
Objectives of this experiment were to determine the length of exposure to an acidic diet (ACD) to elicit an increased response to parathyroid hormone (PTH)-induced changes in blood Ca in prepartum cows. The hypothesis was that cows have increased PTH responsiveness within 3 d of feeding an ACD. Ten parous Holstein cows at 242 ± 7 d of gestation were blocked by lactation (1 or > 1) and pretreatment DMI and, within block, were assigned randomly to an alkalogenic (ALKD; DCAD = +209 mEq/kg DM; n = 5) or an ACD (DCAD = −168 mEq/kg DM; n = 5) on experiment d 0. Water and DMI were measured and blood sampled daily. Urine was sampled every 3 h for 36 h and then daily. The PTH challenges were performed on d 3, 8, and 13. Cows received 0.05 mg PTH/kg BW i.v. every 20 min for 9 h to mimic the pulsatile release of endogenous PTH. Jugular blood was sampled at 0 h, and hourly thereafter until 10 h, and at 12, 18, 24, 36, and 48 h relative to the challenge. Blood acid-base measures and concentrations of ionized Ca (iCa) were evaluated. Results were available for the first challenge on d 3 and data were analyzed by ANOVA with mixed models with SAS. Cows fed ACD had lower (P < 0.01) blood pH (7.382 vs. 7.429 ± 0.005), base excess (−2.4 vs. 4.3 ± 0.5 mM), and bicarbonate (22.8 vs. 28.5 ± 0.4 mM) within 24 h of the experiment compared with cows fed ALKD. Urine pH decreased (P < 0.01) by 15 h of feeding ACD (7.32 vs. 7.818 ± 0.17), and differences increased by 24 h (6.46 vs. 8.10 ± 0.17). Blood iCa increased (P < 0.01) in ACD compared with ALKD by d3 (1.28 vs. 1.22 ± 0.01 mM). During the PTH challenge on d3, cows fed ACD had a higher (P < 0.01) concentration of blood iCa than cows fed ALKD (1.42 vs. 1.33 ± 0.01 mM). Nevertheless, the increment in iCa in the first 36 h after the challenge, relative to baseline at 0 h, did not differ between treatments (ACD = 0.16 vs. ALKD = 0.15 ± 0.01 mM). Diet-induced metabolic acidosis occurred within 24 h of treatment; however, an increase in blood iCa concentration was observed after 3 d of metabolic acidosis. Blood iCa response to a PTH challenge did not differ between treatments on experiment d 3.

Key Words: parathyroid hormone, dietary cation-anion difference (DCAD), calcium


The objective was to determine if supplementing a methionine (Met) derivative, N-acetyl-l-Met (NALM; CJ CheilJedang, Seoul, South Korea) would affect nitrogen (N) metabolism and improve N efficiency in lactating dairy cows. Sixty multiparous Holstein dairy cows in early lactation (27 ± 4.3 DIM) were assigned to 4 treatments in a randomized complete block design. Cows were blocked by actual milk yield and calving date. Treatments were: (1) Control (no NALM); (2) 15 g/d NALM (15NALM); (3) 30 g/d NALM (30NALM); and (4) 45 g/d NALM (45NALM). The NALM product contained 78% Met with 99.5% purity and based on bioavailability values provided from manufacturer, adding 15, 30, and 45 g/d as top-dress on corresponding experimental diets provided 8, 16, and 24 g/d of metabolizable Met, respectively. Diets were formulated to meet nutritional requirements of lactating dairy cows producing 42 kg/d and to under supply metabolizable Met (~8 g/d; Control) or provide adequate (15NALM), or excess (~8 g/d with 30 NALM; ~16 g/d with 45 NALM) metabolizable Met. Samples (fees, urine, blood, rumen fluid, and milk) were collected during the covariate period (2 wk), and at wk 4, 8, 16, and 24 of the treatment period. Data were analyzed using GLIMMIX procedure of SAS using covariates for N intake, fecal-N, urine-N, blood urea nitrogen (BUN), milk urea nitrogen (MUN), ammonia-N (NH3-N) and N efficiency. Contrast statements were included to test linear and quadratic effects of NALM along with Control versus all NALM treatments. Intake of N (P = 0.40) and N loss in fees (P = 0.79), and urine (P = 0.50) and ruminal NH3-N concentration (P = 0.57) were not affected by NALM supplementation, compared with Control. The efficiency of N utilization, measured as conversion of intake N into milk protein, was quadratically (P = 0.03) improved with NALM. No effect was observed on MUN concentration; however, BUN levels were linearly (P < 0.01) and quadratically (P < 0.01) reduced with NALM supplementation. In summary, NALM supplementation improved efficiency of N utilization and decreased BUN concentration.

Key Words: dairy cow, N-acetyl-l-methionine (NALM), nitrogen metabolism


Rumen-protected choline (RPC) supplementation may increase hepatic phosphatidylcholine (PC) synthesis to promote triglyceride (TG) secretion within very-low density proteins. To assess whether RPC enhances lipoprotein PC and TG levels in dairy cows, 41 pregnant, nonlactating, multiparous Holstein cows were fed a RPC (ReaShure, Balchem Corp., New Hampton, NY) that provided 0 (control), 6.5, 12.9, 19.4, and 25.8 g/d of choline ions, respectively. Diets were fed to exceed nutrient requirements for 5 d, then cows were restricted to consume ~31% of their net energy requirements for 9 d. Preprandial plasma and liver were collected on d 9 of feed restriction. Plasma TG-rich and low-density lipoprotein (LDL) fractions were isolated using liquid chromatography. Lipoprotein fraction total TG, cholesterol and phospholipids were quantified. Lipoprotein fractions and liver were processed for lipidomics. Statistical analyses were done using the Mixed procedure of SAS. Birth weight of the calves and number of days prepartum at enrollment were covariates. Normalized omic data were natural log-transformed. A significant linear increase (P < 0.01) in TG-rich lipoprotein total TG levels was observed with choline ion supplementation. Likewise, RPC linearly increased TG levels within LDL fractions (P < 0.02). Total LDL fraction phospholipids tended to be modified by treatment (quadratic, P = 0.09). The majority of PC within the TG-rich lipoprotein fraction increased linearly with increasing RPC (40 PC out of 45 PC detected; J. Dairy Sci. Vol. 102, Suppl. 1
e.g., PC 38:5; P < 0.01). A similar linear outcome was observed for select TG-rich lipoprotein TG (168 TG out of 317 TG detected; P < 0.05). In LDL, RPC increased majority of PC detected (control vs. RPC [all levels], P < 0.05); however, TG was not overtly modified. In liver, RPC increased a limited number of PC (<15% detected; control vs. RPC, P < 0.05). Hepatic total TG was lowered by RPC (17.5 vs. 13.6% of tissue DM; control vs. RPC, P < 0.05). We conclude that RPC increased lipoprotein PC and TG concentrations, and reduced hepatic TG deposition in dairy cows.

Key Words: choline, liver, phosphatidylcholine

M23  Amino acid composition of cattle tissue and milk, and various feeds used in ruminant diets using multiple hydrolysis times. A. F. Ortega*, D. A. Ross, and M. E. Van Amburgh, Cornell University, Ithaca, NY.

Nutrition models have improved in terms of predicting AA requirements and their supply for diet formulation. However, data have demonstrated the essential AA (EAA) content of feeds or animal products are not adequately described using 24 h hydrolysis time. Thus, the objective was to evaluate the EAA content of milk, tissues, and feeds after multiple hydrolysis times, from 2 h to 168 h, and determine a correction factor for each AA. Twenty-six feeds were chosen, as well as 6 tissue samples representing whole body composition of Holstein heifers from serial harvest studies. The milk sample was pooled from 4 bulk tank samples over 3 d from the Cornell University Dairy. Feed samples were analyzed for all EAA by HPLC following acid hydrolysis at 110°C in a block heater for 2, 4, 6, 12, 18, 21, 24, 30, 48, 72, 120 and 168h. Performic acid pre-oxidation was conducted for the sulfur AA and barium hydroxide was used for Trp hydrolysis. Tissues and milk were analyzed for 21, 72 and 168 h using the same methods. A least-squares nonlinear regression was used to determine the true AA content of the samples and significance declared at P < 0.05. The EAA of feeds, milk, and tissues continued to increase after 24 h and overall, had the greatest EAA concentration after 168 h hydrolysis (P < 0.05). The branched chain AA (BCAA) for most feeds, and all milk and tissue samples increased from 24 h to 168 h hydrolysis (P < 0.05). Lys increased in concentration up to 168 h for most feeds (P < 0.05) but decreased in milk after 72 h and tissue after 21 h (P < 0.002). Two ratios, A0/24h and Max/24h, were determined and compared among sources to be used as correction factors for the 24 h hydrolysis. The A0 is the AA concentration at 0 h of hydrolysis and Max being the maximal concentration of AA. The ratios for BCAA vary among sources of EAA and different ratios should be determined for each source to have an accurate correction factor. In summary, a single time point hydrolysis is not an accurate representation of the EAA concentration of a substrate and correction factors could be used to determine the actual EAA content by substrate.

Key Words: amino acid, hydrolysis, correction factor


Our goal was to determine the importance of including body weight (BW) loss in assessing the response of cows to low protein diets. 169 Holstein cows in mid-lactation (92 primiparous) and 69 in late lactation (42 primiparous) were fed diets high or low in protein in crossover designs with 2 28-d treatment periods. Mid-lactation diets were 18% or 14% CP, and late-lactation diets were 16% or 12% CP. All diets had adequate RDP with expeller soybean meal added for high protein diets. Cows were milked 2×/d; intake and milk yield were recorded daily. Milk composition was measured 2 d/wk, and BW was measured 3d/wk. Historical prices of corn and soybean meal, milk class and component prices, and culcow values were used to set financial parameters. Captured energy, captured protein, and gross income from milk production and BW change were calculated for each cow in each diet. Protein responses within each lactation stage were analyzed with the MIXED Procedure (SAS 9.4), including fixed effects of experiment, diet, parity, and period nested within experiment, and random effect of cow nested within experiment and parity. In mid lactation, reducing protein from 18 to 14% saved $0.73 per cow in daily feed cost but resulted in daily losses of: 1) 2.9 Mcal milk energy and 1.8 Mcal body energy; 2) 0.14 kg milk protein and 0.03 kg body protein, and 3) $1.40 milk income and $0.29 body salvage value (all P < 0.05), so that 38% of the total energy loss, 18% of total protein loss, 17% of gross income loss, and 24% of income over feed cost (IOFC) loss were due to BW loss. In late lactation, reducing protein from 16 to 12% saved $0.60 in daily feed cost but resulted in daily losses of: 1) 2.3 Mcal milk energy and 2.2 Mcal body energy; 2) 0.11 kg milk protein and 0.05 kg body protein, and 3) $1.07 milk income and $0.38 body salvage value (all P < 0.05), so that 50% of total energy loss, 31% of total protein loss, 26% of gross income loss, and 45% of IOFC loss were due to BW loss. In addition, the importance of BW loss was greater for primiparous than multiparous cows. In conclusion, BW loss was an important part of the response to low protein, and we suggest that it should not be neglected when assessing responses to dietary protein.

Key Words: protein reduction, milk response, body weight loss


Citral (OO), a component of orange oils, has bacteriostatic and bactericidal properties against isolated mastitis pathogen Escherichia coli P4 at relatively low concentrations that do not interfere with the cow’s cellular immune response in vitro. The objective of this study was to evaluate the effectiveness of OO as an intramammary therapy for experimentally induced E. coli mastitis. One rear quarter from 18 healthy, multiparous mid-lactation dairy cows was inoculated with ~800 cfu of E. coli P4. Infections were established in all inoculated quarters. One of 3 intramammary treatments were administered into the infected quarter at 24 h post-infection for 4 consecutive days (6 cows/treatment). Treatments were 1% vol/vol OO twice daily, cefiofur hydrochloride once daily, and sterile phosphate buffer solution twice daily. Foremilk from the infected quarter was aseptically sampled twice daily before milking (0700 and 1600 h) and coccygeal blood was sampled once daily through d 7 post inoculation and weekly through d 35 post inoculation. Health examinations were performed before blood sampling, and milk production and feed intake were recorded daily. Results were analyzed by ANOVA using the MIXED procedure of SAS 9.4 with treatment, time and treatment by time interaction declared as fixed effects and cow declared as a random effect. Milk E. coli cfu/mL was log10 transformed and not affected by treatment or treatment across time (P > 0.05). Treatments did not affect peak bacteria concentrations in milk (P > 0.05). Somatic cell count (P = 0.03) differed across time by treatment as OO lowered somatic cell count on d 2.5 and 3.5 following inoculation as compared with the antibiotic and control treatments. Somatic cell score, clinical score, health parameters, total daily milk production and daily dry matter intake were not affected by treatment or treatment across time (P > 0.05). In summary, OO did not alter production parameters or health of E. coli.
mastitis-induced cows; however, the anti-inflammatory effects of OO may be useful to reduce the severity of the infection.

Key Words: mastitis, Escherichia coli, alternative therapy

M26 Starch content of the close-up dry cow diet can affect insulin sensitivity of newborn dairy calves early in life. J. Haisan1, Y. Inabu1, W. Shi2, and M. Oba1, 1Department of Agricultural Food and Nutritional Science, University of Alberta, Edmonton, AB, Canada, 2The Research Center for Animal Science, Graduate School of Biosphere Science, Hiroshima University, Higashi-Hiroshima, Japan.

The objective of this study was to determine the effect of starch content in the close-up diet on insulin sensitivity of female calves early in life. Thirty-eight female Holstein heifer calves were born to dams fed either a high (26% starch; HI; n = 20) or moderate (14% starch; MOD; n = 18) starch close-up diet commencing at 28 d before expected calving date. Following birth, calves were removed from the dam within 2 h, and fed 3 2-L meals of colostrum within the first 24 h of life. Calves were housed individually and offered 10 L/d of milk replacer (26% CP, 18% fat mixed to 130 g/L) fed through a Calf Rail feeding system. There was no difference in birth body weight of calves between HI or MOD. A glucose tolerance test (GTT) was performed a minimum of 6 h after their last colostrum, or milk meal on d 2, d 10 ± 2 and d 20 ± 2. The GTT involved an intravenous infusion of glucose at a dose of 180 mg/kg BW via a jugular catheter, with sequential blood sampling for 90 min after the infusion, and samples were analyzed for plasma glucose and insulin concentrations. Data were analyzed using the FIT model of JMP and included the fixed effects of dam treatment, parity and their interaction. There was no difference in basal concentrations of glucose before the GTT at d 2, 10 or 20, and no difference in basal insulin at d 2 or 10, however, at d 20, HI calves had increased basal concentrations of insulin as compared with MOD (3.04 vs. 1.92 ng/mL; P = 0.05). On d 2, HI calves had greater maximum insulin concentrations (11.1 vs. 6.55 ng/mL; P = 0.02) and greater area under the curve for insulin (17.2 vs. 10.8 ng/mL × min; P = 0.03) following the glucose infusion, but during the GTT, with no difference in glucose response. On d 10 HI calves had reduced insulin sensitivity (8.51 vs. 14.3 mg/min × ng/mL; P = 0.03) and tended to have reduced glucose clearance rates, and on d 20, HI calves tended to have higher maximum insulin concentration following the glucose infusion as compared with MOD. These findings suggest that feeding a HI close-up diet may reduce insulin sensitivity of female offspring early in life.

Key Words: close-up diet, insulin sensitivity, newborn calf

M27 Withdrawn

M28 αS1-Casein (CSN1S1) suppresses β-casein expression via JAK2/STAT5a signaling pathway in goat mammary epithelial cells. N. Song* and J. Luo, College of Animal Science and Technology, Northwest A&F University, Yangling, Shaanxi, China.

αS1-Casein, encoded by the CSN1S1 gene, is one of the main milk proteins, which can provide amino acids and other nutrients for the bodies, nevertheless, it can also lead to human allergy. However, the effects of CSN1S1 on other milk proteins in goat mammary epithelial cells (GMEC) remain unknown. To explore the regulatory mechanism of CSN1S1 on major milk proteins, CSN1S1 overexpression adenovirus and small interference RNA targeting CSN1S2 were designed and transfected into GMEC, respectively. GMEC were incubated with treatments for 48 h, and then total RNA and protein of cells were isolated. The mRNA levels and protein levels of caseins (CSN1S1, CSN1S2, CSN2, CSN3), major whey proteins (LALBA, BLG), proteins of Janus kinase 2/ signal transducer and activator of transcription 5a (JAK2/STAT5a) signaling pathway (JAK2, STAT5a, SOCS3, ELF5, PRLR) were detected by RT-qPCR and Western blotting, and analyzed with Student’s t-tests. Results showed that overexpressing CSN1S1 decreased the β-casein mRNA and protein abundance, as expected, CSN1S1 silencing resulted in a significant increase in β-casein (P < 0.05). However, CSN1S1 did not alter the expression of CSN2, CSN3, LALBA, BLG (P > 0.05). Previous studies have shown that JAK2/STAT5a signaling promotes β-casein transcription and synthesis in ruminants, which implied the possibly involvement of JAK2/STAT5a signaling pathway in CSN1S1 regulating β-casein metabolism. We observed that overexpression of CSN1S1 induced reductions of JAK2 and STAT5a mRNA level, as well as STAT5a phosphorylation level (P < 0.05). Similarly, knock-down of CSN1S1 upregulated the mRNA level of JAK2 and STAT5a, also increased phosphorylation abundance of STAT5a (P < 0.05). In conclusion, our findings indicated the regulatory role of CSN1S1 on β-casein through JAK2/STAT5a signaling pathway in goat mammary epithelial cells.

Key Words: αS1-casein, β-casein, JAK2/STAT5a signaling pathway

M29 Effects of feeding moderate- or high-starch close-up diet to cows on response of newborn calves to intravenous injection of glucagon-like peptide 1. Y. Inabu1, J. Haisan2, M. Oba2, and T. Sugino1, 1Department of Biosourse Science, Graduate School of Biosphere Science, Hiroshima University, Higashi-Hiroshima, Japan, 2Department of Agricultural Food and Nutritional Science, University of Alberta, Edmonton, AB, Canada.

The objective of this study was to evaluate the effects of feeding moderate- or high-starch close-up diet to close-up cows on response of newborn calves to intravenously (i.v.) injected glucagon-like peptide 1 (GLP-1). Holstein heifer calves (n = 37) born to cows fed a moderate- (M, 14% starch; n = 17) or high-starch (H, 26% starch; n = 20) diet during the last 28 d of gestation were assigned to one of 2 treatment groups, which were i.v. injected with saline as control (MC and HC, n = 9 and 10, respectively) or GLP-1 solution (MG and HG, n = 8 and 10, respectively) immediately after milk replacer (MR) feeding finished (within 5 s after MR feeding finished) at 2, 10, and 20 d after birth. Blood samples were collected at 190, 10, 20, 30, 40, 50, 60, 90, and 120 min relative to treatment injection and plasma glucose, insulin, and GLP-1 concentrations were measured. Data were analyzed by ANOVA using fit model procedure of JMP® 14 pro (SAS Institute Inc., Cary, NC). Plasma GLP-1 concentration increased rapidly after GLP-1 injection and was higher for the calves injected with GLP-1 than those injected with saline (P < 0.01) at 2 (1.97 vs 1.02 ng/mL for G and C, respectively), 10 (2.10 vs 0.67 ng/mL for G and C, respectively) and 20 d after birth (1.79 vs 0.38 ng/mL for G and C, respectively), but no difference was observed between MG and HG at all sampling days. Both in M and H calves, the rise in postprandial plasma glucose concentration was suppressed (P < 0.01) by direct glucose-lowering action of i.v. injected GLP-1 at 10 (137 vs 150 mg/dL for G and C, respectively) and 20 d after birth (147 vs 158 mg/dL for G and C, respectively), and similar tendency was observed at 2 d after birth (133 vs 144 mg/dL for G and C, respectively; P = 0.09); this direct glucose-lowering action by GLP-1 was greater (P = 0.02) for H than for M calves at 20 d after birth (141 vs 152 mg/dL for HG and MG, respectively). These results indicate that feeding a high-starch diet to cows in close-up period enhances glucose-lowering
action by GLP-1 after feeding depending on age of calves, which can affect glucose status in newborn calves.

Key Words: heifer calf, glucagon-like peptide 1, prepartum diet

M30 Effects of recent and ancient inbreeding on performance of Dutch Holstein Friesian dairy cattle. H. P. Doekes*1,2, R. F. Veerkamp3, P. Bijma3, S. J. Hiemstra4, G. de Jong1, and J. J. Windig1,2, 1Animal Breeding and Genomics, Wageningen University & Research, Wageningen, the Netherlands, 2Centre for Genetic Resources the Netherlands, Wageningen University & Research, Wageningen, the Netherlands, 3Cooperation CRV, Arnhem, the Netherlands.

Inbreeding decreases animal performance (inbreeding depression), but not all inbreeding is expected to be equally harmful. Inbreeding on recent ancestors is expected to be more harmful than inbreeding on more ancient ancestors, because of purging. Purging is the removal of deleterious recessive alleles over time by selection. We investigated inbreeding depression in Dutch Holstein Friesian cattle, expecting to find stronger effects of recent inbreeding compared with ancient inbreeding. The effect of inbreeding on yield, fertility and udder health traits was determined with linear mixed models using 38,792 first-parity cows. Pedigree data were used to compute traditional inbreeding ($F_{PED}$) and 75k genotype data were used to identify regions of homozygosity (ROH) and compute ROH-based inbreeding ($F_{ROH}$). Inbreeding depression was apparent, e.g., a 1% increase in $F_{ROH}$ was associated with a decrease in 305-d milk yield of 36.3 kg (SE = 2.4), an increase in calving interval of 0.48 d (SE = 0.15) and an increase in mean somatic cell score in d 150 to 400 of 0.86 units (SE = 0.28). Distinguishing recent from ancient inbreeding gave mixed results. For example, only very long ROHs (indicating more recent inbreeding) significantly increased calving interval, whereas both long and short ROHs decreased protein yield. Across all traits, standard errors were larger for inbreeding that was more ancient. When $F_{PED}$ was split into new and ancestral components, based on whether alleles were identical by descent for the first time or not, there was clear evidence of purging. For example, a 1% increase in new inbreeding was associated with a 2.2 kg (SE = 0.4) decrease in 305-d protein yield, compared with a 0.9 kg (SE = 0.8) increase for ancestral inbreeding. The mixed results we obtained may be partly due to difficulties in determining ancient inbreeding. Distant ancestors are less well registered, and short ROHs may be less reliable than long ROHs. Furthermore, selection history is complex and purging may have acted on some, but not on all alleles. Results suggest that, despite the presence of purging, both recent and ancient inbreeding contribute to inbreeding depression and should be considered in management strategies.

Key Words: inbreeding depression, purging, dairy cattle