Graduate Student Competition: ADSA-ASAS Northeast Graduate Student Competition

397 The evaluation of a flavor enhancer on intake and production of high producing lactating dairy cows. C. Merrill*[1], M. C. Windle[1], W. F. Souza[2], I. R. Ipharraguerre[3], and L. Kung Jr.[1], *[1]University of Delaware, Newark, Delaware, United States, [2]Universidade Federal de Viçosa, Vicosa, Minas Gerais, Brazil, [3]Lucta S.A., Motornes de Valles, Spain.*

The objective of this study was to evaluate the effect of improving forage palatability on DM intake, milk production and composition, and rumen pH of lactating cows. Twenty one multiparous and 7 primiparous Holstein cows averaging 697 kg in body weight (SD ± 81), 54 DIM (SD ± 32), and consuming 23 kg DMI (SD ± 8) were fed a base TMR comprised of 45% corn silage, 10% alfalfa haylage, and 45% concentrate. After a 2-wk adjustment period, cows were blocked by production, parity, and DIM and randomly assigned to one of 2 treatments for 10 wk. Each treatment had 2 cows with previously fitted rumen fistula. In-dwelling probes were placed in the rumens of the fistulated cows, once weekly, and rumen pH was measured every 30 min for 48 h. For one half of the cows, the forage portion of the diet was pretreated with a palatability enhancer (Luctarom SBS-R, Lucta, S.A., Spain) that was premixed in water to achieve a projected dose of 12 mL/cow/d before mixing into a TMR (TRT). The remaining half of the cows were fed a similar TMR but the forage was mixed with water only (CTRL). Production data were analyzed as a completely randomized and covaried with pre-treatment values. Rumen pH was analyzed in a factorial design with repeated measures with treatment, week, and treatment x week as main effects. For all animals, there were no differences ($P > 0.05$) between treatments for DMI and milk production and composition. However, when data from only multiparous animals were analyzed (n = 10 for TRT and 11 for CTRL) there was a tendency for greater DMI (+1.5 kg/d, $P < 0.07$) and milk production (+3.9 kg/d, $P < 0.10$) for cows fed TRT. Compared with CTRL, cows fed TRT had higher ($P < 0.01$) mean rumen pH and spent less time ($P < 0.02$) throughout the day with pH below £ 5.8. There was no difference between treatments in particle size distribution of the TMR throughout the day as evaluated with a PSU Particle Size Separator Box. Improving the palatability of the forage fraction of the TMR fed to multiparous dairy cows may help to stabilize the daily pattern of ruminal pH and increase DMI and milk production.

Key Words: flavor, feed intake, palatability

398 Poor maternal nutrition affects postnatal growth and development of lambs. K. N. Peck*, M. L. Hoffman, M. E. Forella, A. R. Fox, K. E. Govoni, and S. A. Zinn, *Department of Animal Science, University of Connecticut, Storrs.*

Poor maternal nutrition can affect growth and development of offspring, which may lead to obesity and disease later in life. We hypothesized that lambs born to poorly nourished ewes would have reduced growth rate and increased fat, with corresponding changes in the somatotropic axis, leptin, insulin and glucose. Ewes (n = 36; 12/treatment) were assigned 1 of 3 diets; 100% (CON), 60% (RES), or 140% (OVER) of NRC requirements at d 31 of gestation until parturition. One lamb per ewe (n = 35; 11 to 12/treatment) was used, 18 were euthanized at birth and 17 were fed a control diet until 3 mo and then euthanized. Crown rump length (CRL), heart girth (HG), and BW were measured and blood samples were collected at regular intervals until slaughter. A glucose tolerance test (GTT) was performed at 3 mo. Glucose (colorimetric), insulin (ELISA), leptin (RIA), and IGF-I (RIA) were quantified in blood. Body weight and HG were 13 and 6% greater in OVER vs. CON ($P \leq 0.05$), respectively at birth and 3 mo. At birth, CRL was 5% greater in OVER vs. CON ($P = 0.05$). Heart weight was 38% greater in OVER vs. CON at birth and 27% greater at 3 mo ($P = 0.01$). At birth, relative to CON, liver weight was 43% greater in OVER ($P = 0.01$), and loin eye area was 17% smaller in RES ($P = 0.01$). At 3 mo, backfat was reduced by 50% ($P = 0.04$) in RES vs. CON and OVER. At 3 mo, IGF-I concentrations were greater in OVER vs. CON (150 ± 55, 155 ± 47, 335 ± 78 ng/mL; CON, RES, OVER, respectively; $P = 0.05$). During weaning (wk 1 to 4), RES had 33% greater ($P = 0.06$) leptin concentrations than CON. There were 35% greater insulin concentrations in OVER vs. CON ($P = 0.01$) from birth to 3 mo. During the GTT, relative to CON, peak glucose concentrations in OVER were 18% less ($P = 0.1$); fasting insulin concentrations in RES were 67% greater ($P = 0.09$); and insulin:glucose in OVER were 93% greater ($P = 0.01$) and in RES were 50% greater ($P = 0.1$). In conclusion, OVER lambs were larger, exhibited cardiac hypertrophy and were hyperinsulinemic at 3 mo. This could indicate predisposition to metabolic syndrome programmed by maternal overnutrition during gestation.

Key Words: maternal nutrition, sheep, somatotropic axis

399 Poor maternal nutrition affects muscle fiber size in the semitendinosus muscle of lambs. J. S. Raja*, M. L. Hoffman, K. E. Govoni, K. Peck, S. A. Zinn, and S. A. Reed, *University of Connecticut, Storrs.*

Poor maternal nutrition leads to impaired myogenesis and reduced postnatal growth in lambs. Potential mechanisms for these defects include the formation of fewer muscle fibers during development and/or alterations in regulators of muscle growth postnatally. We hypothesized that poor maternal nutrition would increase muscle fiber cross sectional area (CSA) at birth and increase myostatin protein expression in muscles postnatally. Multiparous ewes (25 Dorset, 7 Shropshire and 4 Southdown) were housed individually and fed 100% (CON), 140% (OVER) or 60% (RES) NRC Requirements for ewes pregnant with twin lambs starting on d 31 ± 1.3 of gestation. One-half of the lambs in each group were slaughtered within 24 h of birth. The remaining lambs were fed a control diet and euthanized at 3 mo of age. At necropsy, semitendinosus muscle was collected and either embedded in OCT and frozen for determination of muscle CSA or snap-frozen for protein analysis. Data were analyzed via ANOVA. At birth, the muscle fiber CSA of lambs from OVER and RES ewes was 47% and 57% greater, respectively than lambs from CON ewes (CON: 553.3 ± 62.8 μm^2, OVER: 817.1 ± 26.0 μm^2, RES: 871.5 ± 114.4 μm^2; $P < 0.01$). At 3 mo the muscle fiber CSA of lambs from OVER and RES ewes was 15 and 17% smaller than lambs from CON ewes (CON: 2139.5 ± 40.3 μm^2, OVER: 1775.6 ± 65.1 μm^2, RES: 1809.4 ± 90.1 μm^2; $P < 0.01$). Additionally, at 3 mo there was no difference in the protein expression of the myostatin precursor (CON: 1.0 ± 0.08, OVER: 1.04 ± 0.80, RES: 1.40 ± 0.64; fold change from CON; $P = 0.77$), latency associated peptide (CON: 1.0 ± 0.71, OVER: 1.18 ± 0.69, RES: 1.43 ± 0.23; fold change from CON; $P = 0.87$) or active protein (CON: 1.0 ± 0.09, OVER: 1.35 ± 0.84, RES: 2.40 ± 1.38; fold change from CON; $P = 0.61$) in lambs from any group. In conclusion, poor nutrition during gestation leads to altered prenatal and postnatal muscle development. Future studies will focus on alterations in signaling pathways influencing postnatal muscle growth.

Key Words: muscle, maternal nutrition

400 Poor maternal nutrition during gestation alters satellite cell number and mRNA expression of genes involved in myogenesis and the somatotropic axis in the muscle of lambs. M. L. Hoffman*, R. C. Forbes, S. A. Reed, K. N. Peck, S. A. Zinn, and K. E. Govoni, *University of Connecticut, Storrs.*

Muscle growth and development is negatively affected by poor maternal diet during gestation. We hypothesized that poor maternal nutrition during gestation would alter satellite cell number and gene expression in the muscle of lambs. Thirty-six multiparous ewes were individually housed and fed 100% (C), 60% (R), or 140% (O) of requirements for ewes pregnant with twin lambs (NRC, 1985) starting at d 31 ± 1.3 of gestation. Lambs were euthanized 24 h after birth (n = 18) or at 3 mo of age (n = 17; maintained on a control diet). Semitendinosis muscle was collected immediately following euthanasia for immunohistochemistry and gene expression analysis. Satellite cells were identified as paired box protein (Pax)-7 positive cells adjacent to muscle fibers. Data were analyzed using ANOVA. Body weights were 13% greater in O than C at birth and 3 mo ($P \leq 0.05$) of age. Maternal diet did not affect mRNA expression of myogenic factors [myogenin, Pax7, or myoblast determination protein (MyoD)] at birth or 3 mo ($P \geq 0.48$). However, mRNA expression of myostatin was 2.9 ± 0.5-fold greater in O ($P = 0.07$) at birth but not at 3 mo ($P = 0.36$). Gene expression of follistatin was greater in R ($P = 0.06$) and O lambs at birth ($P = 0.04$) but not at 3 mo ($P = 0.37$). Similar to previous findings, IGF-I expression was 2.3 ± 0.6-fold greater in R ($P = 0.07$) at birth. In O lambs, IGFBP-3 was reduced 2.8 ± 0.1-fold relative to C at birth ($P = 0.01$). At birth, there were a greater number of Pax7(+) cells in R ($P = 0.10$) and O ($P = 0.05$) lambs (9.0 ± 0.6, 14.0 ± 2.2, 16.0 ± 1.1% of total fiber associated nuclei; C, R, and O, respectively), but not at 3 mo ($P > 0.05$). In conclusion, maternal diet may affect muscle development by altering expression of mediators of muscle growth and the somatotropic axis. The changes in satellite cell number may be a mechanism by which poor maternal nutrition affects muscle growth. Future studies will evaluate mRNA expression in these cells to determine how their role in postnatal muscle development may be altered by poor maternal nutrition.

Key Words: maternal nutrition, muscle, satellite cell