575 Enhancing neonatal intestinal growth, development and repair following injury. J. Odle* and R.J. Harrell, North Carolina State University, Raleigh.

Early postnatal morbidity and mortality of mammalian neonates represent significant challenges to the agricultural and medical sciences. While many stressors come to bear on the neonate soon after birth, it is commonly recognized that gastrointestinal maladies are among the most prominent. This is not surprising given the relatively quiescent state of the intestine in utero and the rapid ontogeny required following birth. Furthermore, the intestinal mucosa, initially sterile, must be protected from viral and bacterial pathogens that are ubiquitous in the postnatal environment. Because the intestine is a “supply organ”, the overall systemic health and vitality of the neonate hinges on its development and function. Therefore, understanding the role of various nutritional, hormonal and pharmacologic agents in ushering the growth, development and function of the intestine is seminal. Our studies have specifically examined rotavirus gastroenteritis, a leading cause of neonatal intestinal injury and diarrhea, with the ultimate goal of improving the rate and extent of recovery. Using rotavirus infection within a neonatal piglet model, we have shown that the level of enteral nutrition delivered post-infection can starkly affect the clinical, biochemical and immunological response during recovery. While a brief period of “gut rest” may be beneficial, if prolonged, it can significantly delay recovery. We also have documented a modest mitogenic response of damaged intestine to supplemental epidermal growth factor, and have shown attenuation of rotavirus damage to the intestine of pigs fed milk replacer formulated with plasma proteins compared with soy-protein-based formulas. However, we have been unable to measure beneficial effects of enteral glutamine or alanyl-glutamine. Our collective findings suggest several positive (but modest) effects of various enteral-treatment regimens/agents on intestinal recovery. Further research is needed to understand better the complex interplay between nutrients, growth factors, immunological, and bacterial determinants which impact intestinal health and ultimately neonatal vitality.

Key Words: intestine, growth, rotavirus


Nutrient requirements of preruminant dairy calves are not well described. Current practices, often favoring a least cost approach, may compromise growth performance and health. The present study evaluated and compared immune function in neonatal calves on a higher nutritional plane with that of calves fed a diet meeting current industry standards. Colostrum-fed, Holstein bull calves (n=19) were assigned randomly to 4 d of age to one of two treatment groups. Treatment (TRT) 1 calves were fed a 20% crude protein (CP): 20% fat milk replacer (MP) at a rate of 1.14% BW of dry matter (DM)/d for 8 wk. Calves assigned to TRT 2 were fed a 30% CP: 20% fat MR at a rate of 2.4% BW of DM/d. The functional capacity of mononuclear (MNL) populations from peripheral blood collected at 0, 4, 6, and 8 wk during the study period was estimated using a battery of in vitro tests. Nitric oxide (NO) and interferon-γ production by mitogen-stimulated MNL were influenced (P < 0.05) by nutritional plane, whereas mitogen-induced DNA-synthesis and secretion of tumor necrosis factor-α and polyclonal immunoglobulin were unaffected (P < 0.05). The total number of peripheral blood leukocytes was also unaffected by nutritional plane. These results suggest that increased dietary energy and protein can modulate specific aspects of the neonatal immune system. Additional research is necessary to determine if these changes reflect increased immunocompetency (i.e. infectious disease resistance). Leukocytes from all calves demonstrated age-related changes in their capacity to produce IgM, both cytokines, and NO and to synthesize DNA, possibly reflecting the maturation of the calf’s immune system.

Key Words: Nutrition, Preruminant calf, Immune function

577 Regulation of leptin and leptin receptor (LR) expression with chronic inflammatory challenge in the growing pig. K.L. Houseknecht1, C.P. Portocarrero1, M.E. Johnston2, R.D. Boyd2, M.E. Spurlock3, M.T. Leininger*1, C.A. Bidwell4, M.A. Mellencamp2, and M.E. White5, 1Purdue University, 2PIC USA, Inc., 3Purina Mills, Inc., 4University of Minnesota.

Leptin is an adipocyte-derived protein that regulates appetite and energy homeostasis. Leptin acts via binding and activation of LR; long-form LR predominates in the hypothalamus and are credited with the regulation of appetite control. Short form LR are found in most tissues, and in vitro studies implicate them in the regulation of peripheral tissue metabolism. In rodents, leptin has been implicated in regulating anorexia associated with acute inflammation. As it is not known how the expression of leptin and its receptors are regulated with chronic inflammation in swine, our aim was to determine the effect of serial inflammatory challenges on leptin and LR gene expression in adipose tissue and circulating leptin concentrations. Gilts and barrows (initial body weight ~ 65 kg) were assigned to Control (saline; gilts n=14, barrows n=12) or lipopolysaccharide (LPS; gilts n=11, barrows n=13) treatments. Animals were injected IM every 7 d for a total of 5 injections. The initial LPS dose was 15 µg/kg BW; dosage was increased 50% each 7d. Blood samples were collected at ~24 and +6 h relative to the 5th LPS injection and at slaughter. Animals were slaughtered ~60 h following the final injection. LPS reduced feed intake in barrows and gilts acutely (24 h post-injection; P < 0.01) and chronically (28 days; P < 0.05). Leptin mRNA abundance in adipose tissue of gilts and barrows were not affected by LPS in either sex (P > 0.05). However, chronic LPS treatment caused a dramatic reduction in LR expression in adipose tissue of gilts (70%, P < 0.002) and barrows (81%, P < 0.01) compared to controls. As leptin is thought to regulate its own expression in adipose tissue as well as to regulate insulin action in the adipocyte, down-regulation of LR with chronic inflammation may have important implications for adipose tissue metabolism and whole-body energy homeostasis.

Key Words: leptin, inflammation, swine


Thyroid status is compromised in a variety of acute and chronic infections and contributes to the impaired growth performance observed during disease states. To simulate and assess the impact of low level disease stress on the coordinated response of the thyroid regulatory/response axis, graded levels of LPS challenge (0, 1, 3, 6 and 12 µg/kg BW; dosage was increased 50% each 7d) were administered to experimentally infected and serum leptin were not affected by LPS treatment (n = 4). In female gilts we observed a modest mitogenic response of damaged intestine to supplemental LPS challenge (5% P < 0.01). Plasma reverse-T3 (rT3) and T3 (43±9.4% vs. 8±1.2 ng/dL; P < 0.05). Plasma reverse-T3 (rT3) increased after all LPS doses at 6 and 12 h (P < 0.05). However, chronic LPS treatment caused a dramatic reduction in LR expression in adipose tissue of gilts (70%, P < 0.002) and barrows (81%, P < 0.01) compared to controls. As leptin is thought to regulate its own expression in adipose tissue as well as to regulate insulin action in the adipocyte, down-regulation of LR with chronic inflammation may have important implications for adipose tissue metabolism and whole-body energy homeostasis.

Key Words: Nutrition, Preruminant calf, Immune function
579 Effects of endotoxin (LPS) challenge on plasma adrenomedullin responses in cattle: correlation with maintenance of insulin-like growth factor-I (IGF-I) status. T. H. Elsasser1, S. K. Durham2, K. E. Sykes3, T. S. Rumsey1, E. Breher4, J. E. Minton1, 1 USDA, Agricultural Research Service, Beltsville, MD, 2 Auburn University, Auburn, AL.

Accompanying the acute phase response (APR) to infection, blood shunting and regional tissue hypoxia contribute to free radical accumulation and disruption of tissue function. Tissue expression and circulating plasma concentrations of adrenomedullin (AM), a potent vasodilating peptide, increase with hypoxia and after in vivo challenge with bacterial toxins like LPS. The objective of the present study was to correlate the relative magnitude of AM response to LPS challenge with the capacity for steers to maintain normal plasma concentrations of IGF-I. Twenty-two Angus Hereford steers (mean BW 318 kg) fed to gain 1.25 kg/d were challenged with a single bolus of LPS (E. coli 055B5, iv; 0.2 pg/kg BW). Blood samples for plasma were collected at 0, 1, 2, 3, 6, 8, 12, 24, and 48 h relative to LPS; liver and kidney biopsy samples were collected at 8 h into Bouin’s fixative for immuno-histochemical determination of nitrated proteins (a measure of aberrant nitric oxide-superoxide anion reactions), AM, and inducible nitric oxide synthase. Plasma IGF-I and AM were measured by RIA; plasma NOx2 and NOx3 (NOx) were measured by the Griess reaction. Animals were grouped by AM response, group 1 (G1) having responses < 100 pg/mL over baseline (22 pg/mL) and group 2 (G2) having AM responses > 150 pg/mL over baseline (P < 0.02). Decreases in plasma IGF-I in G1 were 11% and 27% lower at 8 and 48 h, respectively, after LPS than in G2 (P < 0.02). Increased in plasma NOx2 (area under the curve) were 63% greater in G1 than G2 (P < 0.05). Cells with nitrated proteins were more frequent in G1 steers than G2 steers. IGF-I concentrations at 8 and 48 h were positively (P < 0.05) and NOx responses negatively (P < 0.05) correlated with AM response. In conclusion, steers with greater AM responses experienced fewer effects of the APR as reflected in lesser decline in circulating IGF-I concentrations.

Key Words: Endotoxin, Adrenomedullin, Insulin-like Growth Factors

580 Biological markers of neonatal calf performance: relationships among serum IGF-I, zinc and copper to poor growth in Holstein calves. T. W. Graham4, J. E. Breher5, A. M. Oberbauer2, J. S. Cullor2, T. B. Farver2, and M. E. Kehrli5, 1Veterinary Consulting Services, Davis, Ca, 2 University of California, Davis, 3 USDA, National Animal Disease Center, Ames, IA.

The principle objective of this study was to examine for relationships between serum IGF-I and growth during the first 90 days of life in Holstein calves. Potentially explanatory or confounding variables included in these models were serum IgG, total protein (TP) or packed cell volume (PCV) at birth, gender, twin status, bovine leukocyte adhesion deficiency (BLAD), serum Zn and Cu. Holstein calves (n = 421) were fed colostrum and brought to a calf facility where measurements of weight, length, and height were recorded at birth, 30, 60, and 90 days. Jugal blood was drawn from calves on day 1 to determine PCV, TP, IgG, Zn, Cu, IGF-I, and BLAD genotype (homozygous negative for the D128G CD18 allele compared to the heterozygous condition). Jugal blood was also drawn on days 2 through 10, 30, 60, and 90 days to determine serum Zn, Cu, and IGF-I (predictor variables). Serum IGF-I approximatly doubled from birth (15 ng/ml) to 90 days (30 ng/ml) in bulls and heifers, with bulls having approximately 20% more circulating IGF-I than heifers by 90 days of age. Consistently, twins had less circulating IGF-I than singletons. Serum Zn decreased and Cu increased from birth (15 ng/ml) to 30 ng/ml in bulls approximately doubled from birth (15 ng/ml) to 90 days (30 ng/ml) in bulls and heifers, with bulls having approximately 20% more circulating IGF-I than heifers by 90 days of age. Consistently, twins had less circulating IGF-I than singletons. Serum Zn decreased and Cu increased from birth (15 ng/ml) to 90 days (30 ng/ml) in bulls.

Key Words: IGF-I, Zinc/Copper, Inflammation

581 Infection of weaned pigs with Salmonella typhimurium alters plasma insulin-like growth factor binding proteins. J. E. Minton1, S. K. Durham2, R. Balaji1, and S. S. Neumann1, 1Kansas State University, Manhattan, 2 Diagnostic Systems Laboratories, Inc., Webster, TX.

We demonstrated previously that infection of weaned pigs with S. typhimurium resulted in a suppression of circulating insulin-like growth factor-I (IGF-I). Plasma IGF-I was decreased by 24 h, and was maximally suppressed by 48 h following infectious challenge. Additionally, IGF-I circulates primarily as a part of a ternary complex bound to IGF binding protein-3 (IGFBP-3) and the acid labile subunit. Thus, the fall in plasma IGF-I we have observed in diseased pigs may be associated with alterations in circulating concentrations of IGFBP’s. The objective of the current investigation was to evaluate concentrations of the IGFBP’s, primarily IGFBP-3, in plasma of pigs infected orally with S. typhimurium (S). Pigs were penned individually with ad libitum access to feed and water. After an acclimation period, venous catheters were placed in all animals. Pigs were given sterile broth (C; n = 4) or 3 X 109 cfu S (n = 6) in 5 ml broth. Plasma was collected at 24 and 48 h after disease challenge. Plasma was subjected to western ligand blotting (WLB) utilizing 125I-IGF-I and IGFBP-1. Images were evaluated for total IGFBPs by densometric analysis. In addition, plasma samples were analyzed for content of IGFBP-3 utilizing an immunoradiometric assay (IRMA) developed for human IGFBPs. Total IGFBPs were similar between C and S treatments at 24 h, but were reduced (P < 0.01) in infected pigs at 48 h. Concentrations of IGFBP-3, as estimated by the IRMA, were similar between S and C treatments at 24 h, but tended to be reduced (P < 0.08) at 48 h in S (217 ± 45.8 vs 365 ± 56.2 ng/mL). The data suggest that reduced circulating IGF-I provoked by enteric disease is accompanied by changes in peripheral IGFBPs, including IGFBP-3.

Key Words: Disease, Insulin-like growth factor binding proteins, Pigs

582 Effects of endophyte-infected fescue seed on calf performance and physiological indices. C. Golden*, M. Nihsen, S. Wright, M. Poole, T. Denard, E. Piper, and C. Rosenkrans, Jr., University of Arkansas, Fayetteville.

Cattle consuming endophyte-infected tall fescue (EIF) have reduced productivity. That production loss is reportedly exacerbated by heat stress and bacterial challenge. Our objective was to investigate the interactions between EIF seed on calf feed consumption, weight gain and hematol-}

Key Words: Fescue, Stress, Blood

583 Effects of ivermectin and immune challenge on steers consuming endophyte-infected fescue hay. M. Nihsen*, T. Bedingfield, T. Denard, M. Poole, S. Wright, Z. Johnson, E. Piper, and C. Rosenkrans, Jr., University of Arkansas, Fayetteville.

Ivermectin has been used for many years with limited success in producing an effective and efficient treatment. Our objective was to determine effects of ivermectin, and an immune challenge on steer physiological responses and performance while consuming endophyte-infected fescue hay. Calf feed consisting of 20% endophyte-infected fescue (INF) were allotted to treatment by a complete randomized block design with a 2x2 factorial arrangement of treatments. Main effects were: ivermectin...
slow-release bolus (yes or no) and a lipopolysaccharide (Salmonella typhimurium .7 microgram/kg BW) immune challenge (yes or no). Four steers were placed in each of 16 pens and fed a dietary supplement (.45 kg/d per steer; coccoïdïstiat and mineral supplement in a corn carrier) and ad libitum endophyteinfected tall fescue hay. Steer weights, feed consumption, and hematology were collected weekly. Data were ana-
yzed with pen as the experimental unit. Average daily gain and feed intake were decreased (P < .1) for steers receiving both an ivermectin bolus and immune challenge when compared with steers receiving no bolus and immune challenge, and no bolus no immune challenge. Treat-
ing steers with an ivermectin slow-release bolus increased (P < .05) red blood cell counts (9,369 vs. 8,702 SE 2223 cells/microliter), hemogoblin (121 vs. 115 SE 3 mg/ml). Pro-
linctin (8.3 SE 1.5 mg/ml) and leptin (2.6 SE .13 mg/ml) were not (P > .6) altered by either treatment. Serum alkaline phosphatase and choles-
terol were not (P > .6) altered by either treatment; however, lactate dehydrogenase and triglycerides were altered (P < .05) by ivermectin bolus and immune challenge. These data suggest that ivermectin bolus may improve performance of cattle grazing endophyte-infected fescue by altering blood cell function.

**Key Words:** Pescue, Ivermectin, Stress

584 The effect of composition of liquid milk replacer at a low energy level on the small intestinal permeabil-
ity of piglets after weaning. M.A.M. Spreeuwenberg1, J.M.A. Verdenk, and M.W.A. Verstegen1, 2, Nutreco, 1ID-TNO, 2University of Wageningen, The Netherlands.

A total of 36 pigs (25.8 ± 2.0 days, 7.8 ± 1.0 kg) were used to determine the effect of composition of liquid milk replacer at a low energy level on the small intestinal permeability after weaning. Pigs were allocated to three treatments with 12 piglets per treatment. The difference in three milk replacers (9.36 kg of lactose, 3.3 kg of lactose with a high protein content) is accompanied with a lactose content (and vice versa). In the high protein diet, the control diet and the high lactose diet, the protein content was respectively 448.6, 299.5 and 150.3 g/kg of liquid milk replacer. The lactose content was respectively 73.5, 105.8, 78.3, 97.7. No creep feed was provided during the suckling period. The piglets were housed individually in transparent plastic cages, so they had visible contact. At 1, 2 or 4 days after weaning the pigs were sampled at 3.5 m distal of the Ligament of Treits, under general anaesthesia. Permeability coefficient (10−6 cm/s) was measured by Ussing chamber. Transcellular transport was measured by Gly-Sar, paracellular transport was measured by mannitol. At a low energy level, the milk replacer with a high ratio of lactose / protein had a tendency to have less paracellular transport than the control diet (P < 0.10). Compared to day 1, day 2 and 4 had significantly increased paracellular transport (P < 0.05). The ratio between trans- and paracellular transport was significantly increased for the milk replacer with the high ratio lactose / protein compared to the control (P < 0.05). In conclusion, the ratio between lactose / protein can influence the transepithelial transport.

**Key Words:** Weaned pigs, Milk replacer, Permeability

585 In Utero Dietary Conjugated Linoleic Acid (CLA) Alters Body Composition and Growth Rate in New-
born Pigs. S.P. Poulos1, 2, M.J. Azain1, 2, and G.J. Huisman1, 2, 1University of Georgia, Athens, 2USDA-ARS, Athens, GA.

CLA alters body composition when fed to growing animals. This study investigated effects of CLA fed during gestation and lactation on the growth and development of piglets. Sows were fed a control diet containing corn and soybean meal with 0.83% CLA (n = 8). The CLA diet containing corn and soybean meal supplemented with 0.83% CLA-60, Conlincio (n = 6) from day 40 of gestation through weaning (day 28). Within 24 hours of birth (day 0), one male and one female piglet per litter were sacrificed. Body and organ weights recorded and tissue samples were frozen. Weights of remaining pigs were recorded on day 0, 7, 14, 21 and 28. Blood was collected on day 0 and 28. Two barrows and two gilts per litter were weaned onto a corn and soybean meal based diet until market weight. Animals were weighed 69 days post-weaning, and loin eye area and backfat thickness were determined 133 days post-weaning. Sow’s milk samples were collected on day 21 of lactation and fatty acid composition was determined using gas chromatography. Leptin concentrations of pigs’ serum (days 0, 28) and sow’s milk (day 21) were determined via RIA (Linco). CLA did not alter sow’s feed intake, body weight, backfat, birth weight and weight at birth (P > 0.05). CLA resulted in significant decreases in newborn pig heart, kidney, and lung weights, but not backfat weight relative to their body weights (day 0). Body weight and gain were decreased on day 7, 14 (P < 0.05) however, this effect was not significant at weaning (P > 0.05). There was no difference in either weight or weight gain post-weaning. There were no differences in serum leptin on day 0 and day 28 or in sow’s milk on day 21 (P > 0.05). CLA decreased total milk fat by 17% (P < 0.01) and caused significant changes in the amounts of specific fatty acids resulting in an increase in % saturated fatty acids and a decrease in % unsaturated fatty acids in milk from day 21 of lactation (P < 0.05). In Utero Dietary CLA alters body composition in newborn pigs by altering organ weight, but not backfat. Changes in subsequent growth rates until day 14 may be due to changes in the sow’s milk composition since growth rate and body weight did not differ post-weaning. This effect may be of significance when feeding CLA and in helping to determine CLA’s mechanisms of action.

**Key Words:** Conjugated Linoleic Acid (CLA), Swine, Body Composition

586 Adipose tissue characteristics of weaning pigs fed conjugated linoleic acid. V. L. Adams1, 2, C. D. Gilbert1, H. J. Mersmann2, and S. B. Smith1, 1Texas A&M University, 2Children’s Nutrition Research Center, USDA/ARS.

The purpose of the study was to determine if feeding conjugated linoleic acid (CLA) to weaning pigs depressed lipogenesis and preadipocyte proliferation in s.c. adipose tissue. Eighteen weanling pigs (17 d of age; 4.9 kg BW) were allotted randomly to sorghum-based diets supplemented with 1.5% tallow, corn oil, or CLA. The diets provide equal amounts of total lipid (4.5%), crude protein (20%) and cholesterol (0.2%). The piglets were fed a basal diet for 7 d and their respective diets for 35 d before slaughter. Body weights were not different at day 0 and day 28 or at weaning (P > 0.05). Serum alkaline phosphatase and cholesterol were not (P > 0.05) however, this effect was not significant at weaning (P > 0.05). Compared to day 1, day 2 and 4 had significantly increased paracellular transport (P < 0.05). The ratio between trans- and paracellular transport was significantly increased for the milk replacer with the high ratio lactose / protein compared to the control (P < 0.05). In conclusion, the ratio between lactose / protein can influence the transepithelial transport.

**Key Words:** Pigs, Lipogenesis, Fatty acid


The lactating sow limits the growth potential of the neonatal pig by limiting the supply of nutrients and/or not providing the optimum balance of nutrients to maximize growth. Therefore, alterations in sow milk composition could improve piglet growth. Therefore, mixing a partially purified mixture from lactating sows (Landrace x Chester White) were blocked by parity and randomly assigned to receive either a corn-soybean meal diet (control) or a diet with 1% CLA-60 (ConlinCo Inc. Detroit Lakes, MN). Diets were formulated to meet the nutrient requirements of a high producing lactating sow (NRC, 1998) and sows were fed to appetite. Treatments were initiated at approximately 4 d post-gestation and continued until weaning at 22 d of lactation. Sow weights and backfat measurements were taken initially and again at weaning. Pig
weights and sow milk samples were collected initially, 7 d post treatment, and again at weaning. The inclusion of CLA did not alter sow ADFI, ending litter weights (average 60.9±1.0 kg) or litter size (average 10.3±1 pigs/litter), sow weight or backfat losses (P > .20). Milk samples from sows fed the CLA had a lower percentage of total solids (P < .05), fat (P < .01), but were not different in protein or ash content (P > .20). Milk samples from sows fed CLA had greater C12:0, C14:0, C16:0 (P < .01), but were not different in C18:1 (P > .20). Milk samples from sows fed CLA had greater C18:0 concentrations (P < .01), and tended to have lower concentrations of C18:1 (P < .10). However, sows that received CLA had milk with lower concentrations of C18:1 (P < .05), C18:2 (P < .01), and tended to have lower concentrations of C18:3 (P < .10), but were not different in C16:1 (P > .10) or C18:3 (P > .20) concentrations. These results suggest that sow milk fat content can be reduced with the dietary addition of CLA, but this did not result in any differences in piglet growth rate.

**Key Words:** Swine, Lactation, Conjugated linoleic acid

### 588

An immunocastration vaccine (Improvac®) increases growth in individually and group-housed boars. I. McCauley1, G.M. Cronin1, J.L. Barnett1, K.L. Butler1, D.P. Hennessy2, R.G. Campbell1, B. Luxford1, R.J. Smits3, A.J. Tillbrook1, and F.R Dunshea4,5. 1Agriculture Victoria, Victorian Institute of Animal Science, Werribee, Vic 3030, Australia, 2CSL Limited, Parkville, Australia, 3Bunge Meat Industries, Corowa, Australia, 4Monash University, Clayton, Australia.

A total of 120 entire boars (EB), 120 immunocastrated boars (IB) and 60 barrows (BA) were used in a study to investigate the interactions between sex (S) and housing (H) (group (G) vs individual (I) pens). The study consisted of 4 pens of 15 each of EB, IB and BA and 4 blocks of 15 each of individually housed EB and IB. IB were treated with Improvac® (2 ml) at 14 and 18 wks. Pigs were fed ad libitum and measures made between 18 and 23 wks. Data were analysed by an appropriate ANOVA with block/pens of 15 pigs as the experimental unit. The main effect of S was deliberately confounded with block effects in the design and thus cannot be legitimately reported. Also, the sex’s relate only to comparing S within H. There were no sex/interaction for any variable. ADG was highest in IB (908, 1079, 944, 1098, 1225 g/d for GEB, GIB, GBA, IEB and IIB respectively, sed=.99 g/d) and since there were no differences in initial weight, final weight was also highest in IB (102, 109, 104, 113, 118 kg, sed=.23 kg). Feed intake was highest in IB and lowest in EB (2518, 3050, 2871, 2881 and 3463 g/d, sed=112 g/d). FCR was highest in BA and similar for IB and EB (2.80, 2.88, 3.05, 2.64 and 2.83 g/g, sed=.112 g/d). P2 back fat was highest in BA and lowest in EB (2871, 2871, 2871, 2881 and 3463 g/d, sed=112.1 g/d). FCR was not affected by Improvac® treatment, used to eliminate boar taint, also improves growth performance.

**Key Words:** Immunocastration, Vaccine, Boar

### 589


Three hundred (200 entire boars, 100 barrows) pigs were used in a 2x3 factorial design to assess the efficacy of a gonadotrophin releasing hormone (GnRH) vaccine, Improvac®, in eliminating boar taint. The respective factors were sex (barrows (BA), barrows treated with placebo (EB) or barrows treated with Improvac® (IB)) and slaughter age (23 (E) or 26 ws (L)). Vaccines (2 ml) were administered 8 and 4 wks before slaughter. All IB exhibited anti-GnRH titres. Testes (467 vs 219 g) and bulbourethral gland (142 vs 64 g) weights were reduced (P<.001) and serum testosterone were below 2 nM in the majority of IB (94% and 92% at 2 and 4 wks post secondary vaccination, respectively). Boar taint, as assessed by the concentration of androstenone (1.21-, .16 and .11 µg/g for EEB, EIB and EBA and 1.05, .13 and .10 µg/g for LEB, LIB and LBA, respectively) and skatole (1.33, .068 and .048 µg/g and .056 and .046 µg/g in subcutaneous fat, was suppressed (P<.001) to low or non-detectable levels in 100% of IB with the concentrations of taint compounds not significantly different to BA. No IB had high concentrations of both androstenedione (>1.0 µg/g) and skatole (>2 µg/g). In contrast, high androstenedione and skatole were observed in 10.8% of the EB, resulting in 10% of the EB with high concentrations of both compounds. IB grew rapidly (786 vs 868 g, P=.051 and 858 vs 1119 g, <.001, for E and L) than EB with a similar FCR (3.05 vs 3.05 and 3.30 vs 3.10 for E and L) over the 4 wks after the secondary vaccination. Compared to BA, IB were leaner (P<.001) and more feed efficient (P<.05). The vaccine was well tolerated by the pigs, and no observable side reactions could be detected at slaughter. Vaccination of boars with Improvac® allows the production of heavy entire boars with improved meat quality through the prevention and control of boar taint.

**Key Words:** Immunocastration, Boar taint, Growth

### 590

An immunocastration vaccine (Improvac®) and porcine somatotropin (Reporcin®) have synergistic effects upon growth performance in boars. I. McCauley1, M. Kolek1, D. Suster1, W.T. Oliver2, R.J. Harrell2, and F.R. Dunshea3, 1Agriculture Victoria, Victorian Institute of Animal Science, Werribee, Australia, 2North Carolina State University, Raleigh.

Sixteen individually-penned entire male pigs were used in study to investigate the interactions between commercial immunocastration vaccine (Improvac®) and porcine somatotropin (pST, Reporcin®) regimes. The study was a 2x2 factorial design with the respective factors being immunocastration vaccine (unvaccinated or 2 ml of Improvac® at 14 and 18 weeks of age) and pST (0 or 5 mg/d from 18 weeks of age until slaughter). Pigs were individually-penned and fed ad libitum until slaughter at 22 weeks of age. Chemical indicators of boar taint, androstenone (AEN) and skatole (SKA) were measured in fat samples by HPLC. As shown in the table below, while neither Improvac® or Reporcin® alone had any effect upon daily gain, the combined treatment increased daily gain by 25%. Feed intake was decreased by pST treatment but simultaneous treatment with Improvac® ameliorated the reduction in feed intake. FCR was not affected by Improvac®, but was reduced by pST treatment. Improvac® dramatically decreased testes size and the level of both boar taint compounds in fat whereas pST had no effect upon testes weight or fat SKA but reduced fat AEN. For fat AEN, the effects of pST and Improvac® were additive. In conclusion, Improvac® and Reporcin® have synergistic effects upon growth rate in individually-penned boars.

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**Key Words:** Immunocastration, Porcine somatotropin, Boar

### 591

Effect of Paylean™ (racotopamine hydrochloride) on swine growth performance and carcass leanness as determined by 20- and 13-trial pooled summaries, respectively. D.J. Jones1, D.H. Mowrey1, D.B. Anderson1, A.L. Schroeder1, E.E. Thomas1, L.E. Watkins1, R.E. Karnak1, D.M. Roth1, and J.R. Wagner,1 1Elanco Animal Health, Greenfield, IN.

The effect of Paylean on swine growth performance was evaluated from 1983 to 1993 in 20 dose titration trials involving 1,922 pigs. Barrows and gilts were fed 16% crude protein diets containing 0, 5, 10, or 20 ppm Paylean from approximately 67 kg to approximately 105 kg body weight. All growth performance data were taken after a 5- or Paylean withdrawal. Results showed that Paylean increased rate of weight gain (P<0.01) and improved feed to gain ratio (P<0.01) at all doses evaluated. In 13 of the 20 dose trials, carcass data were taken after either
593 Effects of replacing fish meal protein with meat and bone meal protein as a major dietary ingredient on growth performance in rainbow trout (Oncorhynchus mykiss). G.T. Schelling*, M.T. Casten, N.J. Hughes, R.A. Roeder, and R.W. Hardy, University of Idaho, Moscow.

Feeding experiments were conducted to examine the potential of replacing fish meal protein (FM) with a standard, good quality meat and bone meal protein (MBM) in 25% increments for growing rainbow trout. With the objective of making an overall evaluation of growth performance and carcass composition, semi-purified diets were used to provide FM protein:MBM protein of 100:0, 75:25, 50:50, 25:75, and 0:100 as the sole dietary protein in isonitrogenous and isocaloric diets. Two hundred and twenty five rainbow trout (mean weight 120 g) were allotted to five treatments with three replicates in a randomized block design. The tanks were five cubic feet; water flow = 20.5 L/min; temperature = 15°C. The fish were hand fed to satiation twice daily and were weighed on d 0, 21, 42, and 63. Daily gain, daily feed intake, and feed/gain ratios were determined for growth performance. A sub-population of fish were sacrificed on d 63 for body composition determination by whole carcass proximate analysis. In the 100:0 diet, fish gained 3.8 g/d and the relative percentage gains for the series of diets with increasing MBM protein were 100, 90, 83, 85, and 59% (59 lower, P < .05). The feed/gain ratios were .94, .98, 1.04, 1.09 and 1.46 (1.46 less efficient, P < .05), respectively. There were no marked differences (P > .05) in dry matter and protein content of the whole body carcass fed the dietary treatments. The 0:100 diet resulted in reduced growth (P < .05) and therefore, had somewhat more carcass fat (P < .005). This work indicates that FM protein in semi-purified diets for rainbow trout can be replaced with 25 and 50% MBM protein with only 5 and 10% loss in F/G, and even up to 75% with a 15% loss in F/G.

Key Words: Meat and bone meal protein, Fish protein nutrition, Rainbow trout


The slow growth of white sturgeon (Acipenser transmontanus) results in low production and propagation, and we previously reported a considerable growth increase when they were administered 80 µg bST/g body weight of bovine somatotropin (bST). It is the objective of this work to determine growth responses with 0 (C), 40 (L), 80 (M), and 120 (H) µg bST/g body weight (Posilac) administered intraperitoneally at 3 wk and 15 wk intervals. The sturgeon (initial wt. 1100 g) were grown in raceways that held 16°C water, and were fed a commercial trout diet. At the end of the 272 d trial, the C, L, M, and H treatments were sacrificed on d 63 for body composition determination by whole carcass proximate analysis. In the 0:1 diet, fish gained 3.8 g/d and the relative percentage gains for the series of diets with increasing MBM protein were 100, 90, 83, 85, and 59% (59 lower, P < .05). The feed/gain ratios were .94, .98, 1.04, 1.09 and 1.46 (1.46 less efficient, P < .05), respectively. There were no marked differences (P > .05) in dry matter and protein content of the whole body carcass fed the dietary treatments. The 0:100 diet resulted in reduced growth (P < .05) and therefore, had somewhat more carcass fat (P < .005). This work indicates that FM protein in semi-purified diets for rainbow trout can be replaced with 25 and 50% MBM protein with only 5 and 10% loss in F/G, and even up to 75% with a 15% loss in F/G.

Key Words: Meat and bone meal protein, Fish protein nutrition, Rainbow trout

592 Recombinant bovine somatotropin enhances growth rates in two species of ornamental fish; Giant Danios (Brachydanio rerio) and Zebra Fish (Brachydanio rerio). P. R. Simpson*, B. C. Peterson, N. J. Hughes, and G. T. Schelling.

Zebra Fish (Brachydanio rerio) and other tropical fish, such as Giant Danios (Danio aequipinnatus) and Zebra Fish (Brachydanio rerio), are often used as a model for growth development, molecular genetics, and immunology. Their small size is often a limitation in these studies. To address this, 14-week growth studies were initiated to determine the effects of recombinant bovine somatotropin (rbST; 5.0% dilution of Posilac) on growth performance and carcass leanness of Giant Danios, and was shown to have a short-term effect on adult Zebra Fish.

Key Words: Somatotropin, Giant Danio, Zebra Fish

Table of Period Gains (g/d/fish)

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Six-Week Periods

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Key Words: Fish Growth, Somatotropin, Sturgeon

Growth response of rainbow trout to bovine somatotropin dosage levels and administration patterns. G. T. Schelling*, N. J. Hughes, P. R. Simpson, and B. C. Peterson, University of Idaho, Moscow, ID / USA.

A five-week growth study with juvenile rainbow trout administered a sustained-release bovine somatotropin (bST as Posilac®) was conducted to determine the effect of administration level and frequency on growth performance. The study was designed to evaluate the efficacy and efficiency of the sustained deliver system for fish. The treatments were: (C) control, (10/W) 10 µg bST/g BW/weekly, (20/W) 20 µg bST/g BW/weekly, and (120/3W) 120 µg bST/g BW/3/wks. Each treatment consisted of 3 replicate tanks of 5 fish having an initial weight of 16 g. The fish were grown in 15°C water and were hand-fed daily to satiety. A commercial high-fishmeal trout diet was used that contained 57% protein. The fish were fed a diet that met the recognized nutritional requirements. The fish were hand-fed weekly for weighing and treatment, and all non-injected fish received a weekly needle puncture. The 5-wk gains for the fish were: 17.4, 32.1 30.3 and 29.3 g/fish for the C, 10/W, 20/W and 120/3W treatments. All of the bST treatments resulted in increased gains (P < .01) of similar magnitude (P > .5). The average bST gain response over the controls was 75.9%. The P:F for the 4 treatments were 4.57, 3.11, 2.98 and 3.20, respectively. The average F:S improvement (P < .05) was 32.3%. The feed intake for the 4 treatments was 3.0, 4.2, 3.6 and 3.9 g/fish/week respectively, and was increased (P < .05) by all bST treatments by 30.0%. Previous work in this laboratory demonstrated that 120 µg/g BW at 3 wk injection intervals was needed for maximal gain. Since the 10 µg bST/g BW/wk treatment resulted in the same growth performance as the 120 µg/bST/g BW/3-wk period, there is at least approximately a 4-fold increase for bST by using the 3-wk injection frequency. The current work indicates that while the delivery system is efficacious for at least 3 wks, the efficiency is decreased relative to weekly administrations.

Key Words: Fish growth, Somatotropin, Rainbow trout

 Differential expression of insulin-like growth factor binding proteins (IGFBP) -3 and -5 mRNA by primary porcine satellite cells. M.E. White*, H.R. Hathaway1, and W.R. Dayton2, 1 University of Minnesota, St. Paul, MN.

Muscle satellite cells are myogenic cells, which are critically important for postnatal muscle growth. The insulin-like growth factors (IGFs) are believed to play an important role in satellite cell growth and development and the biological activity of IGFs is regulated by binding of IGFs to IGF binding proteins (IGFBPs). Other growth factors, which affect satellite cell growth, may work in part through the IGF-IGFBP system. We have reported previously that IGFBP-3 and -5 are produced specifically by porcine satellite cells (PSC) but not by muscle derived fibroblasts isolated from these primary cultures. The objective of this study was to determine the basal expression levels of IGFBP-3 and -5, steady-state mRNA levels in PSC cultures. IGFBP-3 and -5 mRNA were measured using ribonuclease protection assays (RPAs) using porcine-specific IGFBP-3 and -5 probes. PSC were isolated from the hind limb muscle of 7 wk old cross-bred pigs, plated on reduced growth factor matigel 1:100 (v/v)-coated plates. Proliferating cultures of PSC in control media or exposed to growth factors for 18 hr were harvested and total RNA was extracted. Both IGFBP-3 and -5 mRNA are expressed by primary PSC cultures. IGFBP-5 mRNA expression level is significantly higher in these cultures than IGFBP-3 mRNA. These data indicate that PSC produce IGFBP-3 and -5 mRNA and that steady-state IGFBP-5 mRNA levels are higher than those of IGFBP-3 in these cultures.

Key Words: Satellite Cells, Porcine, IGFBP

 Cell satellite activation, IGF-1 mRNA, myostatin mRNA and hepatocyte growth factor (HGF) mRNA levels in the semimembranosus muscles of anabolic steroid implanted and nonimplanted feedlot steers. W. R. Dayton*, B. J. Johnson2, M. E. White1, and M. R. Hathaway1, 1 University of Minnesota, St. Paul, 2 South Dakota State University, Brookings.


We have reported that glucocorticoids can induce premature differentiation of GH-secreting cells both in vitro and in vivo during chicken embryonic development. In the present study, the mechanism by which these effects are achieved are unknown and under study. Supported by Theratechnologies, Montreal, Canada.

Key Words: GRF, GH, Pig

 Induction of growth hormone (GH) messenger RNA (mRNA) by corticosterone (CORT) in cultures of chicken embryonic pituitary cells. I. Bosis* and T. E. Porter, University of Maryland, College Park.

We have reported that glucocorticoids can induce premature differentiation of GH-secreting cells both in vitro and in vivo during chicken embryonic development. In the present study, the mechanism by which these effects are achieved are unknown and under study. Supported by Theratechnologies, Montreal, Canada.

Key Words: GRF, GH, Pig

 Fatty acid attachment to human growth hormone-releasing factors (1-29) and (1-44)NH2 increases the release of GH and IGF-1 in growing pigs. P. Dubreuil*, T. Aribat1, and P. Brazeau2, 1 College of Veterinary Medicine, University of Montreal, Quebec, Canada, 2 Asana Laboratories, Longueil, QC, Canada, 3 Notre-Dame Hospital, University of Montreal, QC, Canada.

This study evaluated the effect of a fatty acid (hexenoyl trans-3) (A) attachment to the Tyr-1 of the human (b)GHRF(1-29)NH2 and (1-44)NH2 on GH or IGF-1 release. Male growing pigs between 35 and 45 kg BW were used. Human GRF(1-29)NH2 was compared to AGRF(1-29)NH2 following sc injection at doses of 1.25, 5.0 and 20 µg/kg on GH profile. GH AUCs obtained were 3336, 3647, 3948, 5097, 6362 and 8285 cpm at 1, 3, 6, 12, 24 and 48 h respectively. The GH AUCs were significantly higher (P < 0.05) at doses of 5 and 20 µg/kg of AGRF compared to bGHRF suggesting a higher potency of AGRF. In order to extend the concept to hGRF(1-44)NH2, 5 groups of 8 pigs were injected sc BID for 5 consecutive days with 1 saline (3 mL), 2 hGRF(1-44)NH2 (30 µg/kg), 3-5 AGRF (1-144) NH2 at doses of 7.5, 15 and 30 µg/kg. After 5 days of treatment, IGF-1 concentrations were 204, 221, 358 and 401 ng/mL (SEM: 24) for h and AGRF(1-29)NH2, respectively. Greater GH AUCs were observed (P < 0.05) at doses of 5 and 20 µg/kg of AGRF compared to bGHRF suggesting a higher potency of AGRF.

To gain insight into the molecular mechanisms of skeletal muscle development, we searched for genes regulated by the differentiation of C2C12 myogenic cells. The differentiation of skeletal muscle starts when mononucleated myoblasts (MB) withdraw from the cell division cycle, align, elongate, and fuse into multinucleated myotubes (MT). Using Differential Display PCR (dd-PCR) in C2C12 myogenic cells, we tested the hypothesis that the differentiation of MB to form MT is accompanied by significant changes in gene expression. C2C12 cells were grown to 80-90% confluency in DMEM +10% fetal bovine serum. Differentiation was induced by the addition of DMEM + 2% horse serum + 10 µM cytosine arabinoside. Total RNA was extracted from 6 culture plates (3 containing MB, 3 containing MT). cDNA from these samples was used as template for dd-PCR, providing three replicates within treatment. Bands were excised based on the consistency of banding within replicates (cell state) versus differences across cell type. To date, 100 primer combinations (5 anchor (3) x 20 arbitrary (5)) have been used to identify over 100 putative differentially expressed bands. Preliminary sequencing results from four of these bands yielded homologies to Myosin Light Chain-2, AMP deaminase 3, and Glutathione Peroxidase 1. Northern hybridization will be used to confirm differences observed in gene expression from the dd-PCR results. In the past it has been impossible to examine a large array of changes during this critical step in muscle development. Differential Display PCR has allowed us to observe many differences in gene expression between two treatments (differentiated (MT), undifferentiated (MB)) in C2C12 myogenic cells.

Key Words: Somatotroph, Corticosterone, Pituitary


The objective of this study was to investigate a potential role for LXRXs, a ligand-activated orphan receptor expressed in adipose tissue, in regulating adipocyte differentiation. 3T3-L1 preadipocytes were used to examine the effect of treatment with known activators of LXRXs [22(R)-hydroxycholesterol (22R), 20(S)-hydroxycholesterol (20S)] on adipocyte differentiation. Cells were seeded at a density of 3 x 10^4 cells/cm^2 on six-well (35-mm) tissue culture plates in 2 mL of DMEM medium plus 10% fetal bovine serum and were maintained at 37°C in a 5% CO2-humidified environment. Cells were grown to confluence (d 2). On d 0, differentiation was induced with insulin (10 µg/mL), dexamethasone (1 mM), and IBMX (0.5 mM). Cells were treated with either ligand or carrier (ETOH) from d 0 to d 7. In separate experiments, 22R or 20S was administered at concentrations of 2.5, 5, 10, or 20 µM. Cholesterol (Chol), which does not appreciably activate LXRXs, was administered at concentrations of 2.5, 10, or 20 µM. Differentiation was evaluated by measuring sn-glycerol-3-phosphate dehydrogenase (GPDH; EC 1.1.1.8) activity on d 7. Independent experiments were performed on duplicate wells where n=3 for 22R and n=2 for both 20S and Chol. Protein content was determined by the Bradford method using bovine serum albumin as a standard. Compared to controls, 22R reduced GPDH activity (nmol/µmol*mg protein) by 20% at 5 µM (p<0.05) and 40% at both 10 and 20 µM (p<0.01). Administration of 22S did not affect GPDH activity at 5 µM (p>0.08) and 10 µM (p>0.19) while significantly decreasing GPDH at 20 µM (89%, p<0.01). However, 20S appeared to affect cell viability at 20 µM. Cholesterol administration did not have any effect on GPDH activity at any concentration examined. These data suggest the LXRXs receptor may play an important role in inhibition of adipocyte differentiation.

Key Words: Adipose Tissue, Differentiation, LXRX


Identifying genetic markers pertaining to specific traits for growth and carcass quality would be a substantial benefit to the beef industry. The present study was undertaken to test for differential gene expression in intramuscular adipocytes during the deposition of fat in Angus X Hereford steers (n=50) that were fed a high-energy concentrate ration ad libitum for 20 (n=5), 86 (n=15), 121 (n=15) and 146 (n=15) d to obtain various developmental stages of marbling. Subcutaneous fat measurements at slaughter averaged 0.18", 0.29", 0.43" and 0.53" (P<0.05), respectively. Carcass traits were statistically different (P<0.05) between days on feed. Intramuscular adipose was excised from the longissimus dorsi, snap frozen in liquid nitrogen and stored at -80°C. Total cellular RNA was extracted with TRIzol and Dnased. RNA concentrations were normalized and pooled. Pooled samples of total RNA (2 µg) representing each day on feed were then analyzed by differential-display polyamide chain reaction (DD-PCR), using 200 primer combinations comprised of 20 arbitrary (5) and 10 anchor (3) oligonucleotides. Band differences among treatment groups were scored and bands of interest were harvested. Excised bands were reamplified by PCR, sequenced and submitted to GenBank for homology identification. From the 70 reamplified products, 35 did not sequence, 15 did not have homology in GenBank and 25 contained significant homology to known genes. Sequences encoding regions for the translational repressor of NAT1 (cytidine deaminase) and myopodin were evaluated in adipose tissue by Northern hybridization to confirm differential gene expression among treatment groups. Northern results suggest that both the repressor of NAT1 and myopodin are differentially expressed in younger/leaner animals versus older/fatter animals. Gene expression is altered during adipocyte differentiation in intramuscular adipose of fattening steers. (Research funded by Oklahoma Beef Industry Council)

Key Words: Adipose, Cattle, DD-PCR


Mouse mammary epithelial cells (NMuMG cells) were incubated by the addition of 17β-estradiol(lmE, E)+progesterone(10mM, P) or E+P+EGF with or without various types of oligomers(21-mer) to EGF receptor activity domain(cDNA:+711+731). Sense or antisense oligomers were encapsulated in protein A-bearing liposome. Uncoupled protein A and unencapsulated sense or antisense oligomers were separated from liposomes on Sepharose 4B columns(encapsulation efficiency of oligomers in liposome-protein A; 0.8%). Addition of E+P into various concentrations of EGF showed the interaction in DNA synthesis between EGF and E+P(≤0.05). Antisense oligomers 1µM decreased DNA synthesis induced by E+P or E+P+EGF(P<0.05). However, random-sequenced oligomers(21-mer, 1µM) did not inhibit EGF-induced DNA synthesis. The inhibitory effect of sense oligomers should be due to the unexpected match to functional gene product in growth. Cells were bound with keratin monoclonal antibody(5µg/ml) and then incubated with dilution of protein A-bearing liposomes containing sense or antisense oligomers in the presence of E+P or E+P+EGF. Dose dependent inhibition of DNA synthesis was observed. In the presence of E+P+EGF, 10 or 100mM encapsulated antisense oligomers in liposome-protein A inhibited DNA synthesis by 71.2 or 78.9% to control, respectively(P<0.05). The encapsulated oligomers in liposome-protein A inhibited DNA synthesis at 100 fold lower concentration than the unencapsulated oligomers. Incubation with keratin monoclonal antibody increased uptake of oligomers by mammary epithelial cells for 6 hour incubation compared to those without keratin monoclonal antibody, however keratin monoclonal antibody effect was moderate in inhibition of DNA synthesis.

Key Words: Mammary, EGF receptor gene, Liposome
Two experiments were conducted to study the effects of glucagon and insulin on β-oxidation of 1-14C-palmitate by piglet hepatocytes in primary culture. Hepatocytes were isolated from piglets chosen randomly after birth and prior to 12 h of age. Hepatocytes were plated into 25 cm² culture flasks and allowed a 4 h pre-incubation phase at 37°C in basal culture media. Basal media was replaced with incubation media containing palmitate (0.5 mM) and hormones at 4, 22, 46, and 70 h after the basal culture media. Basal media was replaced with incubation media containing 1-14C-palmitate in the presence of 1-14C-palmitate and insulin (0.5 mM) in CO₂ and acid soluble products (ASP) was determined in duplicate using treatment media containing 1-14C-palmitate. Treatments for Exp. 1 (n=6) consisted of increasing glucagon concentrations (G 10⁻¹⁰ – 10⁻⁶ M) in the presence or absence of palmitate (0.5 mM). Treatments for Exp. 2 (n=4) consisted of increasing insulin concentrations (I 10⁻¹¹ – 10⁻⁷ M) in the presence of palmitate (0.5 mM). DNA content for both experiments was unaffected by treatment but declined progressively (p < .001) with time by an average of 60% from 200 ± 59 to 80 ± 16 μg/flask. Results from Exp. 1 and 2 revealed no effect (p>0.1) of treatment on the accumulation of 14C in CO₂ or ASP. However, in Exp. 2 there was a significant decline with time (p<0.001) in the accumulation of 14C from 1-14C-palmitate in both CO₂ and ASP levels where accumulation dropped 50% (155 ± 10 to 78 ± 12 nmol/h/mg DNA) and 63% (282 ± 20 to 105 ± 23) respectively. These results indicate that chronic exposure of newborn piglet hepatocytes to widely divergent hormonal concentrations of insulin and glucagon resulted in no detectable alterations in β-oxidation of 1-14C-palmitate by newborn piglet hepatocytes in primary culture.

Key Words: fatty acid oxidation, hepatocyte, neonatal swine
Our objective was to investigate the responsiveness of the somatotropic axis in young calves. We hypothesized that young calves provided a higher plane of nutrition would express improved growth rates, higher insulin-like growth factor-I (IGF-I) levels, and a greater response to bST treatment. Nine neonatal Holstein bull calves were randomly assigned to one of two treatment groups (n = 6 per group). At 15 d of age (week one) fed milk replacer (MR) until nine weeks of age. Treatment (T1) calves were fed milk containing 20% crude protein (CP), 20% fat at a rate of 1.4% body weight (BW) dry matter (DM) per day. Calves assigned to T2 were fed a 30% CP, 20% fat MR at a rate of 2.4% BW DM per day. Calves were weighed weekly on two consecutive days and DM intake was adjusted accordingly. At five weeks of age, on three consecutive days, all calves were given a daily injection of bST (120 µg/kg BW). Blood samples were obtained every Tuesday and immediately prior to first bST injection and 14 and 24 hours after the third injection. Plasma samples were later analyzed for IGF-I by radioimmunoassay after glycyl-glycine extraction. Average growth rates for calves assigned to T1 and T2 were 0.44 and 1.10 kg/day (P < 0.001), respectively. From week two to week nine of life, calves assigned to T2 had higher circulating IGF-I levels compared to T1, (128.5 ng/mL vs. 73.3 ng/mL for T2 and 1 and 1, respectively (P < 0.001), consistent with the higher energy and protein intake. Calves on both treatments responded similarly to the bST challenge (40% increase in circulating IGF-I levels). Surprisingly, however, calves assigned to T2 exhibited a 460 g increase in growth rate for the seven-day period following bST challenge with no change in intake. Calves assigned to T1 did not exhibit a change in growth rate. We conclude that the somatotropic axis is functioning in young calves, and that calves on a high plane of nutrition are not only able to respond to a bST challenge with higher IGF-I, but also exhibit a greater response at five weeks of age.

Key Words: Calves, Nutrition, IGF-I

609 Thyroid hormones regulate somatotroph abundance during chicken embryonic development. L. Liu* and T. E. Porter, University of Maryland, College Park.

We reported previously that corticosterone can induce somatotroph differentiation in vitro and in vivo and that triiodothyronine (T3) can act synergistically with corticosterone to further augment the abundance of somatotrophs in vitro. The objective of the present study was to test our hypothesis that thyroid hormones regulate the abundance of somatotrophs during chick embryonic development. First, we tested if administration of T3 to developing chick embryos could increase somatotroph proportions prematurely in vivo. Somatotroph differentiation normally occurs between embryonic day 12 (e12) and e16. The albumen of fertile eggs was injected on e11 with T3 (12 pg, 120 pg, 1.2 ng). The embryos were then allowed to continue developing until e13, when pituitary cells were isolated and subjected to reverse hemolytic plaque assays and immunocytochemistry to detect GH-secreting and GH-containing cells, respectively. Injection of T3 increased GH-secreting cells to 7.6 ± 0.7% (12 pg of T3) and 8.4 ± 0.6% (120 pg of T3) of all pituitary cells (P < 0.05), compared to 3.8 ± 0.6% for basal levels. The 1.2 ng dose of T3 was ineffective. The percentage of GH-containing cells was increased from the control level of 4.6 ± 0.9% to 7.4 ± 0.9%, 9.4 ± 0.9% and 12.6 ± 0.9% by 12 pg, 120 pg and 1.2 mg of T3, respectively (P < 0.05). Next, we evaluated the effects of the thyroid hormone synthesis inhibitor methimazole on somatotroph differentiation during development. Injection of 5 µg of methimazole on e9 decreased the abundance of GH-containing cells on e14 from 13.7 ± 0.5% for vehicle treated embryos to 7.8 ± 0.5% (P < 0.05). Taken together, these results indicate that treatment with exogenous thyroid hormones can modulate somatotroph differentiation and that endogenous thyroid hormone synthesis may contribute to normal somatotroph differentiation. Since we reported that T3 alone was ineffective in vitro, we interpret these findings to indicate that effects of treatments in vivo were due to interactions with endogenous glucocorticoids.

Key Words: Somatotroph, Triiodothyronine, Methimazole

610 Effects of recombinant bovine somatotropin (rbST) and nutrition on growth and muscle fiber profiles in early-weaned beef steers. K. E. Moulton*, T. G. Althen¹, A. R. Williams², L. R. Leaco⁴, M. B. Muchow³, I. Bossis¹, M. R. M. Coelhoⁱ, T. G. Althen¹, T. G. Althen¹, and J. S. Eastridge², ¹Mississippi State University, Mississippi State, ²Beltsville Agricultural Research Center, USDA, Beltsville, MD.

Our objective was to determine effects of rbST and nutrition on growth and fiber profiles in beef calves. At 100 d of age, 48 crossbred steers were assigned to treatments on the Calan Feeding System. At 155 d steers were assigned to treatments in a 2x2 factorial design testing the effects of protein fed at levels according to NRC (NP), vs high protein diet (125% of NRC, HP) and rbST (Posilac, 2.2 mg/kg/14 d s.c., ST) vs no rbST (C). Blood samples were taken every 14 d for IGF-1 analysis. Treatments continued until 255 d of age and semitendinosus muscle biopsy samples were collected to determine myofiber morphology. Every 28 d steers were evaluated via ultrasound for backfat (BF) and REA. The C-NP, C-HP, and ST-NP steers consumed more feed than the ST-HP steers (850, 878, 847 vs 724 kg, P < 0.05). The ST steers had improved feed efficiency (FE) when compared to C (0.17 vs 0.15 G/F, P < 0.05). Treatment with ST reduced BF (59 vs 51 cm, P < 0.05) and tended to increase REA (54 vs 51 cm, P = 0.07) at 255 d when compared to C steers. Steers fed the NP diet had more BF than steers fed the HI diet (58 vs 52 cm, P < 0.05). IGF-1 concentrations, cross-sectional areas for fiber types, and percentage distribution of SO fibers were not different between treatments (P > 0.10). The ST treatment resulted in a decrease in percentage FOG (26 vs 31%, P < 0.05) and increase in percentage FG (58 vs 53%, P = 0.05) fibers when compared to C steers. Steers treated with ST gained more efficiently, have less BF and tend to have larger REA than controls. Although concentrations of IGF-1 in blood serum and muscle cross-sectional areas were unaffected by ST, percentage distribution of FG fibers increased and percentage distribution of FOG fibers decreased in ST steers. These data substantiate earlier findings by our lab and demonstrate that ST treatment alters myofiber morphology in beef calves.

Key Words: rbST, Beef Cattle, Muscle Fiber Types

611 Location and ontogeny of thyrotrophs during chicken embryonic development. M. Muchow*, I. Bossis, and T. E. Porter, Department of Animal and Avian Sciences, University of Maryland, College Park.

We demonstrated previously that messenger RNA levels for the beta subunit of thyroid stimulating hormone (TSHβ) are maximal on embryonic day (e) 19 in chickens. However, little is known about the production of TSHβ protein in this species. The present study used a heterologous antisemur to rat TSHβ to determine the location and abundance of TSHβ-producing cells during embryonic development. Western blot analysis was performed to determine the specificity of the rat TSHβ antisemur against the chicken protein. Rat TSH (10 mg), affinity purified chicken LH and FSH (1 µg each), and homogenates of chicken pituitary, liver, heart, and spleen (5 µg of protein each) were separated on a 16% SDS-PAGE gel and transferred to a nitrocellulose membrane, which was probed with the rat TSHβ antisemur. Identical peptide bands (about 17 and 30 kDa) were detected in both the rat TSH and the chicken pituitary samples. No bands were seen in the LH, FSH, or other tissue extract samples, supporting the specificity of the antisemur for chicken TSHβ. Thrytrophs were localized in whole mount preparations of e19 pituitaries both by immunocytemetry (ICC) using the rat TSHβ antisemur and by in situ hybridization (ISH) using a digoxigenin-labeled antisense riboprobe to chicken TSHβ. Both ICC and ISH localized thyrotrophs to the cephalic lobe of the anterior pituitary. Next, ICC was performed on dissociated pituitary cells to define the ontogeny of thyrotrophs during development. Pituitaries from e11-19 embryos and day 1 posthatch chickens were isolated, dispersed by trypsin digestion, and subjected to TSHβ ICC. TSHβ cells comprised 0.7 ± 0.1%, 4.0 ± 0.4%, 5.3 ± 0.4%, 7.0 ± 0.8%, 6.7 ± 0.7%, and 9.3 ± 0.4% of all pituitary cells on e11, e13, e15, e17, e19, and d1, respectively. Thus, thyrotrophs were rare on e11, and their abundance was maximal on e17 (P < 0.01, n=4 separate trials). We conclude that TSHβ-producing cells are located in the cephalic lobe of the anterior pituitary and that the size of the thyrotroph population increases prior to hatching.

Key Words: Thyrotroph, Chicken Embryo, Development

612 Partial feed restriction induces pyruvate carboxylase mRNA but not phosphoenolpyruvate carboxykinase mRNA in lactating dairy cattle. J.C. Veale* and S.S. Donkin, Purdue University, West Lafayette, IN.

The ability of dairy cattle to adapt to changes in nutrient intake requires appropriate changes in expression of several key genes in liver. We determined effects of partial feed restriction on expression of pyruvate carboxylase (PC), phosphoenolpyruvate carboxykinase (PEPCK), growth hormone receptor (GHR), and insulin-like growth factor I (IGF-I) mRNA. Six mid-lactation Holstein cows were fed a total mixed diet for ad libitum intake during a 6-day period. Liver biopsy and blood samples were obtained at the end of the period and cows were then restricted to 50% of ad libitum intake for 5 days. Liver biopsy and blood samples were obtained at the end of the 5th day of the ad libitum intake restriction and were analyzed. Plasma non-esterified fatty acids (μM) were unchanged (235 vs. 252; ad libitum vs. feed restriction) by feed restriction. Northern blot analysis of total RNA revealed a tendency (P < 0.15) for increased expression of PC mRNA during feed restriction. Expression of PEPCK, GHR and IGF-I remained unchanged during this period. Expression of PC and IGF-I were elevated (P < 0.05) by 68% and 356% respectively during realimentation compared with the ad libitum feeding period but there were no differences for PEPCK or GHR mRNA. The lack of coordinated changes in PC and PEPCK mRNA suggests expression of these enzymes that is mediated by separate signals in bovine liver. The data also demonstrates compensatory overexpression of PC and IGF-I mRNA as a consequence of feed restriction and realimentation.

Key Words: Feed restriction, Gene expression, Gluconeogenesis

613 Production responses to different porcine somatotropin injection regimes. F.R. Dunseh*a,1, Agriculture Victoria, Victorian Institute of Animal Science, Werribee, Australia.

Thirty-two female crossbred pigs (initial weight 75 kg) were utilised in this experiment to investigate the effect of differing porcine somatotropin (pST) regimes on growth performance. Pigs were kept in individual pens and fed ad libitum a wheat-based diet formulated to contain 14.4 MJ DE/kg and 180 g ideal protein/kg. Treatments were daily injection with saline (Sal), daily injection with pST (5 mg) (D), bidaily injection of pST (10 mg) (2D) and injection of pST (12 mg) every Monday, Wednesday and Friday (MWF) for 3 weeks. On the days that pigs were not receiving pST they were injected with saline (0.5 ml). pST treatment had no significant effect upon ADG, despite being 100 g/d greater in the 2D and MWF pigs. All pST regimes caused a reduction in FCR compared with feed intake being low during the week but increasing over the latter part of the weekend. Thus, feed intake on Sunday through Monday was higher (P = 0.01) than on Tuesday through Thursday. Therefore, it appears that the effects of pST may be reduced when a 3d interval is used between injections. P2 back fat was significantly reduced with all pST injection regimes. Alternative pST injection regimes can improve growth performance in finisher pigs.

<table>
<thead>
<tr>
<th>Sal</th>
<th>D</th>
<th>2D</th>
<th>MWF</th>
<th>sed</th>
<th>P-value</th>
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</thead>
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<tr>
<td>ADG, g/d</td>
<td>769</td>
<td>773</td>
<td>874</td>
<td>871</td>
<td>0.36</td>
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<tr>
<td>Feed intake, g/d</td>
<td>2894</td>
<td>2000</td>
<td>2378</td>
<td>2512</td>
<td>0.001</td>
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<tr>
<td>FCR, g/kg</td>
<td>3.88</td>
<td>2.66</td>
<td>2.76</td>
<td>2.89</td>
<td>0.001</td>
</tr>
<tr>
<td>P2 backfat, mm</td>
<td>19.8</td>
<td>14.8</td>
<td>16.3</td>
<td>15.9</td>
<td>0.003</td>
</tr>
<tr>
<td>Change in P2, mm</td>
<td>6.5</td>
<td>2.2</td>
<td>1.8</td>
<td>1.4</td>
<td>0.001</td>
</tr>
<tr>
<td>Dressing, %</td>
<td>71.8</td>
<td>71.1</td>
<td>71.3</td>
<td>71.0</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Key Words: Porcine somatotropin, Swine, Growth


Our objectives in the current study were (1) to compare the responses to repeated ST challenges during the weaning period, and (2) to compare the response to ST challenge between heifer and bull calves. Calves received 4 L colostrum initially, then were fed a 30% CP: 20% fat milk replacer (MR) twice daily (MR DM at 2% of BW per d) and free choice water. Calves were weighed weekly and feed amounts adjusted accordingly. Calves were first offered starter (26.5% CP, 1.07 Mcal NEE/kg, DM basis) after reaching 100 kg BW. When starter was introduced, MR was offered at 1% BW per d for one week, then at 0.5% BW per d for one week before being discontinued. Blood was collected from three heifer and three bull calves during three 24-hr periods following bST challenges. The challenge protocol consisted of injecting 120 μg/kg BW bST once daily for three days. The first bST challenge was performed when calves weighed about 105 kg. Two wk later, which was 104 d after starter was first offered and MR restricted, the second bST challenge was performed. The third bST challenge took place two wk after the second challenge and 10 d after calves had been totally weaned off milk replacer. Blood was collected prior to the first bST injection (-72 hr) and at 0, 4, 8, 12, 14, 16, 18, 20, 22, and 24 hr after the third injection. Plasma aliquots were stored at -20°C until analyzed for IGF-I by RIA. Growth rates for the heifers and bulls during the period encompassing the challenges were not significantly different (P = 0.18), averaging 0.97 and 1.11 kg/d, respectively. Circulating IGF-I at -72 hr was not different (P = 0.61) between heifer and bull calves. For all calves the response to challenge, calculated as the difference between the 14-hr post-challenge value and the -72-hr value, was not different (P = 0.92) among the three periods before, during, and after weaning, but was greater in heifers than bulls (P = 0.038). We conclude that weaning does not necessarily lead to uncoupling of the somatotropic axis and that it is reasonable to apply data derived from milk replacer-fed bull calves to heifers.

Key Words: calves, somatotropin, insulin-like growth factor

615 Accuracy of volume measurements by magnetic resonance imaging. A.M. Scholz1, A.D. Mitchell1, P.C. Wang3, and H Song3. 1University Munich, Experimental Station Oberschleissheim, Germany, 2USDA, ARS, Growth Biology Lab, Beltsville, MD, 3Howard University, Washington, DC.

Volume measurements of body regions were accomplished within three different magnetic resonance imaging (MRI) experiments on totally 96 pigs from 10 to 60 kg (MRI I: n = 28, MRI II: n = 22) and from 30 to 90 kg (MRI III: n = 46). The purpose was to evaluate the accuracy of MRI for predicting the chemical carcass composition (MRI I, MRI II, and the dissected weights of separate muscles or fat tissues [MRI II]), The MRI was performed on a Picker Vista 1.5 Tesla whole body magnet generating successive axial images with a slice thickness of 1 cm. The images were processed by means of a digitizing tablet using the Sigma Plot PC3D program for MRI I and MRI II, and by means of the ‘Analyse’ software (Mayo Foundation) for MRI III. The whole volumes of both longissimus dorsi muscles (MLD), the overlying fat (BF), and ham muscles were quantified in MRI I and MRI II. In experiment MRI III, the volumes of both MLD and the overlying fat was measured in a defined 10 cm section and the volume of the ham with overlying fat in a defined 15 cm section. A stepwise regression analysis was performed, estimating carcass lipid % (CLiPid%) and carcass lean % (CLean%, sum of carcass protein % and water %) from volumes of MRI I and MRI II. A higher accuracy in estimating body composition resulted from a body weight range of 30 - 90 kg compared to 10 - 60 kg due to a very low variation in the pigs < 20 kg. However, the correlations (r) between the dissected weights and MRI volumes of specific tissue groups are very high in the weight range of 10-60 kg, e.g., with r=0.967 for MLD and r=0.973 for BF in MRI I.

Key Words: Magnetic Resonance Imaging

<table>
<thead>
<tr>
<th>CLiPId%</th>
<th>R²</th>
<th>√MSE</th>
<th>C.V.</th>
<th>d.f.</th>
<th>Variables in the Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI I</td>
<td>0.765</td>
<td>0.802</td>
<td>10.764</td>
<td>2</td>
<td>BF Volume, Total</td>
</tr>
<tr>
<td>MRI II</td>
<td>0.798</td>
<td>1.500</td>
<td>6.945</td>
<td>2</td>
<td>Fat-Muscle Ratio</td>
</tr>
<tr>
<td>MRI III</td>
<td>0.857</td>
<td>1.625</td>
<td>2.181</td>
<td>2</td>
<td>Fat-Lean Ratio HAM</td>
</tr>
<tr>
<td>CLean%</td>
<td>0.702</td>
<td>2.174</td>
<td>3.056</td>
<td>2</td>
<td>Total Fat-Muscle Ratio</td>
</tr>
<tr>
<td>MRI I</td>
<td>0.821</td>
<td>2.174</td>
<td>3.056</td>
<td>2</td>
<td>Fat Volume</td>
</tr>
<tr>
<td>MRI II</td>
<td>0.857</td>
<td>1.625</td>
<td>2.181</td>
<td>2</td>
<td>Fat-Lean Ratio HAM</td>
</tr>
</tbody>
</table>

Key Words: Body Composition, Magnetic Resonance Imaging

Traditional methods of assessing bone mineral deposition in pigs involve slaughter followed by dissection, ashing, and/or chemical analysis. By the use of dual energy X-ray absorptiometry (DXA) it is now possible to perform many of these measurements on the live animal. The purpose of this study was to quantify the changes in total body and regional bone mineral content (BMC, g) and bone mineral density (BMD, g/cm²) in pigs between 4 and 137-kg body weight (BWT). A total of 992 DXA scans were performed on anesthetized pigs, using a Lunar DPX densitometer. Linear and polynomial regression analysis was performed using SigmaPlot 5.0 procedures. Relative to BWT, the BMC of the various regions was described by linear regression with growth coefficients (b = slope) of 0.274, 0.298, and 0.213 and R² values of 0.97, 0.98, and 0.91, respectively. Likewise, the increase in BMD relative to BWT was described by 2nd order polynomial regression with R² values of 0.943, 0.905, 0.929, and 0.888, for total body, front legs, back legs, and trunk, respectively. Relative to total body BMD, the BMC of the regions was described by linear regression with growth coefficients (b = slope) of 1.75, 1.01, 0.99, 0.97, 0.93, 0.75, and 0.37 for the head, front legs, back legs, spine, pelvis, trunk, and ribs. Thus, during the growth of pigs from 4 to 137-kg, the largest increase in bone mineral deposition was observed in the back legs while the largest increase in bone mineral density was observed in the head.

Key Words: Bone Mineral Content, Bone Mineral Density, Swine

617 Dual energy X-ray absorptiometry accurately predicts whole body and carcass composition in pigs. D. Suster1, B. J. Leury2, J. D. Wark3, D. J. Kerton3, E. Ostrowska3, and F. R. Dunsea1, 1 Agriculture Victoria, Victorian Institute of Animal Science, Werribee, Victoria, Australia, 2 Dept. of Animal Production, University of Melbourne, Victoria, Australia, 3 Dept. of Medicine, Royal Melbourne Hospital, Victoria, Australia.

An Hologic QDR4500 Dual energy X-ray absorptiometer (DXA) was used to determine body composition in 150 pigs ranging from 10 to 130 kg live weight. Pigs were slaughtered commercially after the final scan, eviscerated and the empty carcass scanned before chemical analysis. Values predicted by DXA for fat, lean and bone mineral (BMM) mass, for live animal and carcass were compared with chemically determined values for empty body and empty carcass, respectively. Fat depth at P2 was measured directly. A linear regression model y=ax+b, where y is chemical composition and x is the DXA predicted value was used. Scan repeatability in the live animal was also examined by scanning 15 pigs (35-45 kg live weight) in triplicate. Lean tissue predicted by DXA (live animal, y=.83x+1.98, r²=.79, g/cm²; carcass, y=.90x-.85, r²=.99) was highly correlated with chemical measurements. While DXA slightly underestimated lean content of the carcass, it overestimated lean content of the live animal. At least some degree of overestimation in vivo presumably arose from water in the gut lumen being included as lean tissue. DXA predictions of fat (live animal, y=1.19+2.2, r²=.99; carcass, y=1.21x-.91, r²=.94) were highly correlated with proximate analyses, although the in-built algorithms underestimated fat. A positive correlation was also observed between P2 fat depth and chemical fat but the correlation was not as strong as the DXA prediction (r=2.89 %, r²=0.78). Bone mineral predicted by DXA (live animal, y=1.19+1.43, r²=.69; g/cm²; carcass, y=1.21x-.91, r²=.24) were highly correlated with proximate analyses, although the in-built algorithms underestimated fat. A positive correlation was also observed between P2 fat depth and chemical fat but the correlation was not as strong as the DXA prediction (r=2.89 %, r²=0.78).

Key Words: DXA, Swine, Body Composition
bivariate linear model having effects of sex of lamb and ration; least-
squares estimates were assumed bivariate normal, and independent be-
tween lambs, but with a 2 × 2 covariance structure within animals. The second analysis fitted a longitudinal mixed effects linear model, with fixed effects of sex and ration and random effects of lamb. The variance-covariance matrix of lamb-specific regression coefficients was estimated by REML; effects of sex and ration were estimated using em-
pirical best linear unbiased estimation. A Bayesian linear mixed-effects model (as in the second analysis) using Gibbs sampling and flat priors for all parameters was undertaken as well. The last two procedures are more efficient, since the two-stage method introduces extra variability in parameter estimation. Likelihood-based and the Bayesian method gave similar results, except for (co)variance components. The Bayesian procedure takes into account uncertainty about all parameters in the model, producing more satisfactory finite-sample inference.

**Key Words:** Longitudinal data, Mixed model, Lamb growth

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### 621 Dietary betaine does not effect whole body palmitate oxidation.


Dietary trimethylglycine (betaine, BET) is associated with reduced car-
cass fat in the growing pig. We explored the potential effects of BET on fatty acid oxidation and metabolism during intravenous infusion of 1-
13C-palmitate (PA). Pigs (55 kg BW, n=6) were fed one of three diets containing 0% BET (control), 0.125% BET or 0.5% BET at 80% of ad li-
bitimum energy intake. Dams were corn-soybean meal-based and contained 17.6% crude protein and 3.27 Mcal ME/kg; experimental diets were fed daily up to parity. BET pigs also consumed .5% BET had 9.8% less carcass fat, (481 vs 434 g/kg DW, P < 0.001) and negative linear trends for all parameters were undertaken as well. The last two procedures are more efficient, since the two-stage method introduces extra variability in parameter estimation. Likelihood-based and the Bayesian method gave similar results, except for (co)variance components. The Bayesian procedure takes into account uncertainty about all parameters in the model, producing more satisfactory finite-sample inference.

**Key Words:** betaine, body composition

80%; 0.11) and total VIS wt (P < 0.13) while negative linear trends for all parameters were noted. These data suggest that BET alters nutrient partitioning in feed-restricted pigs such that protein deposition is enhanced at the apparent expense of carcass fat and in part, VIS tissue. Supported by Finnfeeds Intl. and NATO Science Fellowship (IF-F).

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### 624 Effect of Lean Growth Rate on Puberty Attainment of Gilts.

J. L. Patterson, R. O. Ball, H. J. Willis, E. X. Ahern, and G. R. Foxcroft.

Dietary betaine (BET) is associated with decreased lipid deposition and altered protein utilization in pigs. Recent reports have suggested that substantial positive effects of BET on feed efficiency are greater in energy-restricted pigs. The purpose of this study was to examine the effects of BET on growth and body composition in young feed-restricted pigs. Thirty-two Landrace x York barrows (36 kg, n=8 pigs per group) were fed one of four corn-soybean meal-skim milk based diets containing 0, 1.25, 2.5 or 5g/kg BET. Pigs were fed at 73% ad libitum for 49 d. Calves were removed from the trial due to health problems unrelated to treatment. Calves fed Control were weaned earlier (43.3 vs 45.9 d; P < 0.05) as compared to calves fed Yeast. Inclusion of yeast culture in calf starters reduced (P < 0.03) 49 d starter intake (20.9 vs 26.6 kg). There were no differences in BW at weaning, BW at 49 d, average daily gains, or feed efficiency between calves fed Control or Yeast. Data sug-
ggest yeast culture inclusion in calf starters decreased starter intake and increased weaning age. Mechanisms explaining these observations are unavailable at this time.

**Key Words:** Yeast, Calves, Starter

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### 623 Effect of yeast culture in calf starters fed to Holstein heifer calves.


Eighth Holstein heifer calves (age = 1 d) were allocated to one of two dietary treatments. Calves were offered a commercial calf starter with (Yeast) or without (Control) 10 g/kg of Diamond V XP Yeast Culture ad libitum for 49 d. Calves were allocated to treatments over a 30 d period and were housed in individual calf hutches. Calves were fed 5.0 l/d of pasteurized waste milk in two equal feedings. Calf starters (Yeast and Control) were offered ad libitum starting d 2 until d 49. Calves were weaned when they consumed 900 g of calf starter for 3 consecutive days. Intake of calf starter was recorded weekly. Body weight (BW) of calves was recorded at entry, weaning, and at 49 d. Data were analyzed as a completely randomized design using ANOVA procedures of SAS. Two calves were removed from the trial due to health problems unrelated to treatment. Calves fed Control were weaned earlier (43.3 vs 45.9 d; P < 0.05) as compared to calves fed Yeast. Inclusion of yeast culture in calf starters reduced (P < 0.03) 49 d starter intake (20.9 vs 26.6 kg). There were no differences in BW at weaning, BW at 49 d, average daily gains, or feed efficiency between calves fed Control or Yeast. Data sug-
gest yeast culture inclusion in calf starters decreased starter intake and increased weaning age. Mechanisms explaining these observations are unavailable at this time.

**Key Words:** Yeast, Calves, Starter

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### 624 Effect of Lean Growth Rate on Puberty Attainment of Gilts.

J. L. Patterson, R. O. Ball, H. J. Willis, E. X. Ahern, and G. R. Foxcroft.

The current trend in the production of market pigs places emphasis on lean tissue growth rate. However, it is unclear how high lean growth rate impacts sexual development of gilts. One hundred sixty-eight prepubertal Genex Manor hybrid F1 gilts were used to examine the effect of lean growth rate on the attainment of puberty. At approximately 96 d of age and 54 kg weight, gilts were allocated with respect to growth rate and litter origin to one of two dietary treatments: 1) a diet formulated to optimize lean growth rate (O; n=84) 2) a diet producing normal lean growth rate (N; n=84). All gilts were fed treatment diets ad libitum and housed in groups of six. Weight, backfat and loin depth, and feed intake were measured weekly. Starting at 134.7 ± 26 d (mean ± sem) of age, gilts received 20 min direct exposure to a vasectomized boar daily as a pen group for pubertal stimulation. Puberty attainment was de-
termined as the day gilts first exhibited the standing reflex in response to contact with a boar. At pubertal estrus, body weight, backfat and loin depths were recorded. Diet affected (P ≤ 0.05) weight (O, 73.7 ± 3 kg; N, 71.2 ± 3 kg), growth rate (O, 63.6 ± 0.002; N, 61.0 ± 0.003 kg/d), loin depth (O, 44.0 ± 3.0; N, 41.7 ± 3.0 mm), fat depth (O, 12.3 ± 2.0; N, 11.6 ± 2.0 mm) and estimated lean growth rate (O, 0.37 ± 0.003; N, 0.35 ± 0.003 kg/d) during the growth period (start to stimulation). Feed consumed over the growth period differed (P < 0.01) (O, 2.5 ± 0.05; N, 2.6 ± 0.05). Of the 160 gilts completing the trial, only five did not reach puberty by 200 d. Diet did not affect age at puberty (O, 158.6 ± 2.0; N, 158.5 ± 2.0)
or days to puberty (O, 28.4 ± 2.0; N, 28.3 ± 2.0). Litter origin affected age at puberty (P = 0.02) and days to puberty (P = 0.002). Results indicate that observed differences in lean growth performance during prepubertal development had no effect on the age at puberty in O and N gilts, nor was overall lean growth rate at stimulation associated with pubertal age (r = 0.01 P = 0.75).

**Key Words:** Gilt, Puberty, Growth


The objective of this study was to investigate the effects of nursing a large number of piglets on lactation and post-weaning performance of primiparous sows and whether a larger feed intake can prevent possible negative effects. Data were recorded on 307 ad libitum fed sows of three genotypes in an experiment where litter size was standardized to 8, 11 or 14 piglets during a four-week lactation. Sows were fed ad libitum from day 10 after farrowing and piglets had no access to creep feed during lactation. Daily feed of sows was not affected by litter size for two genotypes, whereas it was curve-linearly affected for the third genotype (P < 0.05) with a maximum at 10.8 piglets. Backfat thickness loss of the sows increased linearly with litter size (P < 0.05) for two genotypes. In the third genotype backfat loss increased only at large litter sizes > 9.8 piglets (P < 0.01). Body weight loss of the sow and litter weight gain increased linearly with litter size (P < 0.001). Differences in responses to increasing litter size found between the three genotypes may be related to differences in feed intake pattern during lactation, upper critical temperature and body composition of sows. Sows nursing more piglets during lactation had a higher probability of a prolonged weaning-to-estrus interval. A higher feed intake during lactation reduced tissue loss of the sow, increased litter weight gain (P < 0.01) and reduced the probability of a prolonged weaning-to-estrus interval. At high levels of litter size, a one-kg increase in feed intake resulted in a lower output, measured as reduced body tissue loss or increased litter weight gain, compared with low levels of litter size. This may be related to higher maintenance

**Key Words:** Feed intake, Primiparous sows, Litter size


Utilisation of consumed feed from 40-100 kg BW and its conversion into pig growth is a major determinant of efficient pig meat production. Targeting specific time windows during gestation can potentially influence lean tissue deposition in subsequent progeny via changes to foetal development. The objective of this study was to examine the effect of increased nutrient intake during day 28-56 of gestation on progeny growth from weaning to slaughter. Twenty four multiparous sows (JSR Genepacker 90) were randomly allocated between two treatments, Standard (ST) 2.5 kg/d or Elevated (EL) 5.0 kg/d from d 28-56 of gestation. Three boars and gilts were weaned from each sow and were housed in groups of twelve from d 58 to slaughter. All pigs received identical nutrition and were weighed on d 58, 93, 128 and 159. Quantity of feed consumed during gestation was lower (P < 0.01) for ST than EL sows (322 vs 383 kg). There were no differences for born alive, litter weight at birth and weaning, or average daily feed intake (ADFI) between ST and EL sows. No significant performance response was observed from weaning to d 93. ST progeny produced a significantly lower average daily gain (ADG) from d 93-128 (P < 0.05) compared to progeny from EL fed sows (0.697 vs 0.743 kg). Gain/Feed (G/F) for ST progeny was also substantially reduced (P < 0.05) during this same time window (0.38 vs 0.41).

Rib lean measurement (52.3 vs 54.4 mm) showed a positive response (P < 0.08) towards those progeny from EL fed sows. These results suggest performance benefits are obtainable from progeny which have been derived from sows that have received increased maternal nutrients during a specific foetal development window.

**Key Words:** Sows, Gestation, Performance

627 Correlation of real-time ultrasonic measurement of longissimus muscle area of thoroughbred horses with lifetime earnings and average earnings per win. R. L. Dobec1, M. L. Borger, and D. B. Foye, The Ohio State University Agricultural Technical Institute, Wooster.

The primary objective of this study was to estimate the relationship of real-time sonoray measurements of fat depth and longissimus muscle area of thoroughbred horses with lifetime earnings and average earnings per win. Horses with racing records at the Keeneland 1998 November Sale (n = 44) were randomly selected and scanned for longissimus muscle area (LEA) and center loin fat depth (BR) posterior to the last rib (18th rib). An Aloka 500V console (Animal Ultrasound Services, Inc. Ithaca, N.Y.) with a 17.0 cm 3.0 megahertz linear probe was used for scanning. Age, earnings, average earnings per win, and total wins were obtained from catalog data. Longissimus muscle tracing and loin fat depth measurements were estimated using the Critical Vision Technology (CVT).

Data were analyzed using SAS. Correlations of LEA with lifetime earnings and average/earn/win were .18 and .13. The value of LEA as a predictor of racing success was significant (p < 0.04). Mean LEA for this study was 23.4, std. dev. = 2.2. There was enough relationship to racing ability and to merit further research with larger sample size.

**Key Words:** Racehorses, Thoroughbred, Ultrasomics

628 Tibial optical bone density is positively correlated with bone strength. K. L. Waite1, B. D. Nielsen, D. S. Rosenstein, and K. D. Roberson1, Michigan State University, East Lansing.

Radiographic photodensitometry is a non-invasive method of estimating optical bone density in the horse. There is concern in the equine research community, however, that optical bone density is not correlated with bone strength. The objective of this study was to determine the correlation between optical bone density as determined by radiographic photodensitometry and bone strength. The hypothesis was that there is a significant positive correlation between optical bone density and bone strength. Tibiae, humeri and femurs were removed from turkeys euthanized as part of a separate study. Dorsopalmar radiographs were taken (57 KV, 400 mA, 4 msec, 1.6 mAs) to determine radiographic bone aluminum equivalence (RBAE). An aluminum step wedge penometer was exposed with each radiograph as a standard. Radiographs were scanned at two locations on the bone and logarithmic regression was used to determine the lateral and medial RBAE using the thickness of the step-wedge and the maximum optical bone density readings of these cortices. Total RBAE was determined using the total area of the bone divided by the total area of the stepwedge. Shear tests were conducted with a double block test fixture designed to exert a shear force on a 5 mm section of the mid-diaphysis of each bone, with a load rate of 5 mm/min. Correlations between RBAE (mm2) and load (N) were calculated using the correlation procedure of SAS (6.12). There was no correlation between RBAE and strength in any of the femur and humerus measurements taken. No difference was found between tibial RBAE taken at the mid-diaphysis or the nutrient foramen, and tibial data were pooled. Total tibia RBAE was correlated with bone strength (r = 0.56, P = 0.0009), as was mediar RBAE (r = 0.47, P = 0.0073) and lateral RBAE (r = 0.56, P = 0.0009). These data suggest there is a positive correlation between bone density and bone strength in the tibia and support radiographic photodensitometry as an effective, non-invasive means of detecting potential differences in bone strength in the live animal.

**Key Words:** Radiographic photodensitometry, Bone strength, Correlation