

to other states in order to get accurate horse counts and true values of horses. In addition to surveying veterinarians, a cross check of results could be obtained by surveying other service providers such as farriers or feed stores. The inclusion of the question about willingness to sell at fair market value question is also justified based on our findings. Finally, even though our three survey instruments attempt to reach the

major interest groups associated with the industry, a wider population may need to be included to more accurately estimate the aesthetic and recreational value of horses.

**Key Words:** Survey, Demographic, Horse

## Nonruminant Nutrition: Amino Acid Nutrition - Nursery to Finisher

**370 True ileal digestible isoleucine requirement and ratio in 12 to 22 kg pigs.** S. X. Fu<sup>\*1</sup>, A. M. Gaines<sup>1</sup>, R. W. Fent<sup>1</sup>, G. L. Allee<sup>1</sup>, and J. L. Usry<sup>2</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Ajinomoto Heartland, LLC, Chicago, IL.

Two experiments were conducted to determine the true ileal digestible (TID) Ile requirement and ratio of late-nursery pigs (TR-4×C22). In Exp. 1, 924 pigs were used in a five-point TID Ile titration (0.597, 0.662, 0.726, 0.791, and 0.856%, respectively) with seven replicate pens per treatment (21 to 23 pigs/pen). The basal diet (0.70% L-Lys HCl) was formulated to contain 1.30% TID lysine. Graded levels of L-Ile were added to increase the TID Ile level from 0.597 to 0.856%. Both ADG and ADFI were not affected by dietary TID Ile level. A quadratic response in G:F (P = 0.04) was observed with increasing dietary TID Ile. Based on these data, the TID Ile requirement of late-nursery pigs is not greater than 0.597% in corn-soybean meal diets. In Exp. 2, 297 barrows were used to determine the effects of protein source on the TID Ile:Lys ratio in 12 to 22 kg pigs with five replicate pens per treatment (five to six pigs/pen). Diet 1 was a corn-soybean meal control diet with an inclusion of 0.30% L-Lys HCl. Diets 2 to 11 were a 2 × 5 factorial design. The factors included: two protein sources 17% soybean meal (SBM) plus crystalline amino acids or 10.75% spray-dried blood cells (SDBC) and five TID Ile:Lys ratios (46, 53, 60, 67, and 74%, respectively). Diet 1 contained 1.20% TID lysine and all other diets were formulated to contain 1.10%. Pigs fed the control diet had improved growth performance (P ≤ 0.05) indicating that lysine was indeed limiting in diets 2 to 11. In corn-soybean meal diets, no response was observed with increasing TID Ile:lys ratio. However, increasing the TID Ile:Lys ratio in corn-SDBC diets improved ADG (linear and quadratic (P ≤ 0.01) and G:F (linear and quadratic P ≤ 0.001). The TID Ile:Lys ratio of 12 to 22 kg barrows fed corn-SDBC diets was estimated to be 65.7% for G:F and at least 70.3% for ADG.

**Key Words:** Isoleucine, Blood cells, Pigs

**371 Branched chain amino acid interactions and isoleucine imbalance in late-finishing pigs.** S. X. Fu<sup>\*1</sup>, R. W. Fent<sup>1</sup>, G. L. Allee<sup>1</sup>, and J. L. Usry<sup>2</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Ajinomoto Heartland, LLC, Chicago, IL.

Two experiments were conducted to explore why late-finishing (TR4 × C22) fed corn-spray-dried blood cell (SDBC) diets require higher Ile to maximize growth performance than pigs fed corn-soybean meal (SBM) diets. The positive control (basal diet) was a corn-SBM diet with 3% SBM and 0.32% L-Lysine HCl and the negative control diet contained 3.85% SDBC. All diets contained 0.52% TID lysine and a TID Ile:Lys of 54%. In Exp. 1, 120 pigs were used with six replicate

pens of five pigs per treatment to determine the effects of excess Val and Leu. Crystalline L-Val and L-Leu were added to the basal diet to achieve the same level of Val and Leu as the negative control. An additional high protein corn-SBM control diet (0.15% added L-Lysine HCl) was also included. Pigs fed the positive control diet had comparable ADG, ADFI, but tended to have lower G:F (P = 0.06) than pigs fed the high protein control diet. With the same dietary TID Ile:Lys of 54%, pigs on corn-SDBC diet had reduced (P ≤ 0.04) ADG, ADFI, and G:F compared to pigs on corn-SBM diet. Adding Val and Leu to the corn-SBM basal diet resulted in similar ADG and G:F, but tended to reduce ADFI (P = 0.09). In Exp. 2, 60 individually penned pigs with 10 replications per treatment were used. Adding graded levels of Val and Leu to a corn-SBM basal diet resulted in a linear decrease in ADG (P = 0.05) and ADFI (P = 0.02), and tended to linearly reduce final BW (P = 0.10). The G:F was not affected by excess Val and Leu. Plasma free Val, Leu (P ≤ 0.01), and blood urea nitrogen (P = 0.05) increased linearly as dietary Val and Leu level increased while plasma free Ile decreased linearly (P = 0.004). Adding Val and Leu to the corn-SBM basal diet to the levels of corn-SDBC diet resulted in similar performance as the high protein corn-SBM control diet. Adding Val, Leu, His, and Phe to the corn-SBM control diet reduced (P ≤ 0.05) final BW, ADG, ADFI, and plasma free Ile and increased serum urea nitrogen (P = 0.02), which resulted in a similar final BW, ADG, ADFI, and G:F as pigs fed the corn-SDBC diet.

**Key Words:** Branch chain amino acid, Imbalance, Isoleucine

**372 Branched chain amino acid interactions increases isoleucine requirement in late-finishing pigs.** S. X. Fu<sup>\*1</sup>, R. W. Fent<sup>1</sup>, G. L. Allee<sup>1</sup>, and J. L. Usry<sup>2</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Ajinomoto Heartland, LLC, Chicago, IL.

Two experiments utilizing 10 individual pigs per treatment were conducted to explore why late-finishing pigs (TR-4 × C22) fed corn-spray-dried blood cell (SDBC) diets require higher Ile to maximize growth performance than pigs fed corn-soybean (SBM) diets. The positive control (basal diet) was a corn-SBM diet with 3% SBM and 0.32% L-Lys HCl and the negative control diet contained 3.85% SDBC. All diets contained 0.52% TID lysine and a basal TID Ile:Lys of 54%. L-Val, L-Leu and/or L-Phe, L-His were added to the basal diet to achieve the same as the negative control. In Exp. 1, adding Val and Leu to the corn-SBM basal diet to the levels present in the corn-SDBC diet did not affect performance. However, adding Leu alone to corn-SBM basal diet resulted in reduced (P = 0.05) ADG, final BW, and G:F. In the corn-SBM basal diet, excess of Val, Leu, His, and Phe did not affect G:F (P = 0.20), but reduced ADFI (P = 0.03),

and tended to reduce final BW ( $P = 0.08$ ) and ADG ( $P = 0.07$ ). Further adding Ile to the diet containing an excess of Val, Leu, His, and Phe restored growth performance to the level of corn-SBM control pigs. In Exp. 2, with same dietary TID Ile:Lys of 54%, pigs on the corn-SDBC had reduced final BW ( $P = 0.01$ ), ADG ( $P = 0.01$ ), ADFI ( $P = 0.01$ ), and G:F ( $P \leq 0.06$ ) compared to pigs on corn-SBM basal diet. Adding Val alone or with Leu to corn-SBM control diet did not affect growth performance. These data suggest when Ile is marginally deficient in a late-finishing diet, excess Leu depresses pig performance, while excess Val had no deleterious effects on growth performance. Excess Val helped reduce the severity of excess Leu. Adding all excess amino acids (Leu, Val, His, and Phe) to the corn-SBM control diet depressed pig performance to the level of pigs fed corn-SDBC diet, which was fully restored by Ile addition. Significant branched chain amino acid interactions and Ile imbalance caused by excess Leu, His, and Phe necessitate higher Ile for pigs fed diets containing SDBC as the major protein source.

**Key Words:** Branch chain amino acid, Imbalance, Isoleucine

**373 Stimulation of muscle protein synthesis by leucine is dependent on plasma amino acid availability.** J. Escobar\*, J. W. Frank, A. Suryawan, H. V. Nguyen, and T. A. Davis, *Baylor College of Medicine, Houston, TX.*

We have reported that a physiological increase in plasma leucine increased translation initiation factor activity during 60- and 120-min leucine infusion. Muscle protein synthesis was stimulated at 60 min but not at 120 min, perhaps due to the decrease (-50%) in plasma essential amino acids (AA). Thus, the objective of the present study was to determine the effect of AA replacement during a 120-min leucine infusion on muscle protein synthesis. Piglets (5 d of age) were food-deprived overnight and infused intra-arterially with saline or 400  $\mu\text{mol} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$  of leucine for 120 min to raise plasma leucine within the physiological postprandial range. Leucine was infused in the presence or absence of an AA mixture (without leucine) to maintain baseline levels of plasma AA. At the end of the infusion, protein synthesis and the activation of translation initiation factors were determined in longissimus dorsi muscle and liver. Administration of AA prevented the leucine induced reduction ( $P < 0.05$ ) in plasma essential AA. Leucine infusion, with and without AA replacement, increased ( $P < 0.05$ ) the phosphorylation of eukaryotic initiation factor (eIF) 4E binding protein-1 (4E-BP1), decreased ( $P < 0.01$ ) the inactive 4E BP1•eIF4E complex, and increased ( $P < 0.02$ ) the active eIF4G•eIF4E complex in skeletal muscle. Protein synthesis was increased ( $P < 0.02$ ) in muscle by the infusion of leucine replacement with AA, but not by leucine alone. In liver, translation initiation factor activation was not affected by leucine infusion with or without AA replacement. Hepatic protein synthesis was unaffected by leucine alone, but tended to increase ( $P < 0.06$ ) with AA replacement. Our results indicate that the leucine induced stimulation of skeletal muscle protein synthesis in neonatal pigs during prolonged leucine infusion is dependent on plasma AA availability (NIH AR 44474 and USDA 58-6250-6-001)

**Key Words:** Leucine, Protein synthesis, Translation initiation factor

**374 Evaluation of the true ileal digestible (TID) valine requirement of 8 to 20 kg pigs.** A. M. Gaines\*<sup>1</sup>, P. Srichana<sup>1</sup>, B. W. Ratliff<sup>1</sup>, G. L. Allee<sup>1</sup>, and J. L. Usry<sup>2</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Ajinimoto Heartland LLC, Chicago, IL.

Two experiments were conducted to determine the true ileal digestible (TID) valine requirement for 8 to 12 kg and 12 to 20 kg pigs. In Exp.1,

a total of 1,104 (TR-4  $\times$  C22;  $8.44 \pm 0.05$  kg) were used to evaluate the TID valine requirement from 8 to 12 kg BW. Pigs were assigned to one of four dietary treatments in a completely randomized design with 12 replicate pens/treatment. Dietary treatments included four concentrations of TID valine (0.81, 0.88, 0.95, and 1.02%). The basal diet was corn-soybean meal based (4.20 g TID lysine/Mcal ME) and contained 0.63% L-lysine HCl. Dietary valine concentration was increased by the addition of L-valine to the basal diet. In Exp.2, a total of 552 pigs (TR-4  $\times$  C22;  $11.9 \pm 0.09$  kg) were used to evaluate the TID valine requirement from 12 to 20 kg BW. Pigs were assigned to one of four dietary treatments in a completely randomized design with 6 replicate pens/treatment. Dietary treatments included four concentrations of TID valine (0.68, 0.74, 0.81, and 0.87%). The basal diet was corn-soybean meal based (3.86 g TID lysine/Mcal ME) and contained 0.70% L-lysine HCl. Dietary valine concentration was increased by the addition of L-valine to the basal diet. For Exp.1, increasing dietary valine increased (linear,  $P < 0.01$ ; quadratic,  $P < 0.01$ ) ADG (367, 404, 409, and 404 g/d) and improved (linear,  $P < 0.01$ ; quadratic,  $P = 0.11$ ) G/F (0.700, 0.722, 0.735, and 0.729). Furthermore, increasing dietary valine resulted in an increase (linear,  $P < 0.03$ ; quadratic,  $P < 0.01$ ) in ADFI (522, 563, 558, and 554 g/d). For Exp.2, increasing dietary valine increased (linear,  $P < 0.001$ ; quadratic,  $P < 0.01$ ) ADG (490, 581, 595, and 599 g/d) and improved (linear,  $P < 0.001$ ; quadratic,  $P < 0.01$ ) G/F (0.634, 0.682, 0.687, and 0.685). Furthermore, increasing dietary valine resulted in an increase (linear,  $P < 0.001$ ; quadratic,  $P < 0.01$ ) in ADFI (772, 849, 867, and 872 g/d). The TID valine requirement of 8 to 12 and 12 to 20 kg pigs was estimated to be 0.92 and 0.78%, respectively.

**Key Words:** Valine, Pigs, Growth

**375 Dietary supplementation of L-Arginine for finishing pigs.** N. R. Augspurger\*<sup>1</sup>, D. M. Webel<sup>1</sup>, and G. Wu<sup>2</sup>, <sup>1</sup>JBS United, Inc., Sheridan, IN, <sup>2</sup>Texas A & M University, College Station, TX.

Endogenous nitric oxide (NO), a product of arginine metabolism, has been shown to be a potent stimulator of mitochondrial oxidation and lipolysis. In obese rats, dietary supplementation of L-arginine increased NO synthesis and fatty acid oxidation, and reduced abdominal and epididymal fat mass by 44 and 25%, respectively (Fu et al., 2005). Based on those data, an experiment was done to determine the effect of L-arginine supplementation on growth performance and carcass backfat depths of finishing pigs. Eighty pigs (Ausgene genetics, equal barrows and gilts,  $64.3 \pm 2.3$  kg) were individually-housed and fed corn-soybean meal-based diets formulated to be adequate in all nutrients. Diets were fed in two phases with phase 1 (0.99% dig. Lys, 1.10% dig. Arg) fed for 29 d and phase 2 (0.81% dig. Lys, 0.90% dig. Arg) fed for the remainder of the trial period. Pigs were blocked by initial weight within sex into 20 replicates and randomly allotted to one of four treatments. Arginine was added to experimental diets as L-arginine at the expense of cornstarch to achieve supplemental concentrations of 0, 0.5, 1.0, and 2.0%. Pigs in replicates one through 10 were fed phase 2 diets for 34 d, while those in replicates 11 through 20 were fed phase 2 diets for 28 d. All pigs were ultrasounded for measurement of 10th rib backfat depth and loin depth prior to being slaughtered at a commercial processing facility, where backfat and loin depths were measured for each carcass. Dietary supplementation with 2% L-Arg increased ( $P < 0.10$ ) weight gain (5.2%) and gain/feed ratio (3.2%) in the first dietary phase. In the second dietary phase, 2% L-arginine increased ( $P < 0.11$ ) weight gain by 5.6% compared to the control, and feed intake was increased ( $P < 0.05$ ) 4.2% by 1.0 and 2.0% L-Arg. Dietary supplementation of L-Arg reduced ( $P < 0.10$ )

ultrasound backfat thickness [18.8 vs 17.6 ( $\pm$  0.8) mm, respectively], but L-Arg had no effect ( $P > 0.10$ ) on carcass backfat [19.6 vs 19.8 ( $\pm$  0.8) mm, respectively], loin depth, or calculated carcass lean content. In genetically-lean pigs, dietary supplementation of arginine during the finishing period has potential to enhance weight gain but may not affect carcass backfat depths.

**Key Words:** Arginine, Pigs, Backfat

**376 Nitrogen retention response of pigs to DL-methionine (DLM) and methionine hydroxy analog free acid (MHA-FA).** J. A. Jendza<sup>\*1</sup>, M. Rademacher<sup>2</sup>, and O. Adeola<sup>1</sup>, <sup>1</sup>Purdue University, West Lafayette, IN, <sup>2</sup>Degussa AG, Hanau-Wolfgang, Germany.

Graded equimolar concentrations of DL-methionine (DLM, 99%) or methionine hydroxy analog free acid (MHA-FA, 88%) were used in a study to evaluate N retention responses of pigs. A methionine-deficient basal diet was formulated to contain 2.2 g methionine/kg; to which was added (in mg/kg) DLM at 0, 200, 400, and 600 mg/kg or MHA-FA at 227, 455, and 682. The 7 diets were fed to 63 barrows (average body weight = 14.2 kg; 9 pigs/diet), housed in stainless-steel metabolism crates, using protocols that consisted of a 5-d adjustment period followed by a 5-d period of total but separate collection of feces and urine. Output of N in the urine linearly decreased ( $P < 0.01$ ) as the concentrations of either DLM or MHA-FA increased in diets. Nitrogen retention expressed as a percent of N intake (NRNI) linearly increased ( $P < 0.01$ ) with increasing dietary concentrations of either DLM or MHA-FA. Furthermore, as dietary concentrations of either DLM or MHA-FA increased, N retention expressed as a percent of N absorbed (NRNA) linearly increased ( $P < 0.01$ ). Common-intercept, multiple linear regression equations were: NRNI = 60.08 + 0.01255 (SE = 0.00295) DLM + 0.01087 (SE = 0.00277) MHA-FA, NRNA = 74.01 + 0.01464 (SE = 0.00233) DLM + 0.01192 (SE = 0.00218) MHA-FA using analyzed dietary concentration as the independent variable; or NRNI = 60.06 + 0.01217 (SE = 0.00290) DLM + 0.00976 (SE = 0.00255) MHA-FA, NRNA = 73.96 + 0.01427 (SE = 0.00229) DLM + 0.01080 (SE = 0.00202) MHA-FA using added dietary concentration as the independent variable. Based on these N retention responses, the biological efficacy of MHA-FA relative to DLM is between 81 and 87% on an equimolar basis; or between 71 and 77% on a weight for weight basis.

**Key Words:** Methionine, Methionine hydroxy analog free acid, Swine

**377 The effect of soybean hulls inclusion on the apparent and true ileal digestibility of selected amino acids in growing pigs.** L. Dégen<sup>\*1</sup>, J. Tossenberger<sup>2</sup>, V. Halas<sup>2</sup>, and L. Babinszky<sup>2</sup>, <sup>1</sup>Agribands Europe Hungary RT, Karcag, Hungary, <sup>2</sup>University of Kaposvár, Kaposvár, Hungary.

Soybean hulls (SBH) have become a widely used component in growing and fattening pig feeds. The aim was to study the effect of SBH on the apparent and true ileal digestibility (AID and TID, respectively) of selected amino acids (AAs). The trial was conducted with a total of 40 PVTC-cannulated hybrid barrows in 2 replicates (n=8, 4 pigs/treatment/replicate) in a live weight range of 30-40 kg. AID and TID of AAs were studied, the ileal endogenous AA excretion was determined in a separate study with a total of 8 growing pigs fed N-free diets. The dietary treatments were achieved by supplementing the basal corn-soybean diet with 0, 25, 50, 75 or 100 g/kg of SBH. The experimental diets were formulated according to the NRC (1998)

recommendations. Daily feed allowance of the pigs was 2.6 times their maintenance energy requirement. The trial consisted of a 5-day adaptation and three times 12-hour collection period. Data were analyzed by ANOVA (SAS, 1990), and the relationships between SBH inclusion in the diet and AID and TID of the amino acids were examined with regression analysis. Our data show that inclusion of 25 g/kg SBH in the diet significantly decreased the AID of Lys, Met, Cys from 80.6 to 75.3%, from 85.4 to 81.6% and from 76.8 to 72.6% ( $P \leq 0.05$ ), respectively. Further increment of SBH in the diet did not result significant reduction in AA digestibility. Similar results were obtained for TID. It was confirmed by regression analyses being linear-plateau manner with sharp transition that for Lys, Met and Cys the AID did not drop after the transition points of 29, 38, 31 g/kg SBH inclusion in the diet, respectively. Therefore, the benefit of using SBH is depending on financial calculation, considering that 25 g/kg SBH decreases significantly the digestibility of AAs, however, more than approximately 30 g/kg SBH inclusion does not reduce it further.

**Key Words:** Soybean hulls, Amino acid digestibility, Growing pigs

**378 Amino acid digestibility and measurement of blocked lysine in five samples of distillers dried grains with solubles in growing pigs.** A. A. Pahn<sup>\*1</sup>, D. Hoehler<sup>2</sup>, C. Pedersen<sup>1</sup>, D. Simon<sup>1</sup>, and H. H. Stein<sup>1</sup>, <sup>1</sup>South Dakota State University, Brookings, <sup>2</sup>Degussa Corp., Kennesaw, GA.

An experiment, which is a part of a two-phase study, was conducted to determine the application of the furosine procedure as an in vitro method to predict the standardized (SID) ileal digestibility of Lys in five sources of distillers dried grains with solubles (DDGS) fed to growing pigs. Twelve barrows (Ausgene Intl., Gridley, IL) with initial BW of 36.9  $\pm$  5.6 kg were fitted with a T-cannula in the distal ileum and randomly allotted to a replicated 6 x 4 Youden square design with six diets and four periods. Five diets were based on DDGS (67.5%) and one diet was a N-free diet. Each feeding period lasted 7 d with ileal digesta collection every 6 and 7 d. Values for AID and SID were calculated for all DDGS sources and compared using an analysis of variance. Furosine contents were determined in DDGS samples and these values were correlated with the in vivo data. Results of the in vivo study showed that the AID and SID of CP did not vary among sources. However, the AID for Lys, Trp, Leu, and Arg and the SID for Lys and Leu varied ( $P \leq 0.05$ ) among samples. The remaining indispensable AA did not differ in AID and SID among the five DDGS sources. The SID for Lys was poorly correlated with total CP ( $R^2 = 0.22$ ) and total Lys content ( $R^2 = 0$ ) indicating that total CP and total AA content may be inadequate to estimate Lys digestibility of DDGS in pigs. We hypothesize that this may be partly due to the heat damage of DDGS during processing which can alter Lys digestibility without altering its analyzed total Lys content. Results of the in vitro study showed that the average blocked lysine of samples (% of total Lys) estimated by the furosine method was 16.6  $\pm$  5.2%. This represents the proportion of the total Lys that is not available to the pig, possibly due to early Maillard reaction. Furosine and blocked lysine were correlated to SID Lys ( $R^2 = 0.67$  and 0.70, respectively). In conclusion, furosine and blocked Lys can potentially be used to predict SID Lys in DDGS by growing pigs. However, additional data are needed to establish a reliable prediction equation using this procedure.

**Key Words:** Amino acid digestibility, DDGS, Furosine

**379 Amino acid and energy digestibility in NutriDense corn and other cereal grains fed to growing pigs.** C. Pedersen\*, M. G. Boersma, and H. H. Stein, *South Dakota State University, Brookings*.

Two experiments were conducted to measure the AA and energy digestibility in NutriDense corn and compare these values to values obtained for other cereal grains. In Exp. 1, six growing barrows were fitted with a T-cannula in the ileum and used to measure apparent (AID) and standardized (SID) ileal digestibility values for AA in NutriDense corn, yellow dent corn, barley, wheat, and sorghum. Five diets based on each cereal grain were formulated and a N-free diet was used as well. Pigs were allotted to a 6 x 6 Latin square design and fed one of each of the six diets during one experimental 7-d period. Digesta were collected from the cannulas for ten h on d 6 and 7. The AID and the SID for AA were calculated for each grain. Results showed that the AID for most indispensable AA are greater ( $P \leq 0.05$ ) in NutriDense corn and wheat than in the other cereal grains. The SID for Lys in NutriDense corn (77.6%) was greater ( $P \leq 0.05$ ) than in yellow dent corn (68.5%) and sorghum (56.9%), but not different from wheat (75.1%) and barley (71.7%). The SID for Arg and Met in NutriDense corn also were greater ( $P \leq 0.05$ ) than in yellow dent corn (88.1 and 87.2% vs. 84.5 and 82.8%, respectively). For the remaining indispensable AA, no differences in SID between NutriDense corn and yellow dent corn were observed. In Exp. 2, 12 growing barrows were placed in metabolism cages and used to measure the DE and ME of NutriDense corn and normal corn. Both grains were used in diets that were formulated either without or with supplemented crystalline AA. Therefore, a total of four diets were formulated. Each diet was fed to six pigs in a 2-period changeover design. Results of this experiment showed that the DE and ME in NutriDense corn (3,964 and 3,869 kcal/kg DM, respectively) were greater ( $P \leq 0.006$ ) than in normal corn (3,872 and 3,781 kcal/kg DM, respectively). However, the DE and ME were not influenced by the addition of AA to the diets. It is concluded that NutriDense corn has a greater value than normal corn in diet formulations because of increased concentrations of digestible Lys, Met, and energy.

**Key Words:** Amino acid digestibility, Energy digestibility, NutriDense corn

**380 Effect of increasing dietary crude protein and crystalline amino acids on carcass composition and IGF-I mRNA expression in growing pigs.** R. Fischer\*<sup>2</sup>, P. Miller<sup>1</sup>, A. Cupp<sup>1</sup>, and D. Clopton<sup>1</sup>, <sup>1</sup>University of Nebraska, Lincoln, <sup>2</sup>Sioux Nation Ag Center, Sioux Falls, SD.

Fifty-six crossbred gilts with an initial BW of 33.1 kg were used in a 26-d growth study. Seven dietary treatments were used; four were standard corn-soybean meal diets, which were formulated by changing the corn and soybean meal ratio and three were low-protein, AA-supplemented diets formulated to contain similar lysine, methionine, tryptophan, and threonine concentrations as the corn-soybean meal diets. The dietary treatments were 1) 10% CP diet; 2) 14% CP diet; 3) 10% CP + AA; 4) 18% CP; 5) 14% CP + AA; 6) 22% CP; and 7) 18% CP + AA. At the end of the experiment, all gilts were slaughtered and the right side of each carcass was ground and a representative sample was used for chemical analysis. Also, at the time of slaughter liver, longissimus muscle, semitendinosus muscle, and adipose tissue samples were collected and used for the determination of IGF-I mRNA expression. Serum IGF-I concentrations (182, 357, 300, 568, 504, 589, and 531 ng/mL, respectively) on d 26 were affected by dietary

treatment ( $P < 0.01$ ); and IGF-I concentration was different ( $P < 0.10$ ) between gilts fed the corn-soybean meal versus AA-supplemented diets (505 vs 445 ng/mL, respectively). Protein accretion rates increased ( $P < 0.01$ ) from 40 g/d in gilts fed the 10% CP diet to 128 g/d in gilts fed the 18% CP + AA diet and there was no difference between gilts fed the corn-soybean meal versus the AA-supplemented diets (101 and 105 g/d, respectively). Real-time PCR results indicated an effect of amino acid form with gilts fed corn-soybean meal diets having greater ( $P < 0.01$ ) IGF-I mRNA expression in the semitendinosus muscle and adipose tissue compared to gilts fed AA-supplemented diets. These results suggest that the form of dietary amino acid supplementation does affect serum IGF-I concentrations and mRNA expression in semitendinosus muscle and adipose tissue; however, this reduction in expression and serum concentration of IGF-I had no impact on growth rate and carcass composition between gilts fed corn-soybean meal and low-protein, AA-supplemented diets.

**Key Words:** Amino acids, Pigs, IGF-I

**381 Effects of dietary crude protein level and crystalline amino acid supplementation on odor from pig manure.** P.-D. Le\*, A. Aarnink, and M. Verstegen, *Animal Sciences Group, Wageningen, The Netherlands*.

Two experiments were conducted in growing pigs to determine the effects of dietary CP levels and specific crystalline amino acids supplementation to a diet on odor emission, odor intensity, hedonic tone, and ammonia emission from pig manure. In each experiment, pigs ( $n=18$ ) were allocated in a randomized complete block arrangement having three treatments in six blocks. In the first experiment, treatment groups were 12%, 15% and 18% CP diets. In the second experiment, treatment groups were 1) diet with three times requirement of sulfur-containing AA (Met + Cys), 14.2 g/kg diet, 2) diet with two times requirement of Trp, and Tyr + Phe, 2.9 and 20.4 g/kg diet as fed basis, respectively and 3) control diet with 15% CP and with supplementation of these AA up to requirement. Pigs with initial body weight of around 39 kg were kept individually in partly slatted floor pens. Daily feed allowance was 2.8 x maintenance requirement for net energy ( $293 \text{ kJ W}^{0.75}$ ). Feed was mixed with water, 1/2.5 (w/w). Feces and urine of each pig were accumulated together in a separate manure pit during four weeks under the slatted floor. In the fifth week air samples for odor and ammonia analyses were collected directly from each manure pit. Reducing CP from 18% to 12% lowered odor emission and ammonia emission ( $P < 0.05$ ) from pig manure by 80% and 53%, respectively, and increased odor hedonic tone (less unpleasant odor) ( $P < 0.05$ ) but did not affect odor intensity ( $P > 0.05$ ) of the odorous air. Supplementing S-containing AA in surplus of pigs' requirement increased odor emission by 723% and odor intensity and reduced odor hedonic tone ( $P < 0.05$ ) of odorous air. Supplementing Trp, Tyr, and Phe in surplus of pigs' requirement did not affect odor emission, odor intensity and odor hedonic tone. No differences were observed in ammonia emission from manure of pigs fed different types of AA ( $P > 0.05$ ). A reduction of dietary CP and minimizing S-containing AA are options to reduce odor emission and odor intensity, increase hedonic tone and ammonia emission from pig manure.

**Key Words:** Odor, AA, Protein

**382 Dietary sources of starch affect intestinal absorption and metabolism of glucose and amino acids in growing pigs.** J. Zhang<sup>1</sup>, Y. L. Yin\*<sup>1</sup>, and G. Y. Wu<sup>1,2</sup>, <sup>1</sup>*The Chinese Academy of Sciences, Changsha, Hunan, P.R. China*, <sup>2</sup>*Texas A&M University, College Station*.

The objective of this study was to determine the effect of dietary starch sources on the balance of glucose and amino acids across the portal-drained viscera (PDV) of growing pigs. Four Duroc×Landrace×Yorkshire cross-bred barrows (with an average body wt of 22.5 kg) were housed individually in stainless steel metabolism cages and trained to consume feed provided daily. After a 2-wk adaptation period, pigs were fitted with permanent catheters in the portal vein, mesenteric vein, and carotid artery. After a 13-d recovery period, pigs were assigned randomly into one of 4 treatment groups in a 4×4 Latin square design representing 4 cornstarch- and casein-based isocaloric and isonitrogenous diets containing 52.0% corn, 65.8% brown rice, 65.3% sticky rice, and 51.8% Hi-Maize 1043 (resistant starch). Pigs were fed 3 times daily at 07:30, 15:30 and 23:30 at a feeding level of >963 kJ DE/kg diet. Each diet was fed to the pig

after a 6-d adaptation period. On d 7, blood samples were obtained simultaneously from the 3 catheters at 30 min prior to feeding and hourly for 8 h after feeding. Portal blood flow was measured using p-aminohippuric acid. Results showed that portal glucose absorption (expressed per 100 g feed intake) was lower ( $P < 0.05$ ) for the resistant-starch diet compared with corn, stick rice and brown rice diets at all sampling times. In comparison with the corn diet, net portal glucose absorption was higher ( $P < 0.05$ ) for the sticky rice and brown rice diets up to 4 h after feeding, but was reduced ( $P < 0.05$ ) thereafter. Feeding the resistant-starch diet reduced ( $P < 0.05$ ) the net portal absorption of total amino acids, particularly Pro, Leu, and Ile. The net appearance of total amino acids absorbed from the ileum differed ( $P < 0.05$ ) among the treatment groups, and was 48.4, 63.8, 61.8, and 59.3%, respectively, for piglets fed the corn, brown rice, sticky rice, and resistant-starch diets. These findings indicate that dietary sources of starch affect intestinal absorption and metabolism of glucose and amino acids in growing pigs. Supported by funds from Chinese Academy of Sciences and China NSF.

**Key Words:** Glucose, Amino acids, Dietary starch

## Physiology and Endocrinology: Metabolic Physiology

**383 Fertility of lactating dairy cows administered bovine somatotropin during heat stress.** F. D. Jousan\*, L. A. de Castro e Paula, J. Block, and P. J. Hansen, *University of Florida, Gainesville*.

While administration of bovine somatotropin (bST) to lactating dairy cows increases milk production, it can also increase body temperature during heat stress and may therefore compromise fertility. However, bST increases secretion of insulin-like growth factor-I (IGF-I) and culture of bovine embryos with IGF-I blocks the reduction in blastocyst development and induction of apoptosis caused by heat shock. The purpose of this study was to determine effects of bST on reproductive function in lactating dairy cows during heat stress. The experiment was conducted in South Georgia from July to November 2005 using 271 lactating Holstein cows and heifers. For first service timed artificial insemination (TAI), cows were presynchronized with two injections of PGF2 $\alpha$  given 14 d apart followed by a modified Ovsynch protocol (GnRH given 72 h following PGF2 $\alpha$ ). Pregnancy was diagnosed using ultrasonography on d 29 and reconfirmed by palpation between d 45-80 post-TAI. Non-pregnant cows were resynchronized with the modified Ovsynch protocol and received TAI. Treatment with bST (500 mg; Posilac, Monsanto) started 1 wk prior to the start of Ovsynch and continued at 2-wk intervals. A subset of cows (n=38) were bled for IGF-I profiles immediately prior to the first bST injection, 1 wk later, and at d 35 of bST treatment. Rectal temperatures were taken on d 29 of bST treatment. Pregnancy rates (d 45-80 post-TAI) did not differ between control (n=129) and bST-treated cows (n=142) for first- (15.5% vs 16.9%) or second-service TAI (17.2% vs 15.0%). Milk yield and plasma concentrations of IGF-I were higher for bST-treated cows following the initiation of bST treatment (bST x time interaction,  $P < 0.01$ ) and bST increased rectal temperature ( $P < 0.05$ ; 39.17°C vs 39.31°C for control vs IGF-I cows, SEM=0.05°C). In conclusion, treatment with bST during heat stress increased IGF-I concentrations and milk production over time and rectal temperature without compromising first- or second-service pregnancy rates. (Research Support: USDA TSTAR grant 2004-34135-14715 and IFAFS grant 2001-52101-11318).

**Key Words:** Dairy cows, Bovine somatotropin, Fertility

**384 Effect of the addition of insulin-like growth factor-1 to embryo culture medium on pregnancy rate following timed embryo transfer in lactating dairy cows.** J. Block\* and P. J. Hansen, *University of Florida, Gainesville*.

Addition of insulin-like growth factor-1 (IGF-1) to embryo culture medium increases pregnancy rate following transfer of in vitro produced embryos to heat stressed, lactating dairy cows (Block et al., *J. Anim. Sci.* 81:1590, 2003). The objective of the present study was to determine whether the effect of IGF-1 on embryo survival was a general effect or one specific to heat stress. An embryo transfer field trial was conducted between March 2005 and January 2006 at 4 different locations. Embryos were produced in vitro using oocytes collected from abattoir-derived ovaries. After fertilization, presumptive zygotes were cultured in the presence or absence of 100 ng/mL IGF-1. Cows were synchronized for timed embryo transfer using the OvSynch protocol (3 locations) or 2 injections of prostaglandin F<sub>2 $\alpha$</sub>  (25 mg, i.m.) 14 days apart (1 location). A total of 287 primiparous and multiparous, lactating cows were selected as recipients based on the presence of a corpus luteum. Grade 1 embryos were selected on d 7 after fertilization and randomly transferred to recipients that were at d 7 after anticipated ovulation. Pregnancy rate was diagnosed by ultrasonography at d 27-32 and by rectal palpation at d 41-49. The experiment was replicated 20 times with 6-28 recipients per replicate. Transfers were divided into two seasons, cool (Jan., Mar., April, Nov., Dec.) and hot (July, Aug., Sep.). There was a significant IGF-1 x season interaction for pregnancy rate at both d 27-32 and d 41-49 ( $p < 0.01$ ). Addition of IGF-1 to embryo culture significantly increased pregnancy rate during the hot season (d 27-32: 34/69 = 49.3% vs. 15/71=21.1% and d 41-49: 28/67=41.8% vs. 13/71=18.3%, respectively), but not during the cool season (d 27-32: 19/70 = 27.1% vs. 23/66=34.9% and d 41-49: 16/73=21.9% vs. 21/74=28.4%, respectively). Results indicate that IGF-1 can be added to bovine embryo culture to increase pregnancy rate in lactating dairy cow recipients during heat stress but there is no advantage in the absence of heat stress. USDA-TSTAR 2004-34135-14715 and BARD US-3551-04

**Key Words:** Insulin-like growth factor-1, Embryo transfer, Cattle