TH58 Supplementation of arginine plus conjugated linoleic acid decreases the fat/lean mass ratio in rats. J. Nall*[1], G. Wu[1], K. H. Kim[2], S. B. Smith[1], and L. A. Ford[1], [1]*Texas A&M University*, *College Station*, [2]*National Institute of Animal Science*, *Suwon, Korea*.

This experiment tested the hypothesis that the combination of dietary conjugated linoleic (CLA) plus arginine will decrease fat accumulation and increase muscle mass. Twenty-four male Sprague Dawley rats were assigned to treatments in a 2 × 2 factorial design with 6 rats per treatment group (control: 2.55% alanine + 1.5% canola oil; arginine: 1.25% arginine-HCl + 1.5% canola oil; conjugated linoleic acid (CLA; mixed isomers): 2.55% alanine + 1.5% CLA; arginine + CLA: 1.25% arginine + 1.5% CLA). There was no significant difference in food intake over the 5-wk treatment period. Both arginine and CLA increased final body weights ($P < 0.04$). Abdominal fat mass ($P = 0.08$) and the abdominal fat:lean body mass ratio ($P = 0.04$) were decreased by CLA but were unaffected by arginine. Epididymal fat pad weight was not affected by arginine or CLA ($P > 0.55$). CLA tended ($P < 0.07$) to decrease the plasma oleic/stearic acid ratio, primarily by increasing stearic acid, consistent with a depression ($P = 0.0001$) in the concentration of oleic acid in liver in CLA-supplemented rats. Conversion of ^{14}C-labeled glucose and palmitic acid to total lipids and CO_2 in epididymal adipose tissue *in vitro* was unaffected by CLA. However, arginine decreased ($P = 0.02$) palmitic acid incorporation into total lipids in epididymal adipose tissue. Also, there was a significant arginine × CLA interaction for glucose incorporation into lipid in epididymal adipose tissue ($P = 0.02$). Arginine stimulated lipid synthesis from glucose in the absence of CLA, but had no effect in the presence of CLA. In liver, arginine increased the rate of conversion of glucose to CO_2 ($P = 0.06$). The combination of arginine plus CLA depressed the concentrations of plasma arginine and lysine ($P = 0.05$ and 0.04, respectively). The data indicate that the combination of arginine plus CLA decreases the fat/lean mass ratio, which may be due to effects on the metabolism of both liver and adipose tissue. (Funded in part by the National Institute of Animal Science, Rural Development Administration, Korea.)

Key Words: Adipose Tissue, Arginine, Conjugated Linoleic Acid

TH59 Developmental regulation of delta-like protein 1 (DLK1) expression during chicken muscle development and regeneration. J. Shin*, D. Bae, J. A. Deiuliis, S. G. Velleman, S. Lim, J. D. Latshaw, M. P. Wick, and K. Lee, *The Ohio State University*, *Columbus*.

DLK1 has been known to be responsible for muscle hypertrophy of callipyge sheep and diseases associated with muscle development as shown in human uniparental disomy (UPD) chromosome 14 and mouse UPD12. However, no study to date has shown the expression pattern of DLK1 during muscle development regarding its role in specific developmental stages. Therefore, we investigated the temporal expression and localization of DLK1 during specific stages of chicken muscle development. Chicken DLK1 (gDLK1) mRNA was significantly induced by 2-fold at day 1 after cell differentiation and thereafter gradually decreased in primary chicken myoblast cultures ($p<0.05$). During mouse C_2C_{12} cell differentiation, DLK1 protein, absent at D0, was expressed as early as D2 and reached maximal amounts at D4 when the myotubes were actively formed. DLK1 protein expression was decreased at D6 when the length and thickness of myotubes increased. During the muscle repair process in chickens, gDLK1 mRNA expression was dramatically induced by 4-fold at day 7 after injury ($p<0.05$), recapitulating the expression pattern observed in normal muscle development. Although gDLK1 gene expression decreased after hatching in both meat- (broiler) and egg-type (layer) chickens, broiler chicken muscle had 3-fold greater expression of gDLK1 compared to layers ($p<0.01$). The temporal expression of DLK1 and localization of its protein in differentiated myoblasts and early myotube suggest its important role in these developmental processes. These findings provide a new insight into the role of DLK1 in muscle development, regeneration, and associated muscle diseases and support the DLK1 gene as a selection marker for superior muscling in food animals.

Key Words: Delta-Like Protein 1 (DLK1), Myotube Formation, Muscle Development

TH60 Serum amyloid A protein mediates the regulation of docosahexaenoic acid on the expression of porcine genes related to lipid metabolism. S. T. Ding*, C. H. Chen, and H. J. Mersmann, *Natioanl Taiwan University*, *Taipei, Taiwan, ROC*.

Serum amyloid A protein (SAA) is an apolipoprotein that may replace apolipoprotein A1 (apoA1). Porcine hepatic SAA mRNA is increased by dietary docosahexaenoic acid (DHA) treatment. The purpose of this study was to investigate the role of SAA protein in regulating gene expression related to lipid metabolism in pigs. We demonstrated that 100 μM DHA treatment significantly increased SAA and apoA1 mRNA expression in porcine hepatic cell culture ($P < 0.05$). Therefore, we produced porcine SAA recombinant protein and found that addition of 40 nM SAA to porcine preadipocytes in culture stimulated interleukin-6 (IL-6) mRNA expression ($P < 0.05$), similar to the biological function of SAA in human. We also found peroxisome proliferator-activated receptor γ (PPARγ) and PPARα mRNA were decreased (40% and 60%, respectively) in differentiated adipocytes after treatment with 2 μM SAA. In addition, the SAA treatment caused an increase in inflammatory cytokine gene expression (IL-6 and tumor necrosis factor α), and glycerol release ($P < 0.05$), indicating increased lipolysis. Because the expression of perilipin, a lipid droplet-protective protein, was reduced by the SAA treatment, we hypothesized that SAA increased lipolysis by decreasing the expression of perilipin, which would then allow an increase in hormone sensitive lipase activity. In conclusion, we demonstrated that the DHA-induced SAA gene expression decreased PPAR expression to consequently down-regulate the expression of several genes involved in lipid metabolism. Accordingly, SAA may play a role in mediating the function of dietary DHA on lipid metabolism and could be a factor regulating obesity.

Key Words: Porcine Adipocyte, Perilipin, Serum Amyloid A Protein

TH61 Exocrine pancreatic insufficiency arrests growth of young pigs even after the parenteral or enteral feeding of an elemental diet. S. Rengman*[1], O. Fedkiv[1], J. Botermans[2], J. Svendsen[2], B. R. Weström[1], and S. G. Pierzynowski[1], [1]*Lund University*, *Lund, Sweden*, [2]*Swedish University of Agricultural Sciences*, *Alnarp, Sweden*.

Weaned pigs fed a commercial feed maintain normal growth while pigs with induced exocrine pancreatic insufficiency (EPI) show an arrested growth during the same conditions. Supplementation with a pancreatic enzyme preparation to the feed is known to normalise the growth of young EPI-pigs. Our aim was to further evaluate the importance of the exocrine pancreas of the growth in weaned pigs.
To induce EPI, the main pancreatic duct was ligated close to the duodenal papilla and then cut between the ligatures. Two weeks later the pigs were fitted with gastric fistulas and jugular vein catheters after which the pigs were given 10 days of recovery.
Conventional pigs were fed a commercial pig feed for young pigs, n=5, elemental diet (ED) intragastrically (ig), n=3 or intravenously (iv), n=3 during 6 days. Pigs with EPI were fed a commercial pig feed, n=6, ED ig, n=6, ED iv, n=6 or a fat-enriched diet (with or without pancreatic enzyme supplementation) during 6 days. The pigs received 0.504 MJ/kg/day of the commercial pig feed or the ED while 0.641 MJ/kg/day of the fat-enriched diet. Weekly weight gain was compared among the groups.
The three groups of pigs that were fed pig feed, ED ig or ED iv, all showed a normal increase in bwt, 14%/week, similar to ordinary production pigs. The recorded weight change in EPI-pigs that were fed pig feed, ED ig or ED iv spanned from -6 to 3% bwt/week. The significant difference in growth between conventional pigs and EPI-pigs was $p \leq 0.001$ for pig feed and ED iv and $p \leq 0.01$ for ED ig. The group that were fed a fat-enriched diet supplemented with pancreatic enzymes, showed a normalised growth, compared to the group receiving fat-enriched diet without pancreatic enzymes $p \leq 0.001$.
Conventional pigs maintain a normal growth independently of diet (pig feed or ED) and administration routes (enteral or parenteral) while the EPI-pigs showed an impaired growth or even lost weight when receiving the same treatments. A proper digestion and absorption of nutrients is not enough to maintain normal growth in weaned pigs with EPI.

Key Words: Pancreas, Growth, Pig

TH62 Indispensability of exocrine pancreatic function for the growth of young weaner pigs. O. Fedkiv*, S. Rengman, B. R. Weström, and S. G. Pierzynowski, *Lund University*, *Lund, Sweden*.

Data regarding the role of exocrine pancreatic enzymes for the growth of pigs of different ages is inconsistent. Thus, the aim of the study was to highlight the role of exocrine pancreas secretion for growth and performance of pigs in different age. The experiments were performed on 24 crossbred pigs. In order to develop exocrine pancreatic insufficiency (EPI), the pancreatic duct was ligated in 6 pigs at the age of 6 weeks (weaners, 10.5 ±1.3 kg) and in 6 pigs at the age of 15 weeks (growers, 43 ± 5 kg). Parallel studies were performed on control pigs at age 8 weeks (13.2 ± 0.7 kg) and 15 weeks (37 ± 4 kg), respectively. The pigs were fed *ad libitum* during one hour, twice a day (in the morning and in the evening) with a commercial feed (Växtill 320, Lantmännen, Sweden). Weekly recordings of food consumption and growth were performed before, during and after supplementation with a pancreatic enzyme preparation (Creon® Minimicrosphers™ , SolvayPharma GmbH, Hanover, Germany) starting 4 weeks after pancreatic duct ligation (PDL). PDL in weaners caused growth arrest while it had a little effect on the growth of growers. The daily weight gain (DWG) and daily feed consumption (DFC) in EPI pigs and corresponding controls one week before, one week during pancreatic enzyme supplementation (PES) and one week after are presented in the table below. Pancreatic exocrine secretion is indispensable to ensure growth of weaner pigs while not for growers. Feed supplementation with a preparation of pancreatic enzymes improves appetite and ensures lower feed conversion in control and in EPI pigs.

Table 1.

Pigs	DFC before (kg/day)	DWG before (kg/day)	DFC during PES (kg/day)	DWG during PES (kg/day)	DFC after (kg/day)	DWG after (kg/day)
EPI weaners	0.33 ± 0.06^{a}	0 ± 0.1^{A}	0.46 ± 0.07^{b}	0.29 ± 0.04^{B}	0.29 ± 0.06^{a}	0 ± 0.3^{A}
Control weaners	0.85 ± 0.09^{c}	0.67 ± 0.1^{C}	1.1 ± 0.07^{d}	0.83 ± 0.2^{C}	1.3 ± 0.13^{e}	0.67 ± 0.16^{C}
EPI growers	$2.2\pm0.3^{f,g,h}$	1.1 ± 0.36^{D}	3.2 ± 0.6^{i}	1.4 ± 0.26^{D}	$3.0\pm0.86^{j,h}$	0.72 ± 0.25^{C}
Control growers	2.1 ± 0.2^{f}	1.2 ± 0.35^{D}	$2.6\pm0.17^{f,g,h,j}$	1.4 ± 0.16^{D}	$2.8\pm0.18^{g,h,j}$	1.3 ± 0.17^{D}

Different letters given with results describe statistical differences when $p<0.05$

Key Words: Pigs, Growth, Exocrine Pancreatic Secretion

TH63 Effects of maternal low and high protein diets on body composition and skeletal muscle properties of newborn piglets. C. Rehfeldt, C. Kalbe, J. Block, G. Nuernberg, B. Stabenow, D. Loesel*, and C. C. Metges, *Research Institute for the Biology of Farm Animals*, *Dummerstorf, Germany*.

To study the impact of maternal low and high protein intake on body composition and cellular properties of skeletal muscle of the offspring, 40 German Landrace gilts were artificially inseminated (age 8 mo, 148 kg) and fed iso-energetic diets (11.6 MJ ME/kg DM) with high (HP, 30%; n=14), low (LP, 6%; n=14) or control protein (CP, 12%; n=12) levels throughout gestation. The resulting median of litter size was 13. All piglets were weighed at birth and 4 of them were taken from each litter for detailed analyses.
Birth weight was lower in LP and HP compared with CP piglets (1.19, 1.22, 1.38 kg, respectively; $P<0.01$). Preliminary data reveal that LP and HP piglets exhibited a higher percentage of internal organs ($P=0.08$). The weight of the kidneys was significantly affected by diet ($P=0.01$) with being increased in HP piglets. Within large litters (>13) HP piglets exhibited a higher percentage of skeletal muscle tissue than LP piglets (44.5 vs 41.6%; $P=0.05$). Skeletal muscle characteristics were analyzed in *semitendinosus* (ST), *longissimus*, and *biceps femoris* muscles. Weight ($P=0.09$) and circumference ($P=0.02$) of ST muscle were affected by diet and tended to be lowered by 11% in LP piglets. On average of all muscles protein/RNA ratio was decreased by 12% in LP ($P<0.05$), which was more pronounced in piglets of litters >13 showing also numeric decreases in protein concentration and creatine kinase activity ($P=0.07$; 0.04, respectively, for diet*litter size class). Total DNA content in ST muscle was higher in HP compared with CP ($P=0.09$; 12%) and LP ($P<0.05$; 15%). The results suggest that a 50% decrease in protein supply to gilts during pregnancy impairs intrauterine growth and skeletal muscle development, in particular in piglets of large litters. In contrast, a respective increase in nutritional protein stimulates myonuclear proliferation, which may indicate a higher potential for postnatal lean growth. (supported by DFG, KA 1844/1-1, PAK 24).

Key Words: Pregnant Gilts, Muscle Cellularity, Development

TH64 Body composition of transgenic pigs expressing the myostatin pro domain. A. D. Mitchell* and R. J. Wall, *USDA-ARS, Animal Bioscience and Biotechnology Laboratory*, *Beltsville, MD*.

Previous results have shown that male mice expressing a myostatin pro domain construct (MLC-Pro) have increased body weight, more total body lean mass, and lower percentage of total body fat. Founder transgenic (TG) pigs were generated by standard pronuclear microinjection techniques using the same MLC-Pro construct. Subsequently, MLC-pro TG and littermate control pigs were produced by mating a G-2 TG boar with non-TG females. The purpose of this study was to use dual energy X-ray absorptiometry (DXA) to monitor, in vivo, the course of changes in body composition of female control (n = 19) and female MLC-Pro TG (n = 19) pigs between 60 and 120 kg BWT. The female TG pigs expressing the MLC-Pro construct has less total body lean mass at 60, 100 and 120 kg BWT when compared to littermate controls ($P < 0.05$). Consequently, at the same weights the TG females had a higher ($P < 0.05$) percentage of total body fat (9.0 vs. 11.2, 14.4 vs. 19.3, and 15.3 vs. 20.9%, respectively). There was no difference in total body bone mineral content. When the pigs were restrictively fed at maintenance energy intake for eight weeks starting at either 60 or 100 kg BWT, the change in body composition was similar for TG and control pigs. Likewise, when the pigs restricted at 60 kg were subsequently fed ad libitum to 100 kg, the response was similar for TG and control pigs. These results indicate that TG female pigs expressing the MLC-Pro construct have a higher percentage of total body fat compared littermate controls and that these differences persist during a period of restricted intake.

Key Words: Swine, Myostatin, Body Composition