P-release values were reduced ($P < 0.01$) to 0.085 and 0.099% P, respectively. At 1,000 FTU/kg of EcoPhos^{TM}, Zn reduced ($P < 0.01$) P-releasing efficacy from 0.195% P to 0.140 and 0.124% P for the TBZC and ZnO treatments, respectively. These results suggest that growth-promoting levels of Zn chelate the phytate complex, thereby reducing its availability for hydrolysis by phytase.

Key Words: Pigs, Phytase, Zinc

396 Differences in total tract and ileal digestibility coefficients of calcium and phosphorus in growing pigs fed low phytate corn, normal corn, soybean meal, and corn soybean meal based diets. R. A. Bohlke*, H. H. Stein, A. R. Wirt, and R. C. Thaler, *South Dakota State University*.

The primary objective of this experiment was to determine the apparent ileal digestibility coefficients (AID) and the apparent total tract digestibility coefficients (ATTD) of calcium (Ca) and phosphorus (P) in low phytate corn (LPC), normal corn (NC), soybean meal (SBM), and corn-soybean meal-based diets by growing pigs. The second objective was to determine if there were differences between the AID and the ATTD for Ca and P. Eight diets were formulated and fed to nine growing barrows. Three diets contained LPC, NC, and SBM as the sole source of Ca and P. Three similar diets contained supplemental inorganic Ca (iCa) and P (iP) to bring the contents up to the requirements of the animals (i.e. 0.5% Ca and 0.2% digestible P). Two diets containing LPC-SBM and NC-SBM were also supplemented with iCa and iP to reach the animals requirements. Each diet was fed to the pigs for nine days with ileal digesta being collected from 0800 to 2000 on d 8 and d 9. Fecal samples were collected on d 7 and d 8. The AID and the ATTD (70 and 69%, respectively) of Ca in LPC were higher ($P < 0.05$) than in NC (47 and 50%) and SBM (51 and 47%). The addition of iCa did not affect ($P > 0.05$) the AID or the ATTD of Ca for any of the three feed ingredients. No differences ($P > 0.05$) in the AID of Ca were found between the LPC-SBM (55%) and NC-SBM (51%) diets. The AID and the ATTD of P in the LPC diet were higher ($P < 0.05$) than that of the NC and SBM diets (57 and 55% vs. 28 and 29% and 37 and 38%). When iP was added to NC and SBM, the AID and the ATTD of P increased ($P < 0.05$). However, the addition of iP did not ($P > 0.05$) improve the AID or the ATTD of P in LPC. For both Ca and P, there were no differences ($P > 0.15$) between the AID and the ATTD. In conclusion, LPC has a higher Ca and P digestibility than NC and SBM. There appears to be no net absorption or excretion of Ca and P in the large intestine of growing pigs fed corn or soybean meal based diets.

Key Words: Pigs, Digestibility, Low phytate corn

397 Phytase additions to conventional or low-phytate corn-soybean meal diets on performance, bone traits, and phosphorus excretion of growing pigs. E. G. Xavier*, G. L. Cromwell, and M. D. Lindemann, *University of Kentucky, Lexington*.

Effects of phytase in diets containing low-phytate (LP) or normal (N) corn and LP, low-oligosaccharide or N soybean meal (SBM) were evaluated. The corn and SBM were provided by Pioneer Hi-Bred International, Johnston, IA. The LP-corn, N-corn, LP-SBM, and N-SBM contained 0.26, 0.31, 0.77, and 0.70% total P and 0.09, 0.25, 0.22, and 0.48% phytate P with estimated P bioavailabilities of 75, 20, 50, and 20%, respectively. Individually-penned pigs (six/treatment) were fed eight corn-SBM diets (1.05% lysine, 0.65% Ca) from 15 to 42 kg (40 d). Diets 1-5 were N-corn + N-SBM with 0.20, 0.10, 0.10, 0.00, and 0.00% added P from monocalcium phosphate. Diets 6-8 were LP-corn + LP-SBM with 0.10, 0.00, and 0.00% added P. Phytase (Natuphos$^{®}$, BASF) was added to Diets 3, 5, and 8 at 750 units/kg. The N and LP diets without added P contained 0.39 and 0.37% total P and 0.08 and 0.23% bioavailable P, respectively. Diet 1 met the P requirement for pigs of this weight range (NRC, 1998). At termination, metatarsals, metacarpals, and femurs were obtained from all pigs. Reducing dietary P negatively affected ($P < 0.01$) growth rate, feed/gain, and mean bone strength (relative to pigs fed Diet 1) to a greater extent in pigs fed N vs LP diets (751, 700, 723, 571, 660, 791, 685, and 706 g/d; 1.80, 1.95, 2.01, 2.55, 2.23, 1.86, 1.87, and 1.88; 100, 73, 98, 45, 67, 103, 78, and 97 for Diets 1-8), and phytase prevented ($P < 0.01$) some of the effects of reducing dietary P level. Apparent digestibility of P (using Cr_2O_3) for Diets 1-8 was 44, 33, 49, 25, 40, 60, 55, and 70% ($P < 0.01$). Fecal P excretion was influenced ($P < 0.01$) by type of corn-SBM, P level, and phytase addition (4.49, 4.45, 3.67, 4.26, 3.39, 2.79, 2.11, and 1.45 g/d). Soluble P in feces was low (1.69, 1.74, 1.63, 1.56, 1.96, 1.81, 1.94, and 2.16% of total P), but increased when phytase was added to the low-P, N ($P < 0.01$) or LP ($P < 0.05$) diets. The results indicate that growing pigs fed LP-corn and LP-SBM require less P to optimize performance and bone density; and when phytase is included in LP-corn-SBM diets, pigs excrete up to 68% less fecal P than pigs fed conventional corn-SBM diets without phytase.

Key Words: Pigs, Phosphorus, Phytase

Physiology: Nutrition-reproduction, stress, and growth

398 Effects of experimental fascioliasis on pubertal development in heifers. M. J. Paczkowski*, T. M. Craig, D. D. Magee, J. A. Thompson, and D. W. Forrest, *Texas A&M University, College Station, TX*.

Angus-sired heifers were allotted by age (mean=4 mo), BW (mean=135 kg), and sire (n=4) to either a control (uninfected, n=10) or infected group (n=11). Metacercariae of *Fasciola hepatica* were administered (intraruminally, d 0) to study effects on interval to puberty, circulating ovarian steroids, serum liver enzymes and BW. Blood samples were collected bimonthly from d 0 to 56 and biweekly from d 60 through 210 for analysis of serum estradiol 17β (E_2) and progesterone (P_4) concentrations by RIA. At 2-wk intervals, BW was recorded, a blood sample was obtained to quantify serum aspartate-aminotransferase (AST) and γ-glutamyltranspeptidase (GGT) and a fecal sample was collected to assess excretion of *F. hepatica* eggs. Puberty was defined by the occurrence of the first luteal phase (serum P_4 concentrations >1.0 ng/ml for a minimum duration of 10 d). A univariate ANOVA using the RANDOM statement in PROC GLM was used to determine significant linear and curvilinear responses to treatment in prepubertal heifers (from d 0 to 113) for BW, E_2, P_4, AST, and GGT. Treatment effects at d 113 were determined by one way ANOVA. *F. hepatica* eggs were detected in all infected heifers after day 92. Linear ($P<0.01$) and curvilinear ($P<0.05$) responses for AST and a linear ($P<0.05$) response for GGT concentrations were detected over time in infected heifers. On d 113, mean GGT levels were higher ($P<0.01$) in infected than in control heifers (116.4 $\pm$ 31.2 vs 20.2 $\pm$ 2.8 U/L, respectively). Mean BW, serum AST, E_2, and P_4 concentrations did not differ between treatment groups on d 113. By d 210, 60% (six of 10) of heifers in the control group and 36% (four of 11) of heifers in the infected group attained puberty. We conclude that *F. hepatica* infection induced elevated levels of serum enzymes which are indicative of liver damage, and there was a more persistent elevation in GGT than the elevation in AST levels. Experimental fascioliasis resulted in a lower percentage of heifers that reached puberty within 7 mo of infection as compared to control heifers.

Key Words: Heifer, Fascioliasis, Puberty

399 Leptin modulates fertility in oMt1a-oGH transgenic mice. A. T. Thomas*, T. R. Famula, J. D. Murray, and A. M. Oberbauer, *University of California, Davis, California*.

Elevated growth hormone (GH) changes body composition and suppresses fertility in livestock and rodents. The ovine metallothionein 1a-ovine growth hormone (oMt1a-oGH) transgenic mouse model allows the study of GH effects on body composition and fertility, as the transgene is easily activated and inactivated to express GH by provision of 25 mM zinc in the drinking water. Chronic expression of the transgene results in a lean phenotype and activation followed by inactivation of the transgene causes obesity. Plasma leptin concentrations reflect adipose stores within the body and also influence reproduction. We hypothesize that reproductive function will be reduced in obese oMt1a-oGH mice due to elevated leptin levels. Thus, the purpose of this study was to determine how fertility changes as a function of body composition

and how plasma leptin levels vary with transgene expression and reproductive performance in oMt1a-oGH mice. At weaning oMt1a-oGH transgenic (TG) and wild type (WT) females were allocated to a treatment: oMt1a-oGH females chronically expressing the transgene (TG ON, n=170), oMt1a-oGH females expressing the transgene from 3 to 8 weeks of age (TG ON/OFF, n=172), WT females receiving the transgene stimulus from 3 to 8 weeks of age (WT ON/OFF, n=177), and WT females never receiving the transgene stimulus (WT OFF, n=190). Eight-week-old females were housed with males for a 2-week period, after which females were isolated from males and allowed to carry pregnancies to term. Body and gonadal fat pad (GFP) weight, plasma leptin concentrations, and pregnancy rate for each animal were recorded. The transgene stimulus did not affect any parameter measured in the WT animals (P>0.1) and the data for the WT animals were pooled. TG ON mice were larger and leaner than TG ON/OFF mice that became obese (P<0.001). Plasma leptin correlated with GFP (r^2=.63) and were approximately 2 and 2.5 fold higher in TG ON/OFF than WT and TG ON, respectively (P<.05). Leptin was elevated in infertile versus fertile females in all groups, suggesting that elevated leptin, reflecting altered adipose depots, in combination with GH, may impair fertility in these animals.

Key Words: Leptin, Obesity, Infertility

400 Orexin-B modulates LH and GH secretion: Interaction with the brain-pituitary axis in the pig. C. R. Barb*[1], J. B. Barrett[1], R. R. Kraeling[1], and R. L. Matteri[2], [1]*USDA-ARS, Athens, GA,* [2]*USDA-ARS, Columbia, MO.*

Two experiments (EXP) were conducted to test the hypothesis that orexin-B affects LH and GH secretion. In EXP I, prepuberal gilts received intracerebroventricular (ICV) injections of 0.9% saline (S; n = 2), 10 ug (n = 2) or 100 ug (n = 2) of orexin-B in S. Blood was collected every 15 min for 2 hr before and 2 hr after ICV injections. In EXP II, anterior pituitary cells from prepuberal gilts were studied in primary culture. On d 4 of culture, 10^5 cells/well were challenged with 10^{-10}, 10^{-8} or 10^{-6} M GnRH; 10^{-8}, 10^{-7} or 10^{-6} M [Ala^{15}]-hGRF-(1-29)NH_2 or 10^{-10}, 10^{-9}, 10^{-8} or 10^{-7} M orexin-B individually or in combinations with 10^{-10} and 10^{-6} M GnRH or 10^{-8} and 10^{-6} M GRF. Secreted LH and GH were measured at 4 hr after treatment. In EXP I, serum LH and GH concentrations were similar among pigs before treatment and were unaffected by orexin-B treatment; averaging 0.5 0.2, 1.0 0.2 and 1.0 0.2 ng/ml for LH and 2.1 3.4, 6.1 3.4 and 5.8 3.4 ng/ml for GH after ICV injection of S, 10 ug or 100 ug orexin-B, respectively. In EXP II, basal LH and GH secretion (control; n = 9 wells) was 183 18 and 108 4.8 ng/well, respectively. Relative to control at 4 hr, all doses of GnRH and GRF increased (P<0.001) LH and GH secretion. All doses of orexin-B increased (P <0.001) GH secretion, while only the 10^{-10} M dose increased (P<0.005) LH secretion. Secreted LH and GH were unaffected by addition of 10^{-10}, 10^{-9}, 10^{-8} or 10^{-7} M orexin-B in combinations with 10^{-10} and 10^{-6} M GnRH or 10^{-8} and 10^{-6} M GRF compared to GnRH or GRF alone, except 10^{-9} M orexin-B suppressed (P<0.02) the LH response to 10^{-6} M GnRH. These results indicate that orexin may directly modulate LH and GH secretion at the level of the pituitary gland, but not the brain.

Key Words: Orexin, Hormone, Pig

401 Associations among circulating concentrations of IGF-1 and GH during the postpartum period with resumption of estrus, calf weights, and milk production in mature crossbred cows fed varying levels of energy intake. A. J. Roberts*[1] and T. G. Jenkins[2], [1]*USDA-ARS, Fort Keogh LARRL, Miles City, MT,* [2]*USDA-ARS, MARC, Clay Center, NE.*

Circulating concentrations of IGF-1 and GH fluctuate in response to nutritional status. Objectives of this study were to evaluate usefulness of circulating profiles of IGF-1 and GH during the postpartum period as predictors of capacity to resume estrus and level of production (milk and calf growth). Mature crossbred cows produced from Angus, Hereford, Shorthorn, Galloway, Longhorn, Nellore, or Salers sire breeds were fed at 132 or 189 kcal ME/kg metabolic BW or ad libitum (6 to 8 cows/sire breed/feed level). Concentrations of progesterone in weekly blood samples collected 2 through 14 wk post-calving were used to estimate length of anestrus. Concentrations of IGF-1 and GH were determined in serum samples collected at wk 2, 4, 8, and 14 postpartum. Within cow regressions were used to obtain estimates (i.e., slopes) of changes in IGF-1 and GH concentrations over time. Analyses of covariance were used to evaluate linear effects of concentration at wk 2 and slope of IGF-1 or GH, fixed effects of sire breed, and interactions among linear and fixed effects on length of anestrus, peak week and level of milk production, and adjusted weaning weight (**WW**) of calf. Breed of sire accounted for variation ($P < 0.02$) in all variables except peak week of milk production. Length of anestrus was influenced ($P < 0.03$) by interactions between IGF-1 covariate terms with breed of sire. Peak level of milk production was associated negatively ($P < 0.01$) with IGF-1 at wk 2. Time of peak milk production was influenced ($P < 0.1$) by the interaction of GH at wk 2 with breed of sire. Adjusted WW of calf was associated negatively with both GH covariate terms ($P < 0.01$). Within breed, initial concentrations (wk 2) and pattern of change in IGF-1 and(or) GH concentration during the postpartum period are predictive of capacity to resume cycling and potential for productivity (milk and calf wt).

Key Words: GH, IGF-1, Postpartum

402 Endocrine responses to 72 h feed deprivation in weanling pigs. B. E. Salfen*[1], J. A. Carroll[1], and D. H. Keisler[2], [1]*Animal Physiology Research Unit, Agricultural Research Service-USDA,* [2]*University of Missouri-Columbia.*

The study objective was to assess endocrine and tissue responses to 72 h feed deprivation in weaned pigs. Thirty-two barrows were weaned at 18 d of age and placed on a complex nursery diet. At 27 d of age, pigs were non-surgically fitted with an indwelling jugular vein catheter. Starting at 28 d of age, pigs were either fed for 72 h (CON72; n = 8), fed for 96 h (CON96; n = 8), feed deprived for 72 h (FD72; n = 8), or FD72 and then re-fed from 72-96 h (FD72/RF24; n = 8). Pigs were sacrificed at 72 h (CON72 and FD72) or 96 h (CON96 and FD72/RF24) for collection of tissues. Body weights were determined at cannulation and sacrifice, and feed consumption was determined at 23 d, 26 d, 28 d and at sacrifice. Blood was collected at 12 h intervals starting at -12 h relative to the start of the feed deprivation period and continuing until sacrifice. Mean body weights of pigs in the FD72 treatment was less than CON72 at sacrifice ($P < 0.05$); however, the mean body weight of FD72/RF24 pigs did not differ from CON96 ($P > 0.05$). Concentrations of ghrelin in the FD72 and FD72/RF24 groups differed throughout time ($P < 0.001$) and when presented as values relative to 0 h were 89% at 12 h ($P < 0.03$), then increased to 112% at 36 and 48 h ($P = 0.10$), then decreased to 75% at 72 h ($P < 0.001$). Serum IGF-I and leptin decreased following feed deprivation ($P < 0.001$) and remained low until re-feeding. Cortisol was elevated from 12 h to 72 h during feed deprivation ($P < 0.01$). Expression of ghrelin mRNA tended to be lower in the FD72 pigs' stomachs, pituitary glands, and hypothalami ($P = 0.06$, 0.07, and 0.08, respectively), compared to CON pigs. These results provide evidence that feed deprivation is accompanied by multiple changes in the endocrine and neuroendocrine axis which influences feed intake, somatotrophic regulation and stress hormone concentrations.

Key Words: Piglet, Food deprivation, Weaning

403 Influence of short-term fasting on ovarian follicular development in ewes. M. McFarland*, Z. Kiyma, E. A. Van Kirk, and G. E. Moss, *University of Wyoming, Laramie.*

The objective of this experiment was to determine if fasting during the luteal phase of the estrous cycle influenced ovarian follicular development during the ensuing proestrus. Fasted (n = 15) ewes were not fed from d 7 to 12 of the estrous cycle. Control (n = 10) ewes were fed ad libitum. On d 12 ewes were treated with $PGF_2\alpha$ and ovarian follicles present after 0 and 72 h in control and 0, 72 and 96 h in fasted ewes were enumerated and categorized as small (< 2 mm), medium (3 to 4 mm) or large (>5 mm). At 0 h, ovaries from fasted ewes contained fewer small ($P < 0.05$) and medium ($P < 0.05$) follicles than control [19.6 vs. 9.4 ($\pm$ 2.9) and 8.4 vs. 3.4 ($\pm$ 1.5) for small and medium follicles, respectively]. Three fasted ewes exhibited an LH surge and ovulated by 96 h and were removed from analysis. When follicular populations were compared in the remaining animals at approximately 16 to 21 h prior to the anticipated preovulatory LH surge no differences ($P = 0.63$) were detected among groups. Serum concentrations of estradiol following administration of $PGF_2\alpha$ were influenced by a treatment by time interaction ($P < 0.01$). At comparable times prior to the anticipated LH surge (i.e. 72 h in C vs. 96 h in F) concentrations of estradiol were nearly 2-fold greater in control than fasted ewes. Serum concentrations of FSH were influenced ($P < 0.01$) by a treatment by time interaction and were greater

(32.3 ± 2.2 vs. 25.0 ± 3.0 ng/mL) in control than fasted ewes. Concentrations of LH were not influenced ($P > 0.43$) by treatment, time, or interactions. In summary, fasting during the luteal phase of the estrous cycle acutely decreased numbers of small and medium ovarian follicles. Realimentation resulted in a rapid equilibration in follicular populations, however, concentrations of estradiol during proestrus remained depressed perhaps due to diminished secretion of FSH.

Key Words: Ewes, Fasting, Proestrus

404 Effect of fish meal supplementation on endometrial sensitivity to oxytocin in beef heifers having low luteal phase progesterone. N. E. Wamsley*, P. D. Burns, T. E. Engle, and R. M. Enns, *Colorado State University, Fort Collins, CO.*

The objective of this study was to evaluate the ability of n-3 fatty acids in fish meal to attenuate oxytocin-induced release of uterine prostaglandin F2a (PGF) in heifers having low luteal phase concentrations of progesterone (P4). Heifers were individually fed a corn silage-based diet supplemented with either fish meal (FM; 5% DM; n=12) or corn gluten meal (CM; 6% DM; n=13). After d 25 of supplementation, heifers were given 25 mg of PGF to induce estrus. On d 3 after estrus, half of the heifers in each supplement group were given 3 injections of PGF (25 mg/injection) at 12 h intervals to induce formation of corpora lutea that secrete lower concentrations of P4. Jugular blood samples were collected daily from d 1 to d 16 after observed estrus and assayed for P4. On d 16, heifers were challenged with oxytocin (100 IU; iv). Jugular blood samples were collected at -60, -30, -15, 0, 15, 30, 45, 60, 90, and 120 min post oxytocin injection and assayed for 13, 14 dihydro 15-keto PGF2a (PGFM). Administration of PGF on d 3 induced low luteal phase concentrations of P4 in 5 FM heifers and 3 CM heifers. Non-responding heifers were sorted to the high luteal phase group. One FM heifer and 3 CM heifers receiving no PGF on d 3 had low luteal phase P4 and were sorted to the low group. After sorting, treatments consisted of high luteal P4 + FM (n=6), low luteal P4 + FM (n=6), high luteal P4 + CM (n=6), and low luteal P4 + CM (n=7). Dietary supplement had no effect (P>0.20) on serum concentrations of P4, but concentrations of P4 were lower in heifers in the low luteal phase group (P<0.01). Serum concentrations of PGFM following oxytocin stimulation were greater in heifers having low luteal phase concentrations of P4 compared to heifers having high luteal phase P4 (P<0.01). Fish meal supplementation attenuated this response in heifers having low luteal phase concentrations of P4 (P<0.05), but had no effect on heifers having high luteal phase concentrations of P4 (P>0.10). In conclusion, the n-3 fatty acids in fish meal appear to decrease uterine PGF synthesis in heifers having low luteal phase concentrations of P4.

Key Words: Heifer, Fish meal, Prostaglandin

405 Growth hormone (GH) binding in liver of periparturient Holstein cows is correlated with growth hormone receptor (GHR) 1A mRNA. R. P. Radcliff*[1], B. L. McCormack[1], B. A. Crooker[2], and M. C. Lucy[1], [1]*University of Missouri, Columbia,* [2]*University of Minnisota, St. Paul.*

Growth hormone plays a central role in metabolic adaptations that occur during the initiation of lactation. The primary liver GHR transcript (GHR 1A mRNA) is transiently decreased around parturition. The decrease in liver GHR 1A mRNA may cause a reduction in GH-dependent signaling that leads to low blood IGF-I concentrations in periparturient cattle. We tested the hypothesis that the decrease in GHR 1A mRNA at parturition is associated with a decrease in GH binding (i.e., GHR protein expression) in liver. Blood and liver samples were collected from Holstein cows (n = 12) on d -12 ± 1, +3 and +17 relative to parturition. Total cellular RNA was isolated from a sub-sample of liver and reverse transcribed (RT) to cDNA. The GHR 1A and IGF-I cDNA were measured by quantitative real-time polymerase chain reaction. Microsomal membranes were isolated from the remaining liver sample and assayed for GH binding. Liver GHR 1A mRNA (183, 31 and 132 ± 27 fg/25 ng RT, $P < 0.004$), liver IGF-I mRNA (172, 31 and 83 ± 20 fg/25 ng RT, $P < 0.001$), and blood IGF-I concentrations (130, 55 and 71 ± 8 ng/ml on d -12, +3 and +17, respectively, $P < 0.001$) were coordinately decreased on d +3. A decrease ($P < 0.03$) in specific ^{125}I-GH binding also occurred on d +3 (5.2 ± 0.8, 1.7 ± 1.0 and 5.1 ± 0.8% on d -12, +3 and +17, respectively). Across all days, ^{125}I-GH specific binding was correlated with GHR 1A mRNA ($R^2 = 0.68$; $P < 0.001$). Saturation binding analysis of pooled microsomal membranes demonstrated a 30- and a 3-fold decrease in GH receptor number (B_{max}) for liver on d +3 and +17 relative to d -12 (4.95 ± 0.57, 0.16 ± 0.03 and 1.38 ± 0.06 fmole/mg protein on d -12, +3 and +17, respectively). We conclude that the decrease in GHR 1A mRNA leads to a decrease in GHR protein and a decrease in GH binding to liver. This reduced GH binding likely contributes to decreased liver IGF-I synthesis and secretion and the postpartum reduction in circulating IGF-I in periparturient cows.

Key Words: Growth hormone, receptor, parturition

406 Obesity disrupts the duration of the estrous cycle in the mare. B. P. Fitzgerald*, S. E. Reedy, D. R. Sessions, M. M. Vick, and B. A. Murphy, *University of Kentucky, Lexington KY.*

In several species obesity is associated with anovulation, cystic or polycystic ovaries or increased interovulatory intervals. In the horse, aberrant estrous cycles occur in transition to or from the breeding season. However, it is unknown whether obesity specifically disrupts reproductive activity in the mare. To test the hypothesis that obesity disrupts estrous cycles in the mare, a group of mature mares were feed restricted or fed ad-libitum during a period encompassing the breeding and non-breeding seasons (July–Feb). Specifically, 12 mares (aged >15 years) were maintained on a dry-lot (Group 1; restricted, n=6) or pasture (Group 2; ad-libitum, n=6). Feed restriction was initiated in July and comprised a period of adaptation followed by a maintenance diet. Mares were initially fed timothy hay (6.5-6.8 kg/d; 10.5 and 11.0 Mcal DE/d). Once the target body condition (score 4/10) was achieved, mares were maintained on dry-lot and fed timothy hay (13.5 - 14.0 kg/d; 22-22.8 Mcal DE/d) until completion of the study. Beginning Sept 6, blood samples were collected three times per week until Feb 26; bodyweights were determined at 3 week intervals. Blood samples were assayed for progesterone, thyroxine, leptin and insulin. In unrestricted mares, increased adiposity (condition score 7 and above) was accompanied by lengthened luteal phases, compared to lean mares (32.060.83 versus 18.250.78 days; P<0.001, n=6/group). Mean interovulatory intervals appeared longer in obese versus restricted mares (40.139.17 versus 26.770.51 days). Mean monthly bodyweight (P<0.01) insulin (P<0.001) and leptin (P<0.001) were higher in obese versus lean mares, whereas T4 was lower (P<0.01). In summary, obesity leads to aberrations in the estrous cycle, specifically a lengthened luteal phase and is associated with significantly increased circulating concentrations of leptin and insulin.

Key Words: Equine, Obesity, Estrous cycle

407 Characterization of equine bacterial artificial chromosomes (BACs) relevant to endocrine and immune system regulation. T. M. Bryan*, C. A. Abbey, T. Raudsepp, B. P. Chowdhary, C. A. Gill, T. L. Blanchard, N. H. Ing, and T. H. Welsh, Jr., *Texas A&M University System, College Station.*

The long-term objectives of this project are to increase the number of endocrine and immune system genes on the horse cytogenetic map and to develop horse specific cDNA probes for use in physiological studies. The glucocorticoid (GR), luteinizing hormone (LHR), and Toll-like receptors (TLR4) are pivotal regulators of adrenal, gonadal, and immune functions, respectively. Consensus primer sequences were designed for the GR, LHR and TLR4 using multiple species sequence alignment. Based on human genome sequence data, these genes are predicted to map to chromosomes 14 or 21, 15 or 18, and 23 or 25, respectively in the equine genome. Primers were used to screen the CHORI-241 Equine BAC library and PCR-positive BAC clones were confirmed by sequencing. Verified BACs are being mapped by fluorescence in situ hybridization (FISH). One set of primers specific for the alpha isoform of GR is in the 3# UTR of exon 9A. The equine sequence shows 97% identity with human genomic sequence. A five nucleotide deletion in the equine sequence is 1288 bases from the exon 9A stop codon. Primers were designed that amplify a product in exon 2 of GR, which hybridizes to both alpha and beta isoforms. This nucleotide sequence in the horse shows 91% identity with human genomic sequence. A deletion is present in the equine coding sequence eliminating Lys-Leu at amino acid 182-183. Also, there are ten amino acid substitutions in the PCR product for exon 2. Beta specific GR primers have been identified in the 3# UTR of exon 9B and are currently under development. The PCR product for LHR is in the twelfth exon predicted by NCBI Model Maker and there is 92% sequence identity between horse and human sequence. There are eleven amino acid substitutions in the LHR PCR product for the horse.

A BAC clone amplifying a product of the expected size has been identified for TLR4 and will be verified by sequencing prior to FISH. These methods overcome the disadvantage associated with limited availability of whole genomic sequence information for domestic animals. Confirmed sequence analysis of equine BAC clones permits chromosome assignment and physiological investigation of genes that are primary regulators of stress responsiveness, fertility and immunity in the horse.

Key Words: Glucocorticoid receptor, Luteinizing hormone receptor, Toll-like receptor 4

408 Breedtype influences adrenal responsiveness to corticotropin-releasing hormone (CRH) in beef steers. R. J. Hollenbeck*[1], D. A. Neuendorff[2], A. W. Lewis[2], T. A. Strauch[2], R. D. Randel[2], and T. H. Welsh, Jr.[1], [1]*Texas Agricultural Experiment Station, College Station,* [2]*Texas Agricultural Experiment Station, Overton.*

Adrenal responsiveness to exogenous bovine CRH was studied using Angus, Brahman, Bonsmara and Bonsmara X Angus steers (BW=33239 kg; n=6 for each breedtype). Blood samples were collected via indwelling jugular cannula at 120, 90, 60, and 30 min prior to, and at 10, 20, 30, 60, and 120 min after CRH administration (Time 0; 0.1 ug/ kg BW). Plasma cortisol (CS) concentration was determined by RIA. During the 120-min period prior to CRH administration Brahman steers had higher plasma CS (19.32.1 ng/ml) than Angus (14.22.1 ng/ml, P<.1), Bonsmara X Angus (11.32.1 ng/ml, P<.01), and Bonsmara (6.92.1 ng/ml, P<.01). Plasma CS did not differ (P>.10) among breeds at Time 0. Amplitude of the CS response was lower (P<.08) in Bonsmara X Angus (14.33.3 ng/ml) than Angus (22.73.3 ng/ml), Bonsmara (20.43.3 ng/ml) and Brahman steers (203.3 ng/ml); peak plasma CS was greater in Angus (32.23 ng/ml) than Bonsmara (24.33 ng/ml, P<.07) or Bonsmara X Angus (18.53 ng/ml, P<.01), but not Brahman steers (28.73 ng/ml). Angus and Bonsmara X Angus steers displayed a more rapid CS peak response to CRH (11.72 and 13.32 min, respectively) than Brahman (21.72 min, P<.01), or Bonsmara steers (26.72 min, P<.01). Plasma CS returned to basal concentration more slowly in Bonsmara (83.314.4 min) than Angus (5014.4 min, P<.1), Brahman (4014.4 min, P<.04), or Bonsmara X Angus steers (4014.4 min, P<.04). Following re-establishment of basal CS post-CRH, the Brahman steers had higher plasma CS (14.31.8 ng/ml) than the Angus (8.71.8 ng/ml, P<.04), Bonsmara (6.61.9 ng/ml, P<.01), or Bonsmara X Angus (5.91.8 ng/ml, P<.01). Relative to the other breedtypes, the Bonsmara and Bonsmara X Angus maintained lower plasma CS throughout the pre- and post-CRH sampling periods. In summary, plasma CS varied among breedtypes prior to and after administration of CRH. These data are useful in evaluating adrenal function and/or stress-responsiveness in various tropically-influenced cattle breeds.

Key Words: Corticotropin-releasing hormone, Cortisol, Beef cattle

409 Effect of transportation on hypothalamic-pituitary-adrenal axis activation and subsequent responsiveness to trophic hormone stimulation in cattle. M. Knights* and G. W. Smith, *Michigan State University, East Lansing, MI.*

In the present study, we examined the effect of transportation on circulating ACTH and cortisol concentrations and the subsequent responsiveness of the anterior pituitary (AP) to corticotropin releasing factor (CRF) and arginine vasopressin (AVP) stimulation in cattle. Holstein steers (n = 13; 227.3 5.1 kg, 5.4 0.1 months of age) were transported for 10 h or used as un-transported controls. Blood samples were collected via indwelling jugular cannula at 0, 1, 2, 3, 4, 6, 8 and 10 h relative to start of transportation for subsequent assay of plasma ACTH and cortisol concentrations. After 2 weeks, treatments were switched and the experiment repeated. All animals were transported or used as controls only once. No effect of replicate was observed and data for transported and control steers were pooled (n = 13). To test AP responsiveness to trophic hormones, steers were challenged with either CRF (0.5 mg/kg) or AVP (1 mg/kg) administered i.v. immediately after the end of transportation in each replicate, and blood samples were collected for another 3 h at 30 min intervals. Transportation resulted in an increase (P < 0.001) in plasma ACTH within 1 h that remained elevated for 6 and 8 h relative to controls (P < 0.01) and time 0 (P < 0.05), respectively. Plasma cortisol showed a similar pattern except that concentrations were higher (P < 0.05) in transported steers at the end of transportation. Injection of CRF or AVP resulted in a significant increase in plasma ACTH within 30 min (P < 0.001) and concentrations remained elevated for 60 min in control animals. However, the magnitude and duration of ACTH secretion in response to CRF or AVP was dramatically reduced in transported steers (Transport, P < 0.05; Transport X Time, P < 0.01). In conclusion, transportation stress results in an increase followed by a gradual suppression of AP secretion of ACTH accompanied by a decrease in AP responsiveness to CRF and AVP stimulation. Supported by USDA 2001-35204-10801 (GWS) and the Michigan Agricultural Experiment Station.±±

Key Words: Transportation stress, HPA axis, Tropic hormones

410 Effects of bromocriptine treatment on prolactin, prolactin receptor, and immune function of calves on different photoperiods. T. L. Auchtung* and G. E. Dahl, *University of Illinois, Urbana, IL.*

Photoperiod enhances milk production in lactating cattle. In addition, we have observed photoperiod manipulation alters function of immune cells. For example, dry cows exposed to short day photoperiod (SD; 8h light: 16h dark) have increased immune cell competence relative to cows maintained on long days (LD; 16L: 8D). Photoperiod also has a profound effect on prolactin (PRL) concentrations and PRL is known to be a mediator of various functions of the immune system. The objective of this experiment was to determine if PRL mediates changes in immune cell function seen under different photoperiods. Our model was Holstein steers (n = 6) exposed to 12:12 lighting for acclimation, then maintained under LD or SD. Steers were exposed to LD for two periods of 14 d each and SD for one period. Bromocriptine (0.05 mg/kg) was administered subcutaneously to each animal during one of the periods when they were on LD in a balanced randomized design. Bromocriptine was administered to reduce PRL in LD animals to concentrations similar to that of SD steers. Each steer was injected daily for 7 d with either bromocriptine (LD-b) in vehicle (ethanol:methanol) or vehicle alone (LD-v, SD-v). Blood was collected daily during each treatment period and PRL was measured using RIA. Lymphocytes were isolated from heparinized blood and used for RNA isolation or a proliferation assay. Neutrophils were isolated from blood collected on EDTA and chemotaxis was performed using interluekin-8 and C5a as chemoattractants. Prolactin receptor (PRL-R) mRNA was estimated in lymphocytes using real-time PCR. Relative to SD-v and LD-b, LD-v steers had greater PRL concentrations ($P < 0.05$), whereas PRL of SD-v and LD-b steers did not differ. LD-v lymphocytes had lower PRL-R mRNA expression ($P < 0.05$) than either SD-v or LD-b. Both chemotaxis and lymphocyte proliferation were enhanced in SD-v and LD-b steers compared with LD-v. Our results suggest that shifts in PRL sensitivity may mediate the SD photoperiod enhancement of certain immune cell functions in cattle.

Key Words: Cattle, Photoperiod, Bromocriptine

411 Weight gain, carcass and meat characteristics of pasture fed LHRH immunocastrated, castrated and intact bulls. E. Ribeiro*[1], J. Hernandez[2], E. Zanella[3], M. Shimokomaki[1], S. Ferreira[1], E. Youssef[1], H. Ribeiro[1], and J. Reeves[2], [1]*Universidade Estadual de Londrina,* [2]*Washington State University,* [3]*Universidade e Passo Fundo.*

This experiment was carried out to evaluate the effect of surgical and immunocastration on growth and carcass characteristics of beef cattle slaughtered at 3 years of age. Seventy bulls (Nellore-cross) were divided into three groups: 1) immunized against LHRH fusion protein, 2) castrated and 3) intact control. The animals were 24 mo old at the initiation of the study and ranged on Brachiaria grass, in Mato Grosso, Brazil. Testes and epididymides weights were heavier (P < 0.05) for intact bulls than immunized bulls (460, 140 g and 45, 20 g, respectively). At slaughter intact bulls had higher body weights, and ADG compared to immunized and surgically castrated animals (517, 485, 478 kg and 0.672, 0.513, 0.488 kg/d, respectively). Intact bulls had higher carcass weights and muscle percentage compared with the other two groups. Both castrated and immunized animals had greater marbling (3.5 and 5.0) and percent carcass fat (23.9 and 25.2 %) than the intact bulls (2.1 and 17.9 %, respectively). Although averages for tenderness, measured by a trained panel (scale from 1 to 9) and by a texturometer (Newton's force), were inferior for intact bulls, they did not reach statistical significance (P = 0.12 and P = 0.13, respectively). The tenderness averages for castrate, immunized and intact bulls determined by the panel were 5.5, 5.8 and 5.0, and by the texturometer, 119, 125 and 145, respectively.

Other quality meat traits, as juiciness, flavor, thawing and cooking losses did not differ among the three groups. Carcass yield was also similar for the groups. Immunocastration was effective in producing carcass traits similar to that of surgical castration. Therefore, this vaccine appears to have practical utility in the management and castration of grazing bulls in Brazil.

Key Words: LHRH immunization, Carcass, Bulls

Ruminant Nutrition: Nutritional management & transition

412 Nutritional management of the dairy cow: Minimizing disorders to optimize production and maximize profitability. T. R. Overton* and M. R. Waldron, *Cornell University, Ithaca NY.*

Successful lactation depends on sound nutrition and management programs that are interdependent. Attention to detail in these areas, especially during the periparturient period, is a major determinant of farm profitability. Sound reproductive and nutritional management during the breeding period and gestation are required to achieve optimal body condition (BCS) at parturition. Typical recommendations for BCS at parturition are 3.5 to 3.75; however, recent data indicate that cows of BCS ∼3.0 may have improved health and early lactation performance. Management of periparturient BCS is critical to minimize the extent of negative energy balance and its associated mobilization of adipose that results in elevated plasma NEFA levels. Plasma NEFA can accumulate in the liver as triacylglycerol (TAG) and impair both metabolic and immune function. Superior nutrition and management can avert excessive TAG accumulation during the peripartum period. Dietary supplementation or oral administration of nutrients or compounds such as choline, niacin, calcium propionate, propylene glycol, glycerol, fat, and trace minerals are used as prophylactic measures when nutrition or management is suboptimal. Though commercial use of these supplements is common, recent data and review of the research literature indicates efficacy only under certain circumstances and when administered by specific methods. Recent data also have provided possible physiological links between the associations of primary infectious disease with the occurrence of secondary metabolic disorders, thereby emphasizing the importance of sound energy, protein, and macromineral nutrition for immunocompetence of the periparturient cow. Dietary vitamin and trace mineral supplementation above NRC requirements or from alternative sources have been emphasized to promote immune function. Although in vitro data sometimes are supportive of this practice, research into the requirements of these nutrients to optimize immune function in lactating dairy cows needs to be conducted.

Key Words: periparturient cow, metabolism, immune function

413 Feeding glycerol to transition dairy cows: Effects on dry matter intake, milk production, and blood metabolites. J. M. DeFrain*[1], A. R. Hippen[1], K. F. Kalscheur[1], and P. W. Jardon[2], [1]*South Dakota State University, Brookings,* [2]*West Central Soy, Ralston, IA.*

Twenty-one multiparous and nine primiparous Holstein cows blocked by parity and expected calving date were used in a randomized block design to evaluate the effects of feeding glycerol from 14 d prepartum until 21 DIM. Energy density and crude protein were 1.50 and 1.65 Mcal/kg and 16.5 and 18.6 % for pre- and postpartum diets, respectively. Treatments (kg/d) were: 1 of corn starch (CON), 0.5 corn starch + 0.5 glycerol (MIX), or 1 glycerol (GLY), topdressed, and hand-mixed into the upper 1/3 of the TMR. Prepartum DMI was greater for cows fed CON compared with MIX or GLY (13.0, 10.9, and 10.9 ± 0.36 kg/d, respectively). Postpartum DMI was not affected by treatments. Milk yields during the first 70 DIM were greater for multiparous cows fed CON or MIX than for GLY (44.7, 44.1, and 39.9 ± 1.48 kg/d, respectively) whereas milk yields of primiparous cows fed CON or GLY were greater than for MIX (29.2, 29.1, and 26.1 ± 2.32 kg/d). The MIX and GLY diets decreased MUN relative to CON (14.04, 12.52, and 12.59 ± 0.46 mg/dl, respectively). Prepartum plasma glucose, BHBA, and NEFA were not affected by treatments. At 7 and 14 DIM, plasma glucose was similar among treatments; however, plasma glucose in cows fed CON and MIX were greater than those fed GLY at 21 DIM (67.5, 64.9, and 50.2 ± 3.71 mg/dl, respectively). Feeding GLY decreased plasma NEFA at 7 DIM compared with CON and MIX (458, 855, 896 ± 118 μEq/L, respectively); however, NEFA were similar among treatments at 14 and 21 DIM. There was a tendency ($P = 0.07$) for animals fed GLY to have greater concentrations of plasma BHBA postpartum (7, 14, and 21 DIM) compared with CON, but BHBA levels in cows fed MIX were intermediate to those fed CON and GLY. These data indicate glycerol fed at 1 kg/d delayed the onset and degree of fat mobilization during the first 3 wks postpartum. The greatest potential for glycerol to prevent ketosis was observed during the first 7 DIM and the optimal inclusion rate is between 0.5 and 1 kg/d.

Key Words: Periparturient, Glycerol, Metabolites

414 Effects of prepartum diet and postpartum drenching on production performance and blood parameters of early lactation primiparous and multiparous Holstein cows. B. M. Visser*, J. G. Linn, S. M. Godden, and M. L. Raeth-Knight, *University of Minnesota, St. Paul, MN, USA.*

This study was a 2 x 3 factorial with 3 prepartum dietary treatments and a propylene glycol (PG) drench of 0 (-) or 300 (+) ml on day 1 and 2 postpartum. Prepartum diets were control (C), anionic supreme (A), and base supreme (B). Diet C was 75% forage and a 25% mixture of corn, soybean meal, minerals and vitamins. Supreme diets were 61% forages and a 39% mixture of corn, soybean meal, sugar, soluble fiber, yeast, enhanced minerals and vitamins with (A) and without (B) anionic salts. All cows received the same postpartum diet the first nine weeks of lactation. Seventy multiparous (M) cows were assigned to diets A, B and C and 32 primiparous (P) cows were assigned to diets B and C starting 21 days before parturition. Half of the M and P cows assigned to each dietary treatment received the PG drench. Diet A reduced DMI prepartum of M cows compared to cows fed diet B and C over the 21 days prepartum (12.1, 13.5 and 14.4 kg/d for diet A, B, and C), however, cows fed diet C had the largest decline in DMI week -1 prepartum (20%, 13%, and 12% for diet C, A, and B). There was no effect of diet, drench or diet by drench interaction within parity on milk yield or milk components the first nine weeks of lactation. Milk production for M cows was 49.1, 48.1, 49.3, 48.2, 46.9, and 46.7 kg/d for treatments A-, A+, B-, B+, C-, and C+ the first nine weeks of lactation. Milk production for P cows was 34.4, 32.6, 33.0, and 33.3 kg/d for treatments B-, B+, C-, and C+ for the first nine weeks of lactation. Milk fever incidences of M cows fed diets A, B, and C were 0%, 4.8%, and 22.7%. Ketosis incidences were 12% and 25% for P cows and 17% and 13% for M cows on drench (+) and (-), respectively. Blood calcium concentrations of M cows fed diet A were higher ($P<0.05$) at parturition (8.3 mg/dl) than for cows fed diets B and C (7.9 and 7.4 mg/dl). Blood glucose concentrations of P cows were higher ($P<0.05$) the first 7 days of lactation (87.4 vs 76.8 mg/dl) with drenching (+).

Key Words: Transition, Metabolic, Drench

415 Interrelationships of prepartum dry matter intake with postpartum intake and hepatic lipid accumulation. J. K. Drackley*, *University of Illinois, Urbana, IL.*

Grummer (JAS 73:2820) reported a correlation (r=0.54) between dry matter intake (DMI) 1 d prepartum and DMI 21 d postpartum. We reported previously, however, that cows fed restricted amounts of diet during the dry period had greater DMI postpartum and less lipid accumulation in liver (JDS 81[Suppl. 1]:295). The hypothesis tested here was that extent of prepartum DMI decrease is more important than actual prepartum DMI for postpartum DMI and hepatic lipid content. Multiparous Holstein cows (n=50) were fed 1 of 5 diets during the dry period; anionic salts were added during the last 14 d prepartum. Three diets were fed for ad libitum intake; two were fed to supply only 80% of calculated NE_L requirements. All cows received a lactation diet postpartum. Mean DMI for wk -3 and wk -1 were 12.0 kg/d (range 6.2 to 21.3 kg/d) and 9.2 kg/d (3.0 to 18.3 kg/d). Decreases in DMI at wk -1 from wk -3 and at d -1 from d -7 averaged -20.0% (-10.0 to -77.1%) and -23.3% (-31.5 to -93.0%), respectively. Contents (wet weight) of total lipid and triglyceride (TG) at d 1 postpartum averaged 7.0% (3.7 to 16.9%) and 4.6% (0.3 to 15.5%), respectively. DMI for wk 3 postpartum was not correlated with DMI prepartum. DMI for wk 1 postpartum was