed restriction altered milk components and variables differently over time with no effect of HGA except on MUN, which decreased (28%; \( P = 0.01 \)) relative to FRCON during P3. Feed restriction increased NEFA and decreased circulating glucose and insulin for both periods and the most pronounced differences were observed during P2 (3.6-fold, 13 and 74%, respectively; \( P < 0.01 \)). Starch infusion did not influence circulating NEFA, glucose, and insulin patterns during FR. Relative to FRCON, BHBA concentrations increased (55%; \( P = 0.04 \)) in FRST cows during P3. Over time, FR decreased BUN for both treatments but starch infusions further exacerbated this response during P3 as BUN levels decreased (31%; \( P = 0.03 \)) relative to FRCON. No effects of FR or HGA were observed for SAA and LBP. By design, FR caused marked alterations in metabolism, however, no effects of FR or FR in combination with HGA were observed on inflammation.

Key Words: inflammation, starch infusion

173 Prepartum light shifting circadian rhythm disruption did not affect amount of muscle and adipose mobilized in transition dairy cows. C. J. McCabe*, A. Suarez-Trujillo, T. M. Casey, and J. P. Boerman, Purdue University, Department of Animal Sciences, West Lafayette, IN.

Circadian clocks function to maintain homeostasis by coordinating internal physiology to the external environment through the generation of 24 h rhythms. Circadian clocks are integrated with the metabolic system and disruption of clocks by altering timing of external cues affects metabolism, with long-term disruption associated with development of diseases in humans and rodents. During the periparturient period, dairy cattle are often in a negative energy balance and accommodate for nutrient gaps by mobilizing stores from adipose and muscle. The objective of this study was to determine the effect of exposure to chronic light-dark cycle phase shifts during the nonlactating prepartum period on tissue mobilization postpartum. Multiparous Holstein cows (\( n = 16 \)) were exposed to 16 h of light and 8 h of dark (CON; \( n = 8 \)) or phase shifting (PS; \( n = 8 \)) of the start of the light cycle forward 6 h every 3 d beginning 35 d before expected calving (BEC). Following calving both treatments were exposed to control lighting through 60 DIM. Longissimus dorsi and backfat ultrasounds measured muscle and backfat depth at 35, 21, and 7 BEC and 0, 10, 21, 30, and 60 DIM. Cows lost muscle mass from 35 d BEC to 60 DIM (4.02 vs. 3.01 cm; \( P < 0.01 \)), with no differences between treatments (\( P > 0.05 \)). Muscle depth at 35 d BEC positively correlated to the amount of muscle mobilized over the study (\( P = 0.002; R^2 = 0.50 \)). Backfat depth was less between 35 d BEC and 30 and 60 DIM (\( P < 0.05 \)). Creatinine, 3-methylhistidine, and NEFA, measured in plasma samples taken on ultrasound dates and 28, 14 d BEC and 7, 14 DIM as indicators of total muscle mass, and muscle and adipose mobilized, respectively, were not different between treatment (\( P > 0.05 \)), but NEFA increased and creatinine decreased for all cows between pre and postpartum periods (\( P < 0.01 \)). In this study, circadian clock disruptions in the prepartum did not affect the quantity of tissue mobilized nor blood metabolites during the dairy cow periparturient period.

Key Words: circadian rhythm, ultrasound, tissue mobilization


Study objectives were to evaluate if antioxidant supplementation (AP; AGRADO Plus 2.0; Novus International, St. Charles, Missouri) affects metabolism and inflammatory biomarkers in hyperthermic lactating dairy cows. Thirty-two cows were randomly assigned to 1 of 4 dietary-environmental treatments: 1) thermoneutral (TN) conditions and control (TN-CON; \( n = 8 \)), 2) TN conditions and AP (TNAP; \( n = 8 \)), 3) heat stress (HS) and control (HSCON; \( n = 8 \)), or 4) HS and AP (HSAP; \( n = 8 \)). Before study initiation, cows were fed their respective diets for 30 d and dietary treatments were top-dressed once daily. The trial consisted of 2 experimental periods (P); during P1 (4d) baseline data were collected. During P2 (7d) HS was artificially induced using an electric heat blanket (Thermodex Therapy Systems Ltd., Calgary, Canada). Effects of treatment, day, and treatment × day interaction were assessed using PROC MIXED. HS increased (\( P < 0.01 \)) rectal, vaginal, and skin temperatures relative to TN controls and the largest differences were detected on d3–7 (1.2, 1.1, and 1.9°C, respectfully). On d2 of HS, AP supplementation decreased respiratory rate (15%; \( P = 0.01 \)) relative to HSCON. As expected, HS decreased (\( P < 0.01 \)) milk yield and DMI during P2 and this was most pronounced on d4–7 (28, and 33%, relative to TN). Feed efficiency was increased by AP supplementation on d4–7 of HS relative to HSCON (15%; \( P = 0.06 \)). DMI from HSAP cows tended to be decreased relative to HSCON cows during P2 (10%; \( P = 0.06 \)). Circulating insulin and NEFA did not differ across environmental treatments, however, AP supplementation decreased insulin (37%; \( P = 0.01 \)) and increased NEFA (68%; \( P = 0.03 \)) during HS relative to HSCON cows. HS decreased circulating glucagon (26%; \( P < 0.01 \)) relative to TN cows. Throughout P2, BUN from HS cows increased (21%; \( P = 0.01 \)) relative to TN, and on d3 AP supplementation decreased BUN relative to HS controls (15%; \( P < 0.01 \)). HS increased SAA and LBP relative to TN cows (78 and 59%, \( P = 0.08 \) and < 0.01) but neither variable was influenced by AP. Overall, AP supplementation appeared to alter metabolism but not inflammation during heat stress.

Key Words: heat stress, antioxidant, inflammation