

kg) and wheat gluten (13.34 kg) bases. These differences were driven by significant increases ( $p < 0.001$ ) in ADI (395.1, 372.4 & 351.1 g/d overall, respectively) rather than feed conversion. The difference in ADI between the worst (wheat gluten) and best (maize) performing bases was 44.0 g/pig/day over the trial period (days 1 to 24), equivalent to a overall mean decrease in intake of 1.06 kg/pig. The formation of MRP in vivo in cooking is well documented and they can have a major effect on nutritive value and other factors. The employment of de novo MRPs of Lys, Met and Thr, with maize in complementary feedingstuffs improves post weaning piglet performance (through increases in ADI) over that of other bases. The exact mechanism by which MRP solution exerts its effect on ADI and piglet performance is currently under investigation.

**Key Words:** Post Weaning Pig, Maillard Reaction Products, Amino Acid Delivery

**164 Effects of added natural and synthetic vitamin E in the drinking water of weaning pigs.** E. Wilburn\*<sup>1</sup>, D. Mahan<sup>1</sup>, D. Hill<sup>2</sup>, and H. Yang<sup>2</sup>, <sup>1</sup>The Ohio State University, Columbus, <sup>2</sup>ADM Alliance Nutrition, Quincy, IL.

Previous trials indicated that providing weaning pigs vitamin E in their drinking water was effective in increasing blood and tissue tocopherol than adding it to the diet. This experiment investigated the effect of supplementing various levels of natural (d  $\alpha$ -tocopheryl acetate) or synthetic (dl  $\alpha$ -tocopheryl acetate) vitamin E to the drinking water of weaning pigs. The experiment was a 2  $\times$  3 factorial in a RCB design in 4 replicates. Vitamin E sources were each evaluated at 3 levels (50, 100, 150 IU/L) in drinking water for 21 d postweaning. Drinking water was mixed daily and provided as needed. A total 96 pigs averaging 6.2 kg BW at 17 d of age were allotted by weight and litter to treatment pens. The diets were conventional complex nursery diets and fed for 7 and 14 d, respectively. The diets had 8.2 mg  $\alpha$ -tocopherol per kg complete feed. Pigs were bled via cardiac puncture at periodic intervals. At the 21 d period, 2 pigs per pen were randomly selected and killed and samples of liver, lung, heart, and loin removed and analyzed for vitamin E. No performance differences occurred between treatments. Serum tocopherol initially averaged 3.5  $\mu$ g/mL and declined in all treatment groups by 7 d postweaning. At 3, 7, 14 and 21 d postweaning serum  $\alpha$  tocopherol increased linearly ( $P < 0.01$ ) as vitamin E in the drinking water increased. Serum tocopherol concentrations were approximately 10% greater when natural vitamin E was provided at each measurement period. Tocopherol concentrations of lung, heart and loin were each greater ( $P < 0.05$ ) for pigs fed the natural source of vitamin E than when fed synthetic vitamin E. Although the tissue concentration increased linearly ( $P < 0.01$ ) as the supplemental level increased for both sources, the data suggest a plateau when 100 IU /L was provided. These results suggest that providing vitamin E in the drinking water of weaned pigs was an effective method of rapidly incorporating the vitamin into body tissue.

**Key Words:** Pigs, Vitamin E, Water

**165 Digestible energy content of corn- vs sorghum-based distillers dried grains with solubles in finishing pigs.** C. Feoli\*<sup>1</sup>, J. D. Hancock<sup>1</sup>, C. Monge<sup>1</sup>, T. L. Gugle<sup>1</sup>, S. D. Carter<sup>2</sup>, and N. A. Cole<sup>3</sup>, <sup>1</sup>Kansas State University, Manhattan, <sup>2</sup>Oklahoma State University, Stillwater, <sup>3</sup>USDA/ARS, Bushland, TX.

A total of 120 finishing pigs (avg initial BW of 111 kg) was used in a 19-d experiment to determine the DE content of corn- vs sorghum-based distillers dried grains with solubles (DDGS). The reference diet was 97.5% corn with vitamins, minerals, and amino acids added to meet or exceed all NRC suggested nutrient concentrations. Treatments were corn-based (Sioux River Ethanol, Hudson, SD and MGP Ingredients, Atchison, KS) and sorghum-based (US Energy Partners, Russell, KS and Western Plains Energy, Oakley, KS) DDGS substituted as 50% of the reference diet in place of corn. The pigs were sorted by sex and ancestry and blocked by BW with 12 pigs/pen and two pens/treatment. Feed and water were consumed on an ad libitum basis. The pigs were allowed to adjust to the experimental diets for 4 d. Each morning for the next 2 d, grab samples of feces were collected from at least six of the pigs in each pen via rectal massage. The pigs were fed a common diet for 7 d and the treatments were reassigned with the only restriction to randomization being that a pen could not receive the same treatment twice. The end result was four observations per treatment for determination of DE. For the reference diet, digestibility of DM, N, and GE were 87.4, 74.5, and 85.4%, respectively, and DE of the corn itself was determined to be 3,322 kcal/kg. Comparisons among the treatments indicated that DDGS from corn had greater DE (223 kcal/kg) than DDGS from sorghum ( $P < 0.04$ ). Additionally, DE was different among the sources of corn-based DDGS (3,628 vs 2,940 kcal/kg for Hudson vs Atchison,  $P < 0.001$ ) and sorghum-based DDGS (3,205 vs 2,918 kcal/kg for Russell vs Oakley,  $P < 0.05$ ). In conclusion, our results indicate that both substrate used in the fermentation process and plant of origin affect the energy value of DDGS when fed to finishing pigs.

**Key Words:** Distillers Dried Grains, DE, Pigs

**166 Effects of corn- and sorghum-based distillers dried grains with solubles on growth performance and carcass characteristics in finishing pigs.** C. Feoli\*<sup>1</sup>, J. D. Hancock<sup>1</sup>, C. Monge<sup>1</sup>, T. L. Gugle<sup>1</sup>, S. D. Carter<sup>2</sup>, and N. A. Cole<sup>3</sup>, <sup>1</sup>Kansas State University, Manhattan, <sup>2</sup>Oklahoma State University, Stillwater, <sup>3</sup>USDA/ARS, Bushland, TX.

A total of 176 finishing pigs (avg BW of 64 kg) was used in a 72-d experiment to compare the effects of corn- and sorghum-based distillers dried grains with solubles (DDGS) on growth performance and carcass characteristics. Treatments were a corn-soybean meal-based control diet and diets with 40% high-energy DDGS from Sioux River Ethanol, Hudson, SD (corn-based, crude fat of 10.2%, mean particle size of 353  $\mu$ m, and DE of 3,628 kcal/kg), 40% moderate energy DDGS from MGP Ingredients, Atchison, KS (corn-based, crude fat of 8.5%, mean particle size of 796  $\mu$ m, and DE of 2,940 kcal/kg), and 40% moderate energy DDGS from US Energy Partners, Russell, KS (sorghum-based, crude fat of 6.8%, mean particle size of 563  $\mu$ m, and DE of 3,205 kcal/kg). There were 11 pigs/pen and four pens/treatment with feed and water consumed on an ad libitum basis until the pigs were

slaughtered at an avg BW of 130 kg. For the control, high-energy DDGS, moderate-energy corn DDGS, and moderate-energy sorghum DDGS, ADG was 943, 891, 918, and 908 g/d, ADFI was 3.14, 2.92, 3.13, and 3.24 kg/d, and G:F was 300, 305, 293, and 280 g/kg, respectively. Data analyses indicated that pigs fed the control diet had greater ADG compared to pigs fed the DDGS treatments ( $P < 0.003$ ). Among the DDGS treatments, the high-energy product supported lower ADG with less ADFI, but gave greater G:F than the moderate energy DDGS sources ( $P < 0.06$ ). As for carcass data, dressing percentage (74.8, 73.7, 72.7, and 73.6%, respectively) was greater ( $P < 0.001$ ) for pigs fed the control vs DDGS treatments but percentage carcass lean (53.9, 53.5, 53.6, and 53.7%, respectively) was not affected ( $P > 0.49$ ) by treatment. In conclusion, there was noteworthy variation among pigs fed diets with DDGS from different processors.

**Key Words:** Distillers Dried Grains, Sorghum, Pig

**167 Effects of dried distillers grain with solubles on grow-finish pig performance.** S. K. Linneen\*, M. D. Tokach, J. M. DeRouchey, S. S. Dritz, R. D. Goodband, J. L. Nelssen, R. O. Gottlob, and R. G. Main, *Kansas State University, Manhattan.*

Three experiments were conducted to determine the effects of increasing dried distillers grains with solubles (DDGS) sourced from the same ethanol manufacturing facility on growth performance of grow-finish pigs. All experiments were conducted in the same commercial research facility using 7 (Exp. 1), 10 (Exp. 2), and 9 (Exp. 3) replications per treatment with 24 to 26 pigs/pen in Exp. 1 and 2, and 25 to 28 pigs/pen in Exp. 3. Diets were formulated on a total amino acid basis in Exp. 1 and a TID basis in Exp. 2 and 3. In Exp. 1, 1,050 pigs (50.1 kg) were used in a 28-d study in a 2 × 3 factorial with either 0 or 15% DDGS with 0, 3, or 6% added fat. Overall, there were no DDGS × fat level interactions ( $P > 0.14$ ). Adding DDGS to the diet did not affect ( $P > 0.74$ ) ADG (942 vs 942 g/d), ADFI (2,140 vs 2,148 g/d) or G/F (0.44 vs 0.44). Adding fat to the diet increased (linear,  $P < 0.01$ ) ADG (908, 943, 976 g/d) and G/F (0.422, 0.440, 0.457). In Exp. 2, 1,038 pigs (46.3 kg) were used in a 56-d study and fed diets with 0, 10, 20, or 30% DDGS. Increasing DDGS level in the diet decreased ADG (849, 858, 834, 835 g/d; linear,  $P < 0.09$ ) and ADFI (1,946, 1,975, 1,913, 1,900 g/d; linear,  $P < 0.05$ ). Although responses were linear, the negative response only occurred with greater than 10% DDGS. There were no differences in G:F (0.437, 0.435, 0.437, 0.440;  $P > 0.38$ ). In Exp. 3, 1,112 pigs (50.1 kg) were used in a 56-d study and fed diets with 0, 5, 10, 15, or 20% DDGS. Pigs fed the control diets had increased ( $P < 0.05$ ) ADG (934, 925, 939, 921, 894 g/d) compared to pigs fed diets containing 20% DDGS with others being intermediate. Increasing DDGS level in the diet tended to decrease ADFI (2.27, 2.20, 2.24, 2.18, 2.16 kg/d; linear  $P < 0.09$ ). There was a quadratic ( $P < 0.04$ ) improvement in G:F with increasing DDGS (0.41, 0.42, 0.42, 0.42, 0.41). In conclusion, approximately 15.0% DDGS sourced from this manufacturing facility can be added to diets before growth rate is reduced.

**Key Words:** Dried Distillers Grain with Solubles, Pigs, Growth

**168 Use of corn distillers dried grains with solubles (DDGS) in finishing pigs.** A. M. Gaines, G. I. Petersen\*, J. D. Spencer, and N. R. Augspurger, *JBS United, Inc., Sheridan, IN.*

The purpose of this research was to evaluate growth performance and carcass characteristics of finishing pigs fed high levels of DDGS. A total of 880 pigs (Ausgene;  $43.7 \pm 0.23$  kg) were allotted to one of three dietary treatments in a randomized complete block design with 12 replicate pens/treatment. Dietary treatments included a corn-soybean meal diet with 0% DDGS, corn-soybean meal diet with 30% DDGS, and a corn-soybean meal diet with 30% DDGS plus a commercial cellulase enzyme (100 mg/kg). Experimental diets contained no supplemental fat and were formulated in excess of requirement to the same standardized ileal digestible (SID) lysine level. Pigs were fed from 44 to 129 kg BW in a 5 phase feeding program. At trial termination, pigs were marketed by intact pen for carcass data collection at a commercial processing facility. For the overall finishing period, there were no differences in ADG ( $P < 0.16$ ) or ADFI ( $P < 0.34$ ). Though it was not statistically significant, ADG was numerically lower for pigs fed DDGS, irrespective of enzyme supplementation. As a result, G/F was lower ( $P < 0.05$ ) for pigs fed DDGS (0.318, 0.310, and 0.310, respectively). There were no differences in carcass weight ( $P < 0.33$ ); however, feeding DDGS reduced ( $P < 0.04$ ) carcass yield (76.9, 76.0, and 76.3%, respectively). Carcass yield of pigs fed DDGS plus enzyme was not different from pigs fed 0 ( $P < 0.45$ ) or 30% DDGS ( $P < 0.08$ ). There were no differences in fat depth ( $P < 0.92$ ). Feeding DDGS reduced loin depth ( $P < 0.001$ ; 68.3, 66.3, and 65.5 mm, respectively) and carcass percent lean ( $P < 0.05$ ; 54.9, 54.5, and 54.5%, respectively), irrespective of enzyme supplementation. There were no improvements in morbidity ( $P < 0.55$ ) or mortality ( $P < 0.95$ ) when feeding DDGS. This research demonstrates that finishing swine can be fed high levels of DDGS, but a reduction in carcass yield and lean should be considered when determining their economic value.

**Key Words:** Swine, DDGS, Finishing Pigs

**169 Evaluation of different strategies for supplementing distiller's dried grains with solubles (DDGS) to nursery pig diets.** J. D. Spencer\*, G. I. Petersen, A. M. Gaines, and N. R. Augspurger, *JBS United, Inc., Sheridan, IN.*

Two trials were conducted to evaluate DDGS (10.2% crude fat, 25.4% CP, 0.86% lys) supplementation to nursery pig diets. In trial one, 1500 weaned pigs (6.4 kg BW, 18 to 21 d of age) were allotted to one of four treatments in a RCBD with 15 replicate pens per treatment (20 to 27 pigs/pen). Treatments consisted of introducing DDGS at different phases in a 4 phase corn-soybean meal based nursery program for 6 wks: 1) Control, 0% DDGS; 2) 7.5% DDGS phase 1, and 15% DDGS throughout; 3) 15% DDGS starting in phase 2; and 4) 15% DDGS starting in phase 3. Diets within each phase were formulated to the same SID lysine, but other nutrients varied with DDGS replacing corn and SBM in phase 2, 3 and 4. Trial two utilized a total of 300 pigs (9.0 kg BW, approximately 31 d of age), and evaluated the impact of supplementing 30% DDGS with and without the addition of a combination enzyme (alpha-galactosidase, galactomannanase,

**ABSTRACTS**  
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**Animal Behavior, Housing, Well Being**

**1 Relationship of measures of disposition and feed intake and growth performance of steers.** F. E. Creason\*, W. H. Kolath, M. S. Kerley, and R. L. Weaver, *University of Missouri, Columbia.*

Data were collected on Angus cross steers (n=192) with known pedigree from four sources, to determine the effect of disposition on average daily feed intake (FI), residual feed intake (RFI) and average daily gain (ADG) during the feeding period. Disposition was measured by pen score (PS; 1=gentle, 5=aggressive) and exit velocity (EV; m/sec). EV was measured using infrared electronic triggers to start and stop an electronic recording device to time a steer as it traveled a fixed distance upon exiting a squeeze chute. EV data were recorded when the initial weights were recorded on two consecutive days then averaged for an initial weight (AVGWT) and initial EV (AVGEV). PS were recorded during the feeding trial. At the start of the trial steers weighed  $342.60 \pm 25.33$  kg and  $305.35 \pm 32$  kg, EV averaged  $2.5 \pm 0.68$  m/sec and  $2.68 \pm 0.99$ , while PS averaged  $1.95 \pm 0.70$  and  $1.86 \pm 0.81$  respectively. Individual FI was measured using the Grow Safe System. FI, RFI and ADG were then computed at the end of the trial. A linear mixed model was analyzed using SAS PROC MIXED to investigate sources of variation in AVGEV associated with source, collection location (CL), PS (fixed effects) and AVGWT (covariate) and sire (random effect). Source, PS, AVGWT, and sire (via likelihood ratio test) are significant sources of variation in AVGEV (all  $p < 0.01$ ). Models for FI, ADG and RFI (dependant variables) were developed using source, CL, PS (fixed effects), AVGWT and AVGEV (covariates) and sire (random effect). For FI, only Group ( $p < 0.001$ ) and SID ( $p < 0.01$ ) were significant. For ADG, only AVGWT, AVGEV and Group were significant (all  $p < 0.01$ ). For RFI, only Group ( $p < 0.03$ ) and sire ( $p < 0.01$ ) were significant. Measures of disposition (EV and PS) were not important predictors of variation in phenotypic performance for FI or RFI, however AVGEV was an important source of variation in ADG. Sire effects described a significant portion of AVGEV and may indicate a heritable component of disposition. Selection for improved AVGEV may improve ADG.

**Key Words:** Beef Cattle, Temperament, Feed Intake

**3 Environmental factors affecting water intake in steers finished in feedlots.** R. A. Arias\*<sup>1</sup> and T. L. Mader<sup>2</sup>, <sup>1</sup>*Universidad Catolica de Temuco, Temuco, Chile,* <sup>2</sup>*University of Nebraska, Lincoln.*

Simple and multiple regression analyses were executed using records from 5 trials conducted from 1999 to 2005 at Haskell Ag Lab, to assess the effects of environmental factors on daily water intake (DWI), and to obtain an equation to predict DWI on steers finished in feedlot. Cattle used in these studies were mixed breed, but predominantly Angus or Angus crossbreds. Daily (n=2,134) weather variables and DMI were obtained. Exploratory data analyses showed the presence of multicollinearity for temperature-humidity index (THI), and mean, minimum and maximum temperatures. Thereby, two analyses were conducted; 1) including daily minimum temperature (Tmin) and daily maximum temperature (Tmax), and 2) using THI instead of temperature variables. Results confirm that DWI increases significantly during the summer season, although variability in DWI was greater during this season. Seasonal simple regression equations produced low  $r^2$  values ( $r^2 < 0.5$ ). However, simple regression  $r^2$  values were improved for models utilizing data from both seasons (Tmin  $r^2 = 0.57$ ; Tmax  $r^2 = 0.52$ ; and solar radiation  $r^2 = 0.50$ ). Multiple regression analysis improved predictions across seasons and resulted in better models than simple regression models. Within season multiple regression model  $R^2$  values were 0.34 and 0.30 for summer and winter, respectively. However, when data were pooled among seasons an  $R^2$  equal to 0.71 was obtained with Tmin, solar radiation, and DMI included in the model. When THI was used in the model there was not an improvement in  $R^2$  across the seasons. The models were validated and compared with those reported by Winchester and Morris (1956; JAS 15(3):722-740) and Hicks et al., (NRC, 2000). Data from two experiments conducted during the winter and the summer of 2005-06 were used for this purpose. This analysis demonstrated that models providing the most accurate predictions of DWI were the THI and Hicks models. The data suggest that Tmin or THI are the primary weather parameters which influence DWI in steers.

**Key Words:** Water Intake, Feedlot Steers, Environmental Factors