was due to a combination of legume factors (higher intake and forage quality), and CT effects, which contributed 42% of the increase in yield. CT also contributed 65% of the increase in milk protein concentration and 100% of the increase in conversion efficiency, but did not contribute to the increase in intake or decrease in milk fat concentration. *Lotus* has potential as a forage for dairy cows, although its low herbage yield compared with traditional forages necessitates further investigation of management options for inclusion of *Lotus* into the farm system. Table: Means (30 cows) and SEDs of combined data from all three trials.

	RG	RG+PEG	Lotus	Lotus+PEG	SED
Milk yield (kg/cow/d)	12.87	12.70	18.88	16.22	0.58
Intake (kgDM/cow/d)	15.05	14.69	17.03	16.98	0.65
Fat (%)	4.74	4.70	4.48	4.46	0.12
Protein (%)	3.22	3.19	3.48	3.30	0.05
Efficiency (ml FCM/MJ ME)	139	136	166	137	8

FCM: fat corrected milk

Key Words: Dairying, Tannins, Milk

923 Nutrient composition of forages in Arkansas, 1985-1999. G. V. Davis*, M. S. Gadberry, and T. R. Troxel, *University of Arkansas Cooperative Extension Service, Little Rock, AR.*

The objective of compiling a statewide forage database was to determine the average nutrient composition and variability of forages produced in Arkansas. The database consists of 11,592 forage samples (10,246 hay, 1,001 pasture and 345 silage) collected from 1985 to 1999. Forage samples were analyzed for 1 to 15 nutrients. These included DM, N, ADF, NDF, P, K, Ca, Mg, Na, S, Fe, Mn, Zn, Cu and Se. The mean ± SD CP and TDN levels (% DM) of bermudagrass (n = 3,007), fescue (n = 904), mixed grass (n = 2,394) and all hays (n = 8,316) were, respectively; 12.4 ± 3.5, 60.0 ± 6.2; 11.2 ± 3.0, 53.8 ± 4.7; 11.1 ± 3.1, 52.9 ± 4.7; and 12.0 ± 3.8, 56.8 ± 6.6. For beef cows and calves, TDN was deficient in a higher percentage of hays ($P < 0.05$) than CP. Bermudagrass hay contained greater ($P < 0.05$) levels of CP and TDN, but lower ($P < 0.05$) levels of P and Mg than fescue or mixed grass hays. Fescue and mixed grass hays did not differ ($P > 0.05$) in CP, ADF, NDF or TDN concentrations. Mixed grass hay contained greater ($P < 0.05$) levels of Ca but less ($P < 0.05$) S than bermudagrass. Fescue hay had less ($P < 0.05$) Cu and Zn than bermudagrass or mixed grass hays. Sodium was the most deficient mineral in all hays. Only 6 to 10% of the hays analyzed for Na contained adequate levels for beef cows and calves. Trace minerals Se, Cu, and Zn were deficient in 60, 52 and 41% of the samples, respectively. A lower percentage of the hays were deficient in P, Ca, Mg and S. Fe, Mn and K were deficient in 2% or less of the hays. Wheat, ryegrass, legume-grass and fescue pastures tended to contain greater levels of CP and TDN than the other pasture forages analyzed. Bermudagrass, corn, and sorghum-sudan silages contained greater ($P < 0.05$) levels of TDN than the other silages. This information was provided to county Extension agents, cattle producers, and cattle-related industries to promote forage testing by cattle producers and provide general feeding recommendations whenever a forage test was unavailable.

Key Words: Hay, Pasture, Forage composition

924 Frontal grazing for cattle management on annual ryegrass pasture. H. Lippke*[1], T. D. A. Forbes[1], R. V. Machen[2], and B. G. Warrington[1], [1] *Texas Agricultural Experiment Station, Uvalde, TX,* [2] *Texas Agricultural Extension Service, Uvalde, TX.*

An experiment was conducted to develop a modified frontal grazing system (FGS) based on center pivot irrigation machinery and to compare that system to a traditional continuously stocked management system (CGS) with respect to (a) ADG by yearling steers grazing ryegrass (*Lolium multiflorum*) and (b) livestock production/unit land. In the FGS, a break wire was attached to the towers of the outer 98 m of a 244-m center pivot. Concentric rings of temporary fence restrained lateral movement of the steers, while a manually advanced back fence restricted the cattle to a 15 to 20-degree arc of the circle. Pivot towers were advanced at a rate such that 30% of the ryegrass leaf lamina remained with the ungrazed plant residue. The CGS was lightly stocked initially at 593 kg animal weight/ha. The FGS was initially stocked with 1038 kg animal weight/ha. With the onset of spring growth, cattle were added to both systems so that at the mid-point of the 156-d grazing season, the CGS and the FGS supported 1094 and 1989 kg animal weight/ha, respectively. As an additional measure to control forage growth, 25% of the CGS and 20% of the FGS was de-stocked during the month of March, harvested as high-moisture hay, and restocked in mid-April. Average daily gain for steers on the CGS (1.22 kg) was greater ($P < .01$) than ADG for steers on the FGS (1.08 kg). Animal production/unit land was greater ($P < .01$) for the FGS (834 kg/ha) than for the CGS (668 kg/ha). If the animal production potential of the hay harvested from these systems is included, the FGS again produced more ($P < .01$) gain than the CGS (873 *vs* 746 kg/ha). Frontal grazing offers instant flexibility in cattle management and sufficient promise of higher productivity to be further evaluated in comparison with an array of stocking densities under continuous grazing.

Key Words: Grazing system

ASAS/ADSA Growth and Development: Ruminant Growth and Mammary Development

925 Effects of a dairy calf starter containing yeast culture on daily grain intake, weight gain, structural growth, and rumen development in dairy calves. K. E. Lesmeister* and A. J. Heinrichs, *The Pennsylvania State University, University Park, Pennsylvania.*

The effects of supplemental yeast culture on daily grain intake, weight gain, structural growth, and rumen development were analyzed using 75 Holstein calves (38 male and 37 female) fed one of three grain starters containing a yeast culture (*Saccharomyces cerevisiae*, Diamond V Mills, Inc.) at 0 (C), 1% (1Y), or 2% (2Y) of the ration in a randomized block design. Calves were placed on trial at 2 1 d of age and maintained on trial for 42 d. A non-medicated milk replacer (20% CP, 20% fat) was fed in two equal feedings totaling 10% of birthweight until abrupt weaning at 35 d on trial. Grain and water were provided daily on an ad-lib basis, with grain intake (GI) being measured daily. Measurements of bodyweight (BW), wither height (WH), hip height (HH), hip width (HW), and heart girth (HG) were recorded at 0, 7, 14, 21, 28, 35, and 42 d on trial. Incidences of scours were recorded daily (DS). Two calves per treatment were slaughtered at 42 d, weights of empty stomach compartments (CE) were recorded, and rumens sampled for analysis of papillae length (PL), papillae width (PW), wall thickness (WT), and papillae/cm^2 (PC). No differences were observed between sexes for all variables. Average daily GI was greater ($P = 0.029$) for 2Y (0.687 kg/d) than for C (0.602 kg/d). Average daily gain was numerically greater for 2Y (0.340 kg/d) compared to C (0.304 kg/d) and 1Y (0.287 kg/d). Average daily change in HW was greater ($P = 0.013$) for 2Y (0.064 cm/d) than for C (0.052 cm/d). A trend ($P = 0.128$) for PC from the caudal ventral rumen wall was also observed between C and 2Y (938.75 vs. 711.06 papillae/cm^2). No treatment differences were observed for BW, WH, HH, HG, DS, CE, PL, PW, and WT. These data suggest that the addition of yeast culture in a dairy calf grain starter at 2% of the ration positively influenced average daily grain intake, ADG, hip width, and rumen papillae/cm^2.

Key Words: Dairy Calves, Intake, Rumen Development

926 Calf serum IgG concentrations affects weaning performance. R. C. Vann* and J. F. Baker, *University of Georgia, Tifton, GA/USA.*

The objective of this study was to determine if calf serum IgG concentrations at 24 h of age affects growth performance to weaning. Calves were born in January or February in two consecutive years and weighed monthly beginning in March until weaning in early September. Colostrum samples were collected from Angus (n=94) and Polled Hereford (n=38) cows at the Tifton location and crossbred (n=112) cows at the Alapaha location within 8 h after parturition and serum samples collected from their calves at 24 h of age. The serum and colostrum immunoglobulin (Ig) concentrations were determined using radial immunodiffusion (RID) kits. Calf serum IgG concentrations were classified as Superior (S) Ig concentration (above 1600 mg IgG/100 ml), Average

(A) Ig concentration (between 400 and 1600 mg IgG/100 ml) and Inferior (I) Ig concentration (below 400 mg IgG/100 ml). Failure of passive transfer (FPT) rate (IgG concentration below 800 mg IgG/100 ml) in the first year at the Tifton location was 19.4% and at the Alapaha location 12.5%, however, the FPT rate in the second year was 38.6% at the Tifton location and 32.9% at the Alapaha location. The FPT rate for the two years combined was 34.1% at the Tifton location and 28.6% at the Alapaha location. Data were analyzed by Proc MIXED using a model that included fixed effects of dam breed, year, and FPT class. Covariates included were cow IgG, cow IgM, cow IgA, birth weight and birth day of year. The effects of birth weight, birth day of year and FPT classification were significant for periodic weights and weaning weight. Breed of dam did not have a significant effect on colostrum or calf IgG concentration. Weight gains from March to weaning followed a linear trend, however, at the March weight the S calf group were 3 kg heavier than the A group and 7 kg heavier than the I calf group, and at weaning the S calf group were 14 kg heavier than A group calves and 29 kg heavier than the I calf group. Calves in the A and S FPT groups were significantly heavier at all weigh periods and at weaning compared to calves in the I FPT group.

Key Words: Beef calves, Immunoglobulins, Growth

927 Plasma IgG concentration in neonatal calves in response to a colostrum supplement or colostrum replacer and addition of deoxycholic acid. J. D. Quigley*, C. A. Kost, and T. M. Anspach, *APC Company, Inc., Ames, IA*.

Absorption of IgG from the intestine of neonatal calves is influenced by the milieu in which the IgG are presented. The presence of excess protein or selected ions may affect absorption of IgG during the neonatal period. Bile salts are powerful emulsifiers that affect absorption of fats, vitamins and other compounds and may influence IgG absorption. Our objective was to determine if deoxycholic acid (DOCA) affected IgG absorption in calves fed a colostrum supplement (CS) or colostrum replacer (CR). Holstein bull calves (n = 33) were removed from the dam within 10 min of birth, weighed, and fed 454 g of a commercially available CS (Lifeline Nutritional Colostrum Supplement, APC Company; 10% IgG) or an experimental CR (20% IgG) containing IgG extracted from bovine plasma. The CR and CS were mixed in a blender with 1.9 L of water per feeding. In addition, 0 or 2 g of DOCA were added at each feeding. Calves were fed by esophageal feeder at 1 and 8 h of age. Intake of IgG was 90 and 187 g for CS and CR, respectively. Jugular blood was collected at 0.2 and 24 h of age and analyzed for IgG by turbidimetric immunoassay and total protein by biuret. Plasma IgG and total protein at 0 h were unaffected by dietary treatment and were 0.4 g/L and 4.57 g/dL, respectively. Addition of DOCA had no effect on any parameter measured. Plasma IgG at 24 h in calves fed CR was higher ($P < 0.001$) than in calves fed CS (13.6 vs. 8.0 g/L); however, plasma protein was not different (4.99 vs. 4.98 g/dL). Plasma IgG at 24 h in calves fed CS and CR ranged from 4.8 to 12.9 and 9.9 to 17.5 g/L, respectively. Apparent efficiency of IgG absorption was similar between CS and CR and was 33 and 30%, respectively. Relationship between plasma IgG and total protein at 24 h varied by treatment. For CS, regression equation was plasma IgG (g/L) = 4.92 x plasma protein (g/dL) = 16.5; r^2 = 0.77. For CR, regression equation was plasma IgG (g/L) = 5.38 x protein (g/dL) = 12.5; r^2 = 0.59. The CR used in this study effectively prevented failure of passive transfer in neonatal calves; however addition of DOCA did not influence IgG absorption.

Key Words: calves, colostrum, immunoglobulin

928 Intake, growth and efficiency of calves fed milk replacers containing whey protein concentrate or alternative animal proteins. J. D. Quigley*, C. J. Kost, and M. L. Miller, *APC Company, Inc., Ames, IA*.

Protein ingredients in calf milk replacers (CMR) contribute significantly to the overall cost of the product and alternatives to dried skim milk and whey protein concentrate (WPC) have been evaluated extensively. Spray-dried hydrolyzed red blood cells (SDHRBC) and bovine plasma (SDBP) have been compared to CMR containing WPC. However, the effects of SDHRBC and SDBP in the same formulation have not been determined. Our objective was to compare the performance of calves fed CMR based on WPC or SDHRBC alone or in combination with SDBP. Holstein bull calves (n = 120) were purchased from area dairies or sale barns and were assigned to receive CMR containing WPC, or 10% of the formula as SDHRBC or 10% SDHRBC plus 4% SDBP. All CMR were formulated to contain 23% and 21% of DM as crude protein and ether extract, respectively. Calves were housed in individual hutches and fed 454 g/d of CMR reconstituted to 12% DM for 24 d. Commercial calf starter and water were available throughout the study. Mean BW on d 0, 28 and 56 were unaffected by treatment and were 48.1, 58.5 and 89.5 kg, respectively. Mean intake of DM from CMR from d 0 to d 24 was 413 g/d; intake of calf starter and water were 1308 g/d and 3.6 L/d, respectively from d 0 to 56. Mean fecal scores, days scouring and days treated tended to be higher in calves fed SDBP, although much of the increase in veterinary treatments occurred during the last 2 wk of the study. Mean fecal scores were 1.65, 1.64 and 1.72 in calves fed WPC, SDHRBC and SDBP, respectively. Mean days with scours were 5.5, 5.3, and 8.3, respectively. There were few differences in physical characteristics of the CMR and acceptance by the animals was excellent. Spray dried bovine plasma may be included in CMR formulations containing SDHRBC.

Key Words: calves, milk replacer, intake

929 Economics of dairy heifer growth programs. C.A. Wolf* and M.J. VandeHaar, *Michigan State Univerisity, East Lansing, MI/USA*.

Interest in rapid growth rates for replacement heifers occurs because breeding date, and subsequent calving/lactation, is determined by size. General agreement exists that heifers should be bred when they are 340 to 380 kilograms regardless of age. Given the weight standard, a heifer that grows at a faster rate will achieve the breeding size at a younger age. Accelerated growth rates, gains over 900 grams/day, put heifers at risk for impaired mammary development and have been found to be detrimental to milk production with declines of 5 to 48 percent in the first lactation. The potential advantages of reduced age at first calving include decreased feed costs and lower overhead while the potential disadvantages include lower milk production and the cost of increased planes of nutrition. The tradeoff between potential savings in heifer raising costs and milk production loss is examined in a basic economic model using parameter values from the dairy science literature. The analysis uses 20, 22 and 24 months age to first calving. In a short-run framework, facility and enterprise size variables are held constant and the cost change is driven by the feed costs determined using least-cost rations. Least cost rations indicate that total feed costs decline from 22 to 24 months age at first calving but are essentially constant and may even increase marginally when heifers are grown at rates required to calve at 20 months relative to the 22 month scenario. The savings in feed cost are small enough that even a five percent decline in milk yield in the first lactation will off-set the savings. In a long-run analysis accelerated heifer growth implies less need for facilities and other infrastructure associated with the heifer enterprise and overhead costs decline with age to first calving. Sensitivity analysis is used to compare the changing heifer enterprise costs with milk income loss values using data from the economics literature. The results indicate that milk yield loss is the important factor in the short-run while fixed cost changes substantially affect the long-run heifer growth rate decision.

Key Words: Heifer growth, Economic analysis

930 Effects of added rumen undegraded protein (RUP) and bovine somatotropin (bST) administration on mammary gland growth in prepubertal dairy heifers. A. V. Capuco*[1], G. E. Dahl[2], D. L. Wood[1], and R. A. Erdman[2], [1]*USDA-ARS, Beltsville, MD,* [2]*University of Maryland, College Park, MD*.

The objective of this study was to test effects of added rumen undegraded protein (RUP) and recombinant bST administration on growth of mammary glands of dairy heifers from 90 d of age until 10 mo of age (peripubertal). Thirty-two Holstein heifers (90 d of age) were used in the experiment, eight of which were slaughtered at 90 d, prior to being assigned to treatment. The remaining twenty-four heifers were randomly assigned to one of four treatment groups. Treatments consisted of added dietary RUP (2% RUP, 14.9% CP, DM basis) and 0.1 mg of bST/kg BW/d applied in a 2 x 2 factorial design. Twelve heifers (3 per treatment) were slaughtered at 5 and 10 mo of age. Mammary parenchymal growth was not affected by RUP or bST treatment ($P > 0.1$). Total parenchymal mass increased from an average of 16 g to 364 g, and parenchymal DNA from 58 mg to 1022 mg from 3 mo to 10 mo of age, respectively. Total parenchymal fat increased from 82 g at 3

mo to 618 g at 10 mo of age. Furthermore, the number of mammary epithelial cells likely was not affected by diet or bST because neither total parenchymal DNA nor the lipid content of parenchyma was affected by treatment ($P > 0.1$). Results suggest that mammary parenchymal growth was neither enhanced nor inhibited by RUP or bST at the feeding rates employed in this study.

	Treatment[1]				
udder half (10 mo)	Control	bST	RUP	RUPbST	SE
Parenchyma, g	401	347	345	361	44
Extraparenchymal fat, g	555	539	880	499	68
Fat/parenchyma	1.42	2.22	2.53	1.39	0.25
mg Lipid/g parenchyma	333	380	336	408	37
mg RNA/g parenchyma	0.94	1.00	0.99	0.87	0.07
mg Protein/g parenchyma	16.5	13.9	18.6	14.6	1.2
Total Fat, g	133	120	120	157	21
Total DNA, g	1.05	0.93	1.01	1.10	0.13

[1]No significant main or interaction effects ($P > 0.05$)

Key Words: bST, RUP, Mammary growth

931 Physiological responses and growth rates of dairy heifers when raised from birth to weaning during hot weather. Tomas Belloso*[1], R.A. Bucklin[1], H.H. Head[1], M.J. Hayen[1], A.N. Garcia[1], M.S. Gulay[1], and F. Baccari[2], [1]*University of Florida, Gainesville, Florida,* [2]*Universidade Estadual de Londrina, Londrina-PR, Brasil.*

Objectives were to evaluate effects of hot weather on physiological responses, hormone concentrations, and growth rates of newborn heifers from birth to weaning. Twelve heifers were assigned to each of three housing systems by d-3 of age. These were in calf barn without (H1) or with fans (H2), and outside calf-pens (H3). Approximately equal numbers of heifers with low (C1,<5.0 g/dl) or high (C2,<5.0 g/dl) levels of total plasma protein on d-3 of age were in each H. Fans provided air movement across heifers in H2. Heifers were fed milk replacer twice daily through d-42 then once daily until weaned (d-49). Water and dry feed (>15%CP) were available free choice and intakes measured once or twice daily, respectively. Body weight and height at withers were measured when assigned and then once weekly. Blood samples were collected twice weekly, plasma harvested and frozen until analyzed for concentrations of somatotropin (ST), insulin (INS), insulin-like growth factor-1 (IGF-1), triiodothyronine (T_3), and thyroxine (T_4). Rectal temperature (RT) and respiration rate (RR) were recorded one day a week over a 24-h cycle at 0700, 1100, 1500 and 1900, and at 0700 h. Mathematical models included H, C and H∗C. Highest and lowest mean RT (39.81±0.04 and 38.71±0.03) and RR (66.7±1.71 and 35.33±1.68) were at 1900 h and 0700 h, respectively; daily trends followed daily ambient temperature. Significant effects of H were detected only for T_3 (H1>H2,H3) and mean daily water intake (2.8, 2.5 vs. 3.5 L/d). Differences were detected among C groups. Calves in C2 had greater mean daily water intake (P< 0.0119) and DMI (P<0.0404). They grew faster than heifers in C1 (0.265 vs. 0.239 kg/d, P<0.0415; and 6.1 vs. 4.3 cm increase, P<0.0517). They also had significantly higher mean concentrations of T_3, T_4 and INS in plasma. No significant interactions (H∗C) were detected except for RR; it was greater in C2 except for H1. Importance of providing newborn calves with colostrum and growing heifers with water and feed free choice during summer months was confirmed. Increased water consumption by heifers, especially in H3, likely allowed them to dissipate greater heat load and to maintain body temperature, physiological responses and growth rates the same as heifers in H1 and H2.

Key Words: Heifers, Heat stress, Growth

932 Analysis of cell proliferation in the prepubertal bovine mammary gland. S. Ellis*[1] and A.V. Capuco[1], [1]*USDA-ARS-GEML Beltsville, MD 20907.*

The focus of this research was to investigate the growth and development of the prepubertal ruminant mammary gland. Detailed histologic analyses were conducted to characterize the proliferation of mammary epithelial cells and to determine how each of the mammary cell types contribute to mammary development. Holstein heifers were slaughtered at 2, 5, and 8 mo of age to provide tissues for this study (n = 3 per age group). Each heifer was injected intravenously with bromodeoxyuridine (BrdU, 0.5 mg/kg body weight in pH 8.5 saline) 2 h prior to slaughter to label S-phase cells. After slaughter, mammary parenchymal tissue samples were collected from peripheral, medial, and cisternal parenchymal regions. Tissues were then fixed, embedded, and sectioned at 0.9 μm. Sections were immunohistochemically labeled to detect BrdU and stained with a mixture of Azure II and basic fuschin. Current models of mammary development in rodents suggest that a population of small, basally located, lightly-staining cells (SLC) function as mammary stem cells. In the present study, three distinct levels of cytoplasmic staining were observed in mammary epithelial cells: light, intermediate, and dark. As in the rodent mammary gland, BrdU-positive SLC were observed in all parenchymal zones. BrdU-positive SLC were also observed in contact with the ductal lumen, in contrast with the current rodent model. BrdU labeling was also observed in cells with intermediate and dark cytoplasmic staining. Preliminary results from these analyses reveal both similarities and distinctions from the current model of mammary epithelial cell proliferation in murine mammary glands. The results of these analyses provide critical insight into the cell types involved in ruminant mammogenesis. This information will aid in the development of therapies that improve prepubertal mammary development and increase the return on investment in replacement heifers.

Key Words: Mammary Development, BrdU, stem cell

933 Leptin receptor expression in the bovine mammary gland and other tissues. L.F.P. Silva*, M.J. VandeHaar, M.S. Weber, and G.W. Smith, *Michigan State University, East Lansing, MI.*

The effect of leptin on food intake and energy metabolism relies on leptin receptors (Ob-R) located in the central nervous system. Several peripheral actions of leptin have also been reported, and Ob-R mRNA has been detected in peripheral tissues of human, rodent, pig and sheep. We believe leptin may modulate mammogenesis in heifers. Thus, our objective was to characterize Ob-R expression in mammary and other tissues of prepubertal dairy heifers. We used reverse-transcription PCR to detect Ob-Rb, the long splice variant which has an intracellular signaling domain essential for leptin's weight-reducing effects, and Ob-Ra, a short isoform with unidentified signaling capabilities. Ob-Rb mRNA was detected in all tissues examined: hypothalamus, pituitary, heart, spleen, liver, lung, ovary, testis, skeletal muscle, subcutaneous adipose tissue, primary mammary epithelial cells, mammary extra-parenchymal adipose tissue, a bovine mammary epithelial cell line (MAC-T) and mammary tissue (parenchyma + stroma) from a heifer two months after puberty. However, in contrast with reports in other species, expression of Ob-Ra was detected only in bovine liver, pituitary, subcutaneous adipose tissue and spleen. The partial deduced amino acid sequence (134 a.a.) for bovine Ob-Rb shared 92, 78, 73 and 68% similarity with the reported Ob-Rb sequences for ovine, swine, human and rat, respectively. The partial amino acid sequence (91 a.a.) for Ob-Ra shared 90 and 80% similarity with the human and rat Ob-Ra, respectively. The widespread tissue distribution of Ob-Rb in the growing heifer suggests that leptin may potentially have a direct action on peripheral tissues. Immunocytochemical staining of bovine mammary epithelial cells and MAC-T cells using a specific antibody to Ob-R revealed that Ob-R protein is also expressed in bovine mammary parenchyma. The presence of Ob-Rb mRNA and Ob-R protein in the mammary gland supports the concept that leptin may play a direct role in mammary parenchymal development.

Key Words: Leptin receptor, Mammary, Heifer

934 Postnatal nutrition and fatness affect plasma leptin concentration in neonatal sheep. R.A. Ehrhardt[1], P.L. Greenwood*[2], R.M. Slepetis[1], A.W. Bell[1], and Y.R. Boisclair[1], [1]*Cornell University, Ithaca, NY,* [2]*NSW Agriculture Beef Industry Centre, Armidale, NSW, Australia.*

Effects of birth weight and postnatal nutrition on plasma leptin concentration were investigated in male Suffolk x (Finn x Dorset) lambs from birth to LW 20 kg. Lambs of low (meanSD 2.290.34 kg, n=28) and high (4.840.45 kg, n=20) birth weight were individually fed a milk replacer diet in amounts that promoted rapid (ad lib, ADG 350 g, n=20) or slower (restricted, ADG 150 g, n=20) growth, and slaughtered at selected LW from 5 to 20 kg. Blood plasma was obtained from selected lambs at birth, every second day from birth to slaughter, and during frequent

sampling one day prior to slaughter. At birth, plasma leptin concentration did not differ between low and high birth weight lambs (meanSEM 4.10.3 vs 3.80.3 ng/mL, respectively). During the first week of postnatal life, plasma leptin was higher in small compared to large newborns (4.10.1 vs 3.60.2 ng/mL, P<0.05) and tended to be higher in ad lib compared to restricted fed lambs (4.10.2 vs 3.6 0.1 ng/mL, P=0.07). By week 2 of postnatal life, plasma leptin was significantly higher in the ad lib group (4.60.2 vs 3.70.2 ng/mL, P<0.005) but was not affected by birth weight. Overall, during rearing to 20 kg LW, plasma leptin concentration was greater in ad lib than restricted lambs (P<0.001) but was not significantly affected by birth weight. The effect of plane of nutrition increased with LW; ad lib lambs had leptin concentrations that were twice those of restricted lambs at 15 kg LW (6.01.0 vs 3.10.2 ng/mL), and 3-times greater at 20 kg LW (8.20.5 vs 2.80.2 ng/mL). Although plasma leptin concentration was related to both mass of body fat (r=0.614, P<0.001) and percentage of body fat (r= .624, P<0.001), body fatness was not sufficient to explain the effect of plane of nutrition. This was particularly evident as the lambs reached 20 kg LW, when ad lib lambs were only 16% greater in body fatness than restricted lambs yet had plasma leptin concentrations that were 3 times greater than restricted lambs. Collectively, these data suggest that plane of nutrition independent of its effect on body fatness, is a major factor regulating plasma leptin concentration during early postnatal growth in sheep.

Key Words: lambs, nutrition, leptin

935 Effects of dietary protein and weaning age on hormone and metabolite concentrations in neonatal dairy calves. C. C. Williams*[1], D. L. Thompson, Jr.[1], H. G. Bateman, II[1], B. F. Jenny[1], D. T. Gantt[1], L. R. Gentry[1], G. E. Goodier[1], and C. M. Cheatham[1], [1]*LSU Agricultural Center.*

The objective of this study was to investigate effects of starter crude protein (CP) level and weaning regimen on metabolic hormone and glucose concentrations in neonatal dairy calves through 10 weeks of age. Twenty four Holstein (n = 12 male and 12 female) calves were assigned to one of four treatments in a 2 x 2 factorial arrangement consisting of 2 calf starters (16% vs. 22% CP, as-fed basis) and 2 weaning ages (4 or 8 weeks). Calves received colostrum for 3 days and then milk replacer (22% CP, 15% fat) until weaning. Milk replacer was fed at 10% of birth weight divided into 2 feedings daily until 2 weeks prior to weaning. Then replacer was reduced to 75% of original amount and fed once daily and further reduced to 50% of original amount one week prior to weaning. Beginning on day 4 calves were allowed free access to calf starter. Blood samples were collected weekly from weeks 1 through 10 prior to and 2 hours after the morning feeding. Pre-feeding samples were analyzed for insulin-like growth factor-I (IGF-I), insulin, glucagon, and glucose, while post-feeding samples were analyzed for insulin and glucose. At 2 week intervals, blood samples were collected every 15 minutes for 7.5 hours for determination of growth hormone (GH). Concentrations of plasma GH, IGF-I, insulin, glucagon, and glucose were not affected by starter CP level ($P > 0.05$). Mean plasma GH concentrations tended to be greater ($P = 0.09$) in calves weaned at 8 weeks. Plasma IGF-I concentrations increased with age ($P < 0.01$) but were not influenced by weaning regimen ($P > 0.05$). Plasma glucagon concentrations decreased with age ($P < 0.01$) and were lower in calves weaned at 8 weeks ($P < 0.05$). Glucose concentrations were greater in calves weaned at 8 weeks ($P < 0.01$). There was an interaction of weaning age by week by time relative to feeding for concentrations of insulin ($P < 0.01$) and glucose ($P < 0.05$). Post-feeding concentrations of insulin and glucose increased weekly until weaning. After weaning, concentrations of insulin and glucose, regardless of sampling time, decreased until the end of the 10 week study. While starter crude protein level did not affect hormone or metabolite concentrations, age related changes were evident in these metabolic parameters in developing neonatal calves.

Key Words: Dairy calves, Hormones, Metabolites

936 Thyrotropin releasing hormone (TRH) mediates serotonin-induced release of growth hormone. R. P. Radcliff*, L. T. Chapin, K. J. Lookingland, and H. A. Tucker, *Michigan State University, East Lansing, MI.*

The serotonin receptor agonist, quipazine, induces secretion of growth hormone (GH) in cattle, but the mediator of this response is not known. We hypothesize that TRH mediates serotonin-induced secretion of GH. Holstein steers were injected daily with 3,3',5-triiodo-L-thyronine (T_3) dissolved in corn oil (n=8) to induce negative feedback on the thyrotropic axis, thereby decreasing TRH receptor expression on the anterior pituitary gland and(or) TRH synthesis in the hypothalamus. Controls (n=8) received corn oil. Blood was collected at 20-min intervals for 6 h on days -1, 5 and 10 relative to initiation of injections to quantify basal secretion of GH. After 20 d of injections, steers were challenged every other day with an i.v. injection of growth hormone-releasing hormone (GHRH), TRH, quipazine or vehicle. Blood was collected at -60, -40, -20, 0, 5, 10, 15, 20, 30, 40 and 60 min relative to i.v. challenge and serum assayed for GH. Compared with corn oil, T_3 did not affect basal concentrations of GH in serum. As expected, GHRH increased area under the response curve (AUC) of GH similarly in corn oil- and T_3-treated steers. Compared with vehicle, TRH increased AUC of GH in corn oil-treated (386 vs 873 $\pm$ 95 ng $\cdot$ ml^{-1} min; $P > 0.01$) but not T_3-treated steers (294 vs 609 $\pm$ 101; ng $\cdot$ ml^{-1} min; $P > 0.1$). However, TRH induced AUC of GH in T_3-treated steers was intermediate between T_3-treated steers that received vehicle and corn oil-treated steers that received TRH. Similarly, compared with vehicle, quipazine increased AUC of GH in corn oil-treated 413 vs 1169 $\pm$ 181 ng $\cdot$ ml^{-1} min; $P < 0.01$) but not T_3-treated steers (340 vs 601 $\pm$ 198 ng $\cdot$ ml^{-1} min; $P > 0.5$). Like TRH, quipazine induced AUC of GH in T_3-treated steers was intermediate between T_3-treated steers that received vehicle and corn oil-treated steers that received quipazine. Thus, injections of T_3 reduce but do not completely block TRH- and serotonin receptor agonist-induced secretion of GH. In conclusion, TRH mediates, in part, serotonin-induced secretion of GH in cattle.

Key Words: Cattle, Hyperthyroidism, Serotonin, Growth hormone

937 The effect of photoperiod on hepatic Growth Hormone receptor (GHR) expression in steer calves. P. E. Kendall*[1], T. L. Auchtung[1], K. S. Swanson[1], M. L. Bode[2], M. C. Lucy[2], J. K. Drackley[1], and G. E. Dahl[1], [1]*University of Illinois, Urbana, IL,* [2]*University of Missouri, Columbia, MO.*

Photoperiod manipulation, specifically long days (LDPP), increases milk production in lactating cattle. We have previously reported that the galactopoietic effect of LDPP is associated with an increase in circulating insulin-like growth factor-I (IGF-I), which occurs independent of changes in IGF binding proteins and GH concentrations. This study tests the hypothesis that LDPP increases the expression of GHR 1A mRNA in the liver. Two groups of Holstein steers (98$\pm$4 days old) were maintained indoors and exposed to LDPP (16L:8D; n=6) or short day photoperiod (SDPP) (8L:16D; n=6) for a total of 9 weeks. The calves were fed individual rations of a grain- and alfalfa-based diet, which were adjusted for live weight. Jugular blood samples were collected at weekly intervals to determine changes in serum IGF-I by radioimmunoassay. Liver biopsies were obtained at 3-week intervals to quantify changes in hepatic GHR 1A mRNA using real time polymerase chain reaction on an ABI PRISM 7700 ® Sequence Detection System. Steer live weight increased during the study but did not differ between treatments, nor were differences in feed consumption found. Despite the variation within treatments, there was a tendency for the amount of GHR 1A mRNA to be higher (P=0.08) in LDPP steers on day 39 relative to SDPP steers. This would be consistent with the hypothesis that liver GHR 1A mRNA is correlated with circulating IGF-I concentrations. We conclude that changes in IGF-I secretion in LDPP cattle could be regulated by an increase in GHR 1A, but that the endocrine pathway whereby LDPP influences GHR expression remains to be elucidated.

Key Words: Cattle, Photoperiod, Growth Hormone receptor