

of EESoy from the commercial manufacturers tested and that processing temperature should be 154.4 °C.

**Key Words:** Nursery pig, Soybean meal, Processing

**162 Grower-finisher growth performance and carcass characteristics including attempts to detect transgenic plant DNA and protein in muscle from pigs fed genetically modified "Bt" corn.** T. E. Weber\* and B. T. Richert, *Purdue University, West Lafayette, IN.*

A feeding experiment was conducted to demonstrate similar growth performance and carcass quality in grow-finish pigs fed diets containing "Bt" corn as compared to "non-Bt" corn. Bt corn resists the European Corn Borer by expressing the Cry1Ab selective insecticidal protein from *Bacillus thuringiensis*. Pigs (n=180; DeKalb EB x 45; 30 5.2 kg BW) were randomly assigned to one of three dietary treatments: diets containing 1) Bt corn (Bt); 2) the near isogenic control to the Bt corn (NIC); or 3) commingled conventional, non-genetically modified, corn hybrids (CC). The experimental diets were fed in four phases, and were formulated to contain equal percentages of each corn source within each phase. Pig growth rates were similar between corn sources ( $P > .10$ ) at all time points. Barrows had greater overall ADG, ADFI, and lower feed efficiency (G:F) than gilts ( $P < .01$ ). Pigs were harvested at 121 kg and carcass data collected. Pigs fed CC had greater HCW and dressing percentage ( $P < .05$ ) than pigs fed NIC or Bt. Pigs fed NIC had greater 10th rib fat depth than either Bt or CC fed pigs ( $P < .05$ ). Pigs fed the NIC corn had lower predicted percent lean than CC fed pigs ( $P < .05$ ), but similar percent lean to Bt fed pigs. Pigs fed NIC had greater visible loin marbling than CC fed pigs ( $P < .05$ ) and barrows had greater visible loin marbling than gilts ( $P < .05$ ). Gilts had greater loin eye area and less backfat at the 10th and last rib ( $P < .05$ ) and greater predicted percent lean than barrows ( $P < .05$ ). DNA was extracted from loins of 12 pigs fed Bt and 12 pigs fed NIC diets. Southern blot analysis of PCR products was performed to screen for the presence of specific fragments of the cry1Ab and the endogenous corn protein Shrunken-2 (sh-2) genes. None of the extracted DNA samples were positive for cry1Ab or sh-2 genes. Also, using a competitive immunoassay cry1Ab protein was not detected in the extracts of loin samples from pigs fed Bt corn. Results indicate pig growth performance and carcass characteristics are similar in pigs fed diets containing "Bt" or "non-Bt" corn. Furthermore, no evidence of passage of the transgene from the corn to the pigs tissue was found.

**Key Words:** Bt corn, Pigs, Growth

**163 Comparison of two methods to determine DE content of barley for grower pigs.** M.N. Casano\*<sup>1,2</sup> and R.T. Zijlstra<sup>1</sup>, <sup>1</sup>*Prairie Swine Centre Inc.*, <sup>2</sup>*University of Saskatchewan, Saskatoon, Canada.*

The DE content of cereal grains is measured generally in a protein-deficient diet to which pigs have restricted access. The method does not reflect practical conditions and prevents measurement of voluntary feed intake. The DE content of five barley samples was measured using two methods, in a 2x5 factorial arrangement, in 6 blocks of 10 pigs (202.6kg) penned individually. The restricted-standard diet (RSD)-method consisted of a 95.5%-barley mash-diet (2950 kcal DE/kg, 10.1% CP, 0.81 g d Lys/Mcal DE) fed at 3xDE Maintenance requirement for 12 d after a 4-d acclimation. The ad lib-modified diet (AMD)-method consisted of a barley (75%), soybean meal (18%), and canola oil (2%) mash-diet (3165 kcal DE/kg, 16.5% CP, 2.24 g d Lys/Mcal DE) fed with free access for 16 d. Feces were collected on the final 3 d. The ADFI and daily DE intake were higher ( $P < 0.05$ ) in AMD- vs RSD-pigs, resulting in a 260% increase in ADG (851 vs 239 g/d;  $P < 0.05$ ). Likewise, apparent energy digestibility of diets and calculated barley DE were higher ( $P < 0.05$ ) in AMD- (75.1%, 3066 kcal/kg DM) vs RSD-pigs (74.1%, 2999 kcal/kg DM). For DE content, method and barley sample interacted ( $P = 0.12$ ), indicating that barley samples were ranked differently for each method. The DE intake of RSD-pigs was correlated to ADF ( $r = -0.92$ ), NDF ( $r = -0.91$ ), density ( $r = 0.84$ ), and water-holding capacity ( $r = -0.78$ ). In AMD-pigs, ADFI ranged from 1.36 to 1.51 kg/d for d 1 to 8, and from 1.68 to 1.78 kg/d overall, but DE intake was similar ( $P > 0.10$ ) among barley samples. The DE intake of AMD-pigs was correlated to barley DE ( $r = -0.82$ ), particle size ( $r = -0.73$ ), ADF ( $r = -0.66$ ), and NDF ( $r = -0.59$ ). Fiber predicted barley DE content in the RSD- (ADF,  $R^2 = 0.61$ ; NDF,  $R^2 = 0.58$ ;  $P < 0.05$ ) and AMD-method (NDF,  $R^2 = 0.66$ ; ADF,  $R^2 = 0.62$ ;

$P < 0.05$ ). In summary, an increase in fiber was related to a reduction in DE content of barley and DE intake. Method to analyze DE content affected the measured barley DE content, and voluntary feed intake might differ among barley samples.

**Key Words:** Pig, Barley, Digestible energy

**164 A comparison between feeding plasma and peptide proteins on nursery pig growth performance and intestinal health.** C. A. Boren\*<sup>1</sup>, M. S. Carlson<sup>1</sup>, T. L. Veum<sup>1</sup>, J. R. Turk<sup>1</sup>, and G. W. Tibbetts<sup>2</sup>, <sup>1</sup>*University of Missouri-Columbia*, <sup>2</sup>*Alltech Biotechnology, Inc., Nicholasville, KY.*

Two 28-d studies were conducted to evaluate the effectiveness of peptide protein compared to plasma protein fed during the nursery period with and without carbadox on growth performance and intestinal morphology. In Exp.1, 144 pigs (19 2 d of age; 5.72 kg) were weaned and allotted to 3 dietary treatments (containing 50g/ton carbadox) utilizing 8 replications of 6 pigs/pen. In Exp.2, 84 pigs (20 2 d of age; 6.17 kg) were weaned and allotted to 3 dietary treatments (without carbadox) with 7 replications of 4 pigs/pen. The basal Phase 1 (d 1 14) and Phase 2 (d 15 28) diets contained no animal plasma or blood products. Two more diets were made by the addition of either 5 % (Phase 1) or 2.5 % (Phase 2) of animal plasma or peptide proteins (Ultimate Protein 1672). In Exp.1, there was a trend ( $P = .08$ ) for pigs fed plasma protein to have the highest overall ADG with pigs fed peptide protein being intermediate, and pigs fed the control diet having the lowest ADG (392, 378, and 359 g/d, respectively). In Exp.2, pigs fed either plasma or peptide proteins had the highest overall ADG ( $P < .004$ ) when compared to pigs fed the control diet (395, 385, 338 g/d, respectively). In both Exp. 1 and 2, feed intake was improved ( $P < .05$ ) by the addition of either plasma protein or peptide protein during Phase 1, Phase 2 and overall. Duodenal morphology was not different on d 7 or d 14 of Exp. 1 and d 7 or d 28 of Exp.2 ( $P > .05$ ). On d 28 of Exp. 1, pigs fed either peptide protein or animal plasma had reduced crypt depth and total wall thickness ( $P < .04$ ). Also, on d 28, pigs fed the peptide protein diet had decreased ( $P = .04$ ) villous width and a trend for thinner ( $P = .09$ ) lamina propria area compared to pigs fed the control or animal plasma diets. In conclusion, feeding either animal plasma or peptide proteins with or without carbadox post-weaning improved overall pig performance and to a lesser degree intestinal health.

**Key Words:** Nursery pigs, Peptide proteins, Duodenum

**165 Effects of gamma ray and electron beam irradiation levels in spray-dried blood meal on nursery pig performance.** J.M. DeRouchey\*, J.L. Nelssen, M.D. Tokach, R.D. Goodband, S.S. Dritz, J.C. Woodworth, M.J. Webster, B.J. James, and D.E. Real, *Kansas State University, Manhattan.*

Recent research conducted at our experiment station has shown improved growth performance of nursery pigs that have consumed dried blood products that have undergone irradiation treatment. However, different types and dosage levels of irradiation have not been thoroughly investigated. Thus, 300 weanling pigs (initially 10.7 kg and  $17 \pm 6$  d of age) were used in a 19-d growth assay to determine the effects of increasing levels (2.5, 5.0, 10.0, or 20.0 kGy) of gamma ray or electron beam irradiation of spray-dried blood meal (BM) on nursery pig performance. All pigs were fed the same pelleted SEW and Transition diets to 4 d post-weaning. At d 4, pigs were switched to experimental diets, which included a control diet with no added BM, a diet with 5% regular BM or 5% BM with irradiation treatment. Irradiation treatments included BM subjected to either gamma ray (cobalt-60 source) or electron beam irradiation at increasing dosage levels (2.5, 5.0, 10.0 or 20.0 kGy). All BM used in this experiment was from the same lot. Treatment diets were fed in meal form and formulated to contain 1.40% lysine, 0.90 Ca, and 0.54 available P. Irradiation of BM proved effective in the reduction of aerobic bacteria, *E. coli*, mold, and yeast concentrations. Overall, (d 5 to 19 post-weaning), the inclusion of irradiated BM tended ( $P < .09$ ) to improve feed efficiency (G/F). However, ADG (318 vs 343 g) and ADFI (459 vs 465 g) were similar ( $P < .26$ ) when comparing the nonirradiated versus the irradiated BM treatments. In addition, the inclusion of BM did not improve growth performance over the control diet without BM. These results indicate that irradiation is an effective technology to reduce or eliminate bacteria, molds, and yeast in BM. Increasing the dosage level above 2.5 kGy, regardless of source, did not

affect growth performance. Also, both electron beam and gamma ray irradiation demonstrated similar results in performance.

**Key Words:** Pig, Blood meal, Irradiation

**166 Effects of irradiation processing of specialty protein products on nursery pig performance.** J.M. DeRouchey\*, M.D. Tokach, J.L. Nelssen, R.D. Goodband, S.S. Dritz, J.C. Woodworth, M.J. Webster, B.W. James, and D.E. Real, *Kansas State University, Manhattan*.

Recent research from Kansas State University has shown improved growth performance of nursery pigs fed diets containing irradiated animal plasma (AP) or blood meal compared to nonirradiated forms. In this 14-d growth assay, 300 weanling pigs (initially 6.1 kg and  $20 \pm 2$  d) were used to determine the effects of irradiation processing of other specialty protein products. All diets were fed in pelleted form and formulated to contain 1.50% lysine, 0.90 Ca, 0.80 P, 0.46 Na, and 0.57 Cl. In addition, 2.50% fishmeal and 0.15% L-Lysine HCl were added to all diets with other crystalline amino acids included (if necessary) to maintain similar ratios of amino acids related to lysine. Treatments included a control diet or the control with 5% AP (American Protein Corp., AP 920); animal plasma, dried egg product, animal serum, serum albumin, and serum globulin combination (DuCoa L.P., ProtiOne<sup>TM</sup>); dried porcine digest (Nutra-Flo Protein Products, DPS 30); liquefied and spray-dried beef muscle (Esteem Products Inc., Peptide Plus<sup>TM</sup>); and spray-dried whole egg (California Spray Dry). All specialty products were either fed irradiated or as-is, and originated from the same lot for each source. Since all specialty products were included in the diet at a fixed amount, and not on a nutrient profile basis, direct comparisons between these products were not made, nor was it an objective of this experiment. Overall, irradiation of AP and Peptide Plus<sup>TM</sup> resulted in increased ( $P < .05$ ) ADG compared to pigs fed the nonirradiated form. Irradiation of Peptide Plus<sup>TM</sup> also improved ( $P < .05$ ) G/F compared to its nonirradiated form. The other specialty protein sources were not influenced by irradiation. Bacteria levels varied widely, but irradiation decreased bacteria for every source. Because the two protein sources that responded to irradiation had the highest (AP) and the lowest (Peptide Plus<sup>TM</sup>) bacteria level, the growth improvements from irradiation do not appear to be solely from a decrease in bacteria.

**Key Words:** Pig, Protein source, Irradiation

**167 Ileal mucin output in growing pigs fed semipurified diets with different protein sources.** D. M. Albin\*, M. R. Smiricky, J. E. Wubben, and V. M. Gabert, *University of Illinois, Urbana*.

Crude mucin was isolated from ileal digesta collected from ileally-cannulated growing pigs (BW = 35 kg) fed semipurified diets. Corn starch-based diets were fed, and contained soybean meal (SBM), soy protein concentrate (SPC) or casein as the sole protein source. The diets containing SBM and SPC were formulated to contain 17% CP. A low-protein casein diet was used to estimate endogenous secretions. Chromic oxide was included in all diets at 0.5%. Feed intake was equalized in each period. After adapting to a new diet for 5 d, ileal digesta were collected continuously for 12 h on d 6 and 7. For each diet, crude mucin was isolated from ileal digesta collected from four pigs. The crude mucin isolation procedure obtained the water soluble-ethanol precipitable fraction of ileal digesta. This procedure has also been shown to isolate nonmucin protein and carbohydrates. However, contaminating substances from the diet were present in relatively low quantities, and these substances have been shown to be highly digestible at the terminal ileum. Also, THR, SER and PRO are present in high quantities in purified mucin, and the crude mucin isolate contained significant quantities of these amino acids (approximately 25%). Crude mucin contributed significant quantities of amino acids (from 5 to 46%) to the total amino acids lost at the ileum. The type of diet fed affected ( $P < 0.05$ ) crude mucin output. The use of a semipurified diet to estimate endogenous secretions of amino acids underestimated the contribution from mucin. Feeding diets with SPC, and especially SBM, increased ( $P < 0.05$ ) crude mucin output. When correcting for endogenous losses from mucin only, apparent ileal digestibility coefficients were significantly increased ( $P < 0.05$ ). The apparent THR digestibility for the diet containing SBM was

increased from 70.8 to 81.1% when corrected for mucin only. In conclusion less-refined protein sources increased ileal crude mucin output, which is an important source of endogenous amino acid losses, in pigs.

**Key Words:** Pigs, Amino acids, Mucin

**168 True digestible lysine requirements of PIC barrows over the growing-finishing period.** R. Wei\* and D. R. Zimmerman, *Iowa State University, Ames*.

Five experiments were conducted to estimate the true ileal digestible lysine requirements of PIC barrows at approximately 30, 50, 70, 90, and 110 kg of BW, respectively, by using plasma urea nitrogen (PUN) as a rapid response criterion. Pigs were individually-penned and had free access to feed and water. The dietary treatments were a set of five true digestible lysine concentrations, which were 0.732%, 0.807%, 0.882%, 0.957%, and 1.032% in Exp. 1, 0.527%, 0.602%, 0.667%, 0.752%, and 0.827% in Exp. 2, 0.430%, 0.510%, 0.590%, 0.670%, and 0.750% in Exp. 3, 0.354%, 0.434%, 0.514%, 0.594%, and 0.674% in Exp. 4, and 0.313%, 0.393%, 0.473%, 0.553%, and 0.633% in Exp. 5, respectively. Corn, wheat, soybean meal and crystalline AA were used to formulate the basal diets containing the lowest lysine levels, and the other four lysine levels in each set were achieved by lysineHCl supplementation. Exp. 1 and 2 used 20 PIC barrows with an initial BW of 19.1 kg. The pigs were blocked on litter and initial BW to form four blocks in randomized complete block designs with five dietary treatments. In Exp. 3, 4 and 5, 20 PIC barrows with an initial BW of 59.0 kg were used in completely randomized designs with five dietary treatments. The dietary treatments started when pigs reached about 30 kg in Exp. 1, 50 kg in Exp. 2, 70 kg in Exp. 3, 90 kg in Exp. 4 and 110 kg in Exp. 5, respectively. Each experiment lasted for 5 d and the pigs were bled at 0700 to 0800 for the last 2 d of the period. Pretreatment PUN was used as a covariate to correct the PUN variation not related to lysine adequacy. By fitting the corrected PUN responses to dietary lysine concentrations into a two-slope, broken-line regression model, the estimated true digestible lysine requirements were 16.5 0.2, 17.8 0.8, 20.2 1.2, 16.7 0.8, and 14.4 6.7 g/d for PIC barrows at 33, 52, 72, 93, and 113 kg of BW, respectively. Because of the large variance of PUN concentration and the small sample size, the confidence in the lysine requirement estimates was low.

**Key Words:** Growing-finishing barrows, Lysine requirement, PUN

**169 Optimum threonine:lysine ratio for pigs in the 90 to 120 kg phase.** M.E. Johnston\*<sup>1</sup>, R.D. Boyd<sup>1</sup>, C.E. Fralick<sup>2</sup>, and J.L. Usry<sup>3</sup>, <sup>1</sup>PIC USA Inc., Franklin, KY, <sup>2</sup>Swine-Tek Research and Consulting, Van Wert, OH, <sup>3</sup>Heartland Lysine Inc., Chicago, IL.

The objective was to determine the optimum threonine:lysine ratio for pigs fed from 92.0 to 115.8 kg BW using corn-soy diets. PIC337 x C22 castrates and gilts (45 pens, 8 to 10 pigs/pen) were sorted by weight and randomly allotted to one of nine diets (92.0 $\pm$ 1.0 kg, 44 pigs/diet). Positive (1) and negative (2) control diets contained corn and soy as the only amino acid sources (0.61 and 0.56% true ileal digestible lysine (TID Lys), respectively). Diet 3 contained 0.225% added L-lysine (0.56% TID Lys). Diet 4 contained 0.34% added L-lysine (0.56% TID Lys), 0.02% L-tryptophan, 0.045% L-isoleucine, and 0.045% L-valine. Diets 5, 6, 7, and 8 were the same as diet 4 except corn was replaced by L-threonine at rates of 0.03, 0.06, 0.095, and 0.125%, respectively. Diet 9 contained 0.34% added L-lysine and 0.095% added L-threonine. Feed intake was unaffected ( $P > .60$ ) by dietary treatment. There was a numerical decrease ( $P = .13$ ) in feed conversion (GF) when pigs were fed diet 2 vs diet 1 suggesting that TID Lys was limiting in diet 2. The addition of 0.225% L-lysine (diet 3) resulted in further decline ( $P = .20$ ) in GF compared to the negative control diet (0.30 vs 0.31). The addition of L-tryptophan and L-isoleucine (diet 4) did not bring ( $P < .01$ ) ADG or GF to the same level as in diet 2 (0.78 vs 0.91 kg/d and 0.26 vs 0.31, respectively). The addition of L-threonine to the diet in increasing amounts (diets 5, 6, 7, 8) resulted in a linear improvement ( $P < .01$ ) in ADG and GF compared to diet 4. Daily gain and GF (0.89 kg/d and 0.30) were maximized for pigs fed diet 7 which had a TID Thr:Lys ratio=68%. Removing added L-tryptophan, L-isoleucine, and L-valine (diet 9) and leaving 0.34% added L-lysine and 0.095% added L-threonine in the diet, caused ADG and GF to decrease (0.83 kg/d and 0.28,  $P < .05$ ) compared to pigs fed diet 7 suggesting L-tryptophan, L-isoleucine, and (or) L-valine were limiting. Based on these data, the optimum TID Thr:Lys ratio for pigs in the 90 to 120 kg phase is 68%.

**Key Words:** Pigs, Lysine, Threonine