

bean meal (SBM) fed to growing pigs. Twenty-three growing barrows (initial BW: 26.4 ± 1.8 kg) were allotted to a 23×8 Youden square design with pigs and period as the 2 blocking criteria. Twenty-two sources of SBM were procured from crushing facilities throughout the Midwest. For analysis, the crushing plant locations were separated into 4 zones: 1) Northern U.S., 2) Eastern U.S., 3) Western U.S., and 4) Illinois. The dietary treatments included a corn-based diet and 22 diets based on a mixture of corn and each source of SBM. The ATTD of GE in SBM from Zones 1 and 2 were greater ($P \leq 0.05$) than the ATTD of GE in corn but were not different from the ATTD of GE from Zones 3 and 4. The DE in SBM from Zones 1 and 2 were greater ($P \leq 0.05$) than the DE in corn. The DE in SBM from Zones 3 and 4 were not different from the DE in corn or SBM from Zones 1 and 2. The ME in SBM from Zones 1 and 2 were greater ($P \leq 0.05$) than the ME in SBM from Zone 3 and corn. The ME of SBM from Zone 4 was not different from the ME of SBM from Zones 1–3. Net energy in SBM from Zones 1 and 2 was greater ($P \leq 0.05$) than the NE in SBM from Zone 2 and corn. Net energy in SBM from Zone 4 was greater ($P \leq 0.05$) than corn but not different from other zones. Overall, GE, DE, ME, and NE were similar for SBM from the Northern, Eastern, and Southern United States, but DE, ME, and NE were decreased for SBM from the Western United States.

Key Words: energy, pigs, soybean meal

156 Corn grown under drought-stressed conditions does not have lower energy content than corn grown in a previous “normal” year. M. A. Newman*, C. R.

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Record-breaking heat and lack of rainfall during the 2012 growing season resulted in drought-stressed growing conditions. An experiment was conducted to investigate the impact of these conditions on nutrient composition and apparent total tract digestibility (ATTD) of energy in corn and determine if relationships exist among corn quality measurements, nutrient content, and digestibility of energy. Twenty-eight samples of corn from the 2012 crop were collected across the Midwest using yield as an initial screen for drought impact; 2 samples from 2011 served as a control. Yields ranged from < 3.1 to > 15.7 t/ha (< 50 to > 250 bu/acre). Each sample was graded by an official U.S. grain inspection agency and also analyzed for ether extract and crude protein content (dry matter basis). Diets were formulated using each of the 30 corn samples plus vitamins, minerals, and 0.4% titanium dioxide as an indigestible marker. Diets were fed at a level of approximately 2.6 times the estimated energy required for maintenance (NRC 2012) based on the average initial BW of the pigs at the beginning of 4 collection periods. Each of the 4 collection periods consisted of 6 d of adjustment to the test diet followed by 3 d of fecal sample collection followed by 5 d of feeding a fully balanced grower diet; the latter was fed to ensure that the low amino acid test diets did not impair digestive function in sub-

sequent collection periods. Sixty individually housed barrows (PIC 359 \times C29; initial BW = 34.2 ± 0.2 kg) were randomly allotted in an incomplete crossover design with 30 diets and 4 periods. Diet and fecal samples were analyzed for dry matter (DM), titanium dioxide, and gross energy (GE). ATTD coefficients were then determined. Mean ATTD coefficients of GE between the 2011 and 2012 corn samples were not different (84.3% vs. 83.1%, respectively; $P > 0.10$). Comparing 2011 with 2012, there were no differences in ether extract (4.07% vs. 3.96%; $P > 0.10$) or crude protein content (8.56% vs. 9.19%; $P > 0.10$) of corn samples. There were no differences in physical characteristics, except for 1000 kernel weight, which varied among samples by 220% (176 to 386 g). No relationships were found between any single corn quality measurement, physical or chemical, and digestibility of energy ($P > 0.10$). In conclusion, ATTD of the energy of corn grown under drought-stressed conditions was not different from corn grown in the previous year under “normal” conditions.

Key Words: corn, digestibility, drought, pig

157 Effects of conditioning motor speed and diet form on growth performance of 12–21 kg nursery pigs.

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A total of 180 nursery pigs (PIC 327 \times 1050; initially 12.6 kg) were used in an 18-d study to determine the effects of conditioning parameters and feed form on pig performance. Diets, either pelleted or mash form, were conditioned by slowing or speeding conditioner rotations per minute (rpm), where higher rpm equates to faster conditioning. All diet formulations were similar. Treatments included 1) negative control mash diet, 2) positive control pelleted diet conditioned at 60 rpm, 3) pelleted diet conditioned at 30 rpm and reground, 4) pelleted diet conditioned at 60 rpm and reground, and 5) pelleted diet conditioned at 90 rpm and reground. The differing rpm values among treatments represent the time in the conditioner during processing. Pigs were weaned and fed a common acclimation diet for 21 d before the start of the experiment. Average daily gain and G/F did not differ ($P > 0.12$) between treatments overall, but ADFI was decreased ($P = 0.03$) for pigs fed the pelleted, positive control diet compared to all other diets. Although no overall treatment effects were significant for ADG or G/F, the experiment was designed more specifically to evaluate treatment differences using preplanned comparisons. When considering preplanned contrasts, we observed that pigs fed mash diets tended to have greater ($P = 0.10$) ADG compared to those fed pelleted and reground diets, suggesting that processing may have had a negative influence on feed utilization, which is a hypothesis that is further supported because pigs fed mash diets tended to have greater ($P = 0.06$) ADG compared to those

fed diets that were heat processed, regardless of regrinding. Considering these results, it was not surprising that pigs fed mash diets had greater ($P = 0.05$) ADG and ADFI ($P = 0.01$) than those fed pelleted diets. When directly comparing diets conditioned at 60 rpm, fed either as whole pellets or reground to mash consistency, pigs fed pelleted diets had improved ($P = 0.01$) G/F due to lower ADFI ($P = 0.004$) but similar ADG ($P = 0.60$). This unexpected negative impact of pelleting on ADG may be due to a negative influence of heat treatment on palatability. The expected improvement in G/F from pelleting (6.8%) was observed but was lost when diets were reground to near original mash particle size. This may indicate that diet form (high quality pellets vs. mash) impacts G/F more than degree of starch gelatinization or other intrinsic factors associated with conditioning ingredients.

Key Words: gelatinization, pelleting, starch

158 Effects of corn particle size and diet form on growth performance of 6–22 kg nursery pigs. G. E.

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A total of 192 pigs (PIC 1050, initially 6.7 kg and 31 d of age) were used in a 35-d study. Pigs were allotted to 1 of 4 dietary treatments (6 pigs/pen and 8 pens/treatment). The 4 nutritionally similar diets were arranged in a 2×2 factorial consisting of 1) corn ground to $\sim 387 \mu\text{m}$ in meal form, 2) corn ground to $\sim 703 \mu\text{m}$ in meal form, 3) treatment 1 in pellet form, and 4) treatment 2 in pellet form. Data were analyzed using the GLIMMIX procedure of SAS. Overall (d 0 to 35), there were no effects of corn particle size ($P > 0.24$). However, pigs fed mash diets had improved overall ADG compared to those fed pelleted diets ($P = 0.01$; 0.43 vs. 0.39 kg/d), which was primarily driven by greater ADFI. In fact, pigs fed mash diets had greater ADFI during all periods ($P < 0.02$). Still, feed efficiency was improved by pigs consuming mash diets compared to those consuming pelleted diets from d 0 to 14 ($P < 0.0001$; 0.57 vs. 0.68), but there were no differences from d 14 to 35 or overall. There was no corn particle size \times feed form interaction on ADG or ADFI ($P > 0.17$), but pigs fed pelleted diets from 700 μm corn had improved overall feed efficiency compared to pigs fed any of the other three treatments ($P < 0.05$), including those fed pelleted diets from 400 μm corn. As expected, the diet manufactured in mash form from the 700 μm corn resulted in the poorest feed efficiency numerically. This research suggests that feed efficiency is slightly improved by feeding 400 vs. 700 μm corn in mash diets, but pelleting does not further improve feed efficiency when corn is ground to a fine particle size. Interestingly, pelleting diets manufactured from larger particle size corn improved feed efficiency more than those made with smaller particle size in this experiment. More research is needed to confirm and explain this finding.

Key Words: nursery pig, particle size, pelleting

159 Influence of the zinc to phytate ratio and superdoses of phytase on piglet growth performance. C. L.

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Previous in vitro data indicates zinc (Zn) may bind to phytate at a Zn to phytate ratio of 4 to 1, which reduces Zn absorption. Phytase improves Zn absorption through the hydrolysis of phytate. An experiment was conducted to evaluate the Zn to phytate ratio and phytase supplementation (Quantum Blue) on piglet performance from weaning (d 0) to d 21. Pigs (5.2 ± 0.9 kg; $n = 1280$) were housed at 10 pigs/pen with 8 replicate pens/diet. Diets were arranged as a $2 \times 4 \times 2$ factorial with 2 levels of phytate (analyzed at normal, 0.50%, or high, 0.67%), 4 levels of Zn from zinc oxide (ZnO; 0, 1000, 2000 or 3000 ppm) and 2 levels of phytase (0 or 2500 FTU/kg). Phytate was increased by the inclusion of 2.5% full fat rice bran, and diets were formulated to meet the nutrient requirements of the pig (NCR, 1998), including calcium (0.86%) and available phosphorus (0.52%). This resulted in a Zn to phytate ratio ranging from < 1.0 to > 4.0 in the normal and high phytate diets as ZnO increased. Data were analyzed as a factorial in JMP, and significant means were separated using contrasts. There was no effect of Zn to phytate ratio on performance from d 0 to 21. ZnO supplementation increased ADFI from d 0 to 7 (quadratic $P = 0.05$) and decreased ADFI from d 14 to 21 (linear $P < 0.02$). ADG increased as Zn supplementation increased from d 0 to 7 (quadratic $P < 0.04$). Zn supplementation improved FCR from d 0 to 7 (quadratic $P = 0.02$) and from d 0 to 21 (linear $P < 0.03$). Pigs fed high phytate tended to gain less than pigs fed normal phytate from d 7 to 14 ($P < 0.07$) and d 0 to 21 ($P < 0.09$). In addition, pigs fed high phytate were less efficient than pigs fed normal phytate from d 0 to 7 ($P < 0.03$). Phytase improved ADG and FCR from d 0 to 7 ($P < 0.05$), d 7 to 14 ($P < 0.05$), and d 0 to 21 ($P < 0.05$). In conclusion, small increases in phytate resulted in decreases in piglet ADG and FCR, thereby highlighting the antinutritive effect of phytate. Zn supplementation improved performance with a peak around 2000 ppm. However, there was no significant effect of Zn to phytate ratio on performance or phytase efficacy and phytase significantly improved ADG and FCR regardless of the level of phytate or Zn supplemented.

Key Words: phytase, phytate, piglet

160 The effect of feeding β -mannanase in starter diets on nursery pig growth, feed intake, and feed efficiency performance in a commercial wean-finish setting. S. A.

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Nine hundred weanling pigs (initial BW = 7.59 ± 0.012 kg; 21 d age) were used to evaluate the effect of a commercially available enzyme Hemicell HT@1.5x (HT) in corn-soybean meal-dried