A trial using 210 pigs (TR-4 X PIC C22) was conducted to determine the effects of menhaden fish meal (MF M) on the performance and immune response of nursery pigs. Pigs (17 d; 5.31 ± 0.16 kg) were weaned into a nursery facility and allotted to one of six dietary treatments (Trt; seven replicate pens/trt). Trt 1, 0% MFM/MFO; Trt 2, 5% MFM; Trt 3, 10% MFM; Trt 4, 2.5% MFO; Trt 5, 5% MFO; and Trt 6, 5% pet food grade poultry-byproduct meal (PBM). Experimental diets were fed for 21 d. On d 13, a subset of pigs (six pigs/Trt) were fitted with a jugular catheter for blood collection (30-min intervals for 6 h). On d 14, all pigs (n = 210) were injected i.m. with LPS (15 µg/kg BW). On d 21, pigs were placed onto a common corn-soybean meal fortified diet and growth performance was evaluated until d 28. Prior to LPS challenge (d 0-14) there were no Trt differences for ADG (P > 0.21) or G:F (P > 0.80). However, there was a Trt effect (P < 0.01) for ADPI. Pigs fed 5.0% PBM had lower ADFI (P ≤ 0.05) compared to pigs fed 0% MFM/MFO, 5% MFM, and 10% MFM, Post-LPS (d 14-28), there was a Trt effect for ADG (P < 0.02). Pigs fed 10% MFM had increased (P ≤ 0.10) ADG compared to pigs fed 0% MFM/MFO, 2.5% MFO, 5% MFO, and 5% PBM. Furthermore, ADG was higher (P ≤ 0.10) in pigs fed 5% MFM compared to pigs fed 0% MFM/MFO, 5% MFO, and 5% PBM. There were no Trt differences for ADFI (P > 0.27) or G:F (P > 0.60). There was no Trt effect (P > 0.74) for basal serum cortisol (-1.0, -0.5, and 0 h) prior to LPS challenge. However, post-challenge, there was an overall Trt effect (P < 0.04) on serum cortisol. Serum cortisol was lower in pigs fed 5% MFO compared to pigs fed 0% MFM/MFO, 5% MFO, and 5% PBM. There were no Trt differences for ADFI (P > 0.27) or G:F (P > 0.60). There was no Trt effect (P > 0.74) for basal serum cortisol (-1.0, -0.5, and 0 h) prior to LPS challenge. However, post-challenge, there was an overall Trt effect (P < 0.04) on serum cortisol. Serum cortisol was lower in pigs fed 5% MFO compared to pigs fed 0% MFM/MFO, 5% MFO, and 5% PBM. Additionally, serum cortisol was lower in pigs fed 5% MFO compared to pigs fed 5% MFM/MFO, 5% MFM, and 5% PBM (P > 0.05). PMF was found to be lower in pigs fed 5% MFO compared to pigs fed 5% MFM/MFO (P = 0.09), 5% MFM (P < 0.01), and 5% PBM (P < 0.05). Additionally, serum cortisol was lower in pigs fed 5% MFM/MFO compared to pigs fed 5% MFM (P = 0.06) and 10% MFM (P < 0.04). This research demonstrated that feeding MFM or MFO altered the acute phase immune response, which, in the case of MFM, may have led to improved growth performance.

**Key Words:** Fish Meal, Fish Oil, Pigs

### Evaluation of canola meal as an alternative plant protein source in nursery pig diets.

Two experiments were conducted to evaluate the inclusion rate of canola meal (CM) on nursery pig performance, thyroid hormone status and nutrient digestibility. Experiment 1 used 384 nursery pigs (6.16 kg at 18 d) in three trials to determine the effects of CM as a replacement for dietary soybean meal (SBM) on a protein basis. Canola meal was used to replace (0%, 33%, 66% and 100%) of the SBM in phase I (d 0 to d 11); 0, 11.5, 22.9, and 34.4% dietary CM, respectively) and phase II (d 11 to 35; 0, 13.3, 26.6, and 39.9% dietary CM, respectively) nursery pig diets. During phase I, pigs fed 33% or 66% CM were not significantly different (P > 0.10) from pigs fed the control diet. Pigs fed 100% CM gained less than other treatments (P < 0.001). Significant differences for gain (P < 0.01) and feed intake (P < 0.01) were seen from the phase II diet. The 33% CM was numerically higher but not different from the control diet. As CM increased beyond 33%, gain and feed intake decreased however, no significant difference (P > 0.10) was observed for feed efficiency. No differences (P > 0.10) were observed in the levels of triiodothyronine (T3) and thyroxine (T4) across all diet treatments. In Exp. 2, 16 barrows (8.83 kg at 37 d) were used to determine nutrient utilization. Dietary treatments were the same as in Exp. 1. Diets were fed in a 4 x 4 latin square design with a 5 d adjustment period and a 3 d total collection period. Digestibility parameters showed statistical differences in energy, CP and nitrogen, ash, DM (P < 0.001), and NDF (P < 0.05) digestibility among treatments. The control and 33% CM diets were significantly better in nutrient utilization of energy, CP and nitrogen, ash, and DM when compared to the 66% and 100% CM. NDF digestibility in the 33% CM diet was significantly increased (P < 0.05) compared to the 66% CM diet, but not significantly different (P > 0.10) from the control or 100% CM diets. In conclusion, these studies demonstrated that canola meal can replace up to 33% of the SBM (13% dietary CM) in nursery pig diets without adverse effects on pig performance or thyroid function.

**Key Words:** Canola Meal, Nursery Pigs, Thyroid Hormone Status

### Use of rice in substitution of corn in diets for young pigs.

We studied the influence of feeding rice on the ileal digestibility (ID) of dry matter (DM), organic matter (OM), gross energy (GE) and starch and the morphology of the ileum of piglets at 37 d of age. The control diet was a complex diet without in-feed growth promoters and included 50% cooked corn (99% for 50 min and then rolled). The experimental diets were similar but corn was substituted for rice either raw or cooked (mild and severe temperature). Each treatment was replicated seven times (one pig). Replicates were fed their respective diets from 25 to 37 d of age. Starch gelatinization of the cereal was assessed by $0.29 per ton by changing the safety margin of Met and Lys by 0.5 standard deviations in soybean meal alone. These savings represent the extremes, since in this case the highest and lowest levels of Met and Lys found were used. In a more practical example, formulation cost was reduced by $0.29 per ton by changing the safety margin of Met and Lys by 0.5 standard deviations in soybean meal alone.
piglets fed mild cooked rice than for piglet fed cooked corn. As a result, villous height: crypt depth ratio was higher for piglets fed mild cooked rice (4.0 vs. 2.3; P ≤ 0.001). The morphological values of the ileum obtained from piglets fed raw rice were intermediate between those of piglets fed cooked corn and mild cooked rice. A more severe processing of rice increased starch gelatinization but tended to impair intestinal morphology as compared to mild cooked rice. The results indicate that the benefits on productivity previously observed with rice feeding of weanling pigs might be due, at least in part, to improvements in ileal morphology that results in better digestibility of nutrients.

Key Words: Rice, Ileal Digestibility and Morphology, Starch Gelatinization

490 Effect of dietary level of distillers dried grains with solubles (DDGS) on growth performance, mortality, and carcass characteristics of grow-finish barrows and gilts. D. Cook*,1, N. Paton1, and M. Gibson1, 1Akey, Lewisburg, OH, 1Dakota Gold Research Association, Sioux Falls, SD.

The objective of this trial was to determine the effect of feeding 0, 10, 20, or 30% DDGS from a new generation ethanol plant on growth performance and carcass characteristics of grow-finish barrows and gilts (42 kg initial body weight) reared in a commercial environment. Pigs were split-sexed housed (26 pigs/pen) in a commercial grow-finish barn (1,040 pigs per barn) and randomly allotted within sex and weight block (five blocks) to one of four DDGS levels. Diets were formulated on a digestible amino acid basis with the 1998 NRC values for corn and soybean meal. Key nutrient values used for DDGS were 3,420 Kcal ME/kg, 0.67, 0.62, and 0.31% digestible lysine, threonine, and methionine, respectively. Diets were formulated to be isocaloric by adjusting the dietary percentage of liquid fat. Pigs had ad libitum access to diets and water throughout the trial. There was no effect of DDGS inclusion on final pig bodyweight (116 kg), ADG ADFI or gain to feed ratio, suggesting the nutrient values used for DDGS were appropriate. There was a linear decrease in mortality percentage (6.0, 2.8, 2.4, and 1.6%, respectively) as DDGS inclusion increased (P < 0.05). Carcass yield decreased linearly (77.3, 76.6, 76.2, and 75.6%, respectively) as dietary DDGS inclusion increased (P < 0.01). Back fat level and carcass lean percentage were not affected by the dietary DDGS level fed. The data suggest that up to 30% DDGS from this source can be included in the diet without affecting growth performance or carcass lean percentage and that DDGS may have value in a health challenged system for reducing mortality. The negative effect of feeding DDGS on carcass yield should be accounted for in evaluations of its economic value.

Key Words: DDGS, Pig, Carcass


The objectives of this study were to determine if lengthening the time that soybeans (SB) spend in the extractor during preparation of soybean meal (SBM) result in increased relative bioavailability of phosphorus without negatively impacting true amino acid digestibilities, and to compare those modified SBM to that produced from a low-phytate SB. Three SBM were prepared under uniform conditions with the exception of the length of time SB spent in the extractor (45 min [300 rpm], 60 min [225 rpm], or 90 min [150 rpm]). A SBM prepared from low-phytate SB was obtained for comparison. Relative phosphorus bioavailability in chicks and true amino acid digestibilities in cecotomized roosters were determined. Data were analyzed as a completely randomized design using the mixed models procedure of SAS. Increasing the length of time that SB spent in the extractor from 45 to 90 min resulted in lower (P < 0.05) phytase phosphorus and increased phosphorus bioavailability from 34 to 56%. However, this increase came at the expense of available lysine status, with the SBM extracted for 90 min containing less total lysine and less digestible lysine (P < 0.05) than the SBM extracted for 45 min (traditional extraction time). Total essential, total nonessential, and total amino acid digestibilities were highest (P < 0.05) for roosters fed the SBM extracted for 45 min and lowest (P < 0.05) for the SBM extracted for 60 min. Phosphorus bioavailability from SBM prepared from low phytate SB was 1.5 times higher (P < 0.05) than for SBM extracted for 45 min. Increasing the length of time that SB spend in the extractor led to an increase in bioavailable phosphorus but a decrease in bioavailable lysine, potentially negating the positive effect on phosphorus.

Key Words: Phytate, Soybean Meal, Processing

493 The effect of particle size and feed form on laying hen performance. M. Scott*1 and M. McCann1,2, The Queen's University of Belfast, Belfast, County Antrim, Northern Ireland, 1Agriculture, Food and Environmental Division, Belfast, County Antrim, Northern Ireland.

Particle size in poultry diets has been reported to affect many characteristics, including feed consumption, body weight gain, egg size, egg production rate and nutrient digestibility. The effect of feed form, pellets, crumbs, mash or whole grain cereals on laying hen performance is less well established and inconsistent results have been published. The aim of the study was to determine the optimum particle size and feed form for laying hen performance. A total of 100 hens were offered a diet containing 600 g/kg wheat. Three particle sizes (2, 5 and 8 mm) were examined, and four feed forms (whole wheat plus balance, pellets, crumbs and mash) were investigated. The experiment was a 3 x 3 + 1 factorial arrangement carried out for six weeks on individually caged hens. Particle size significantly affected many performance traits, including gizzard weight, eggs produced, total egg weight, average egg weight, dry matter intake (DMI), yolk diameter, yolk height and shell surface area. The optimum particle size for egg production, in terms of both number and weight, was 5 mm; the total number of eggs produced by the hens fed the 5 mm diet (39.00) was significantly higher (P < 0.05) than the number of eggs produced by the hens...
offered the 8 mm diet (35.18). Feeding whole wheat cereal grain significantly increased egg production, total egg weight, average egg weight and shell surface area. Gizzard weight was significantly increased with the inclusion of whole wheat grains in comparison to both the particle size and feed form treatments. The high grinding pressure and abrasive action generated in the gizzard to effectively crush whole grain cereals have resulted in muscle mass increase, therefore, significantly increasing the weight. Whole wheat grains plus balancer gave the best overall performance in terms of egg production and egg weight. In addition, DMI was significantly lower for the whole wheat plus balancer treatment than for the other treatments. It is concluded, in terms of particle size, 5 mm is optimal for egg production. Whole cereal grain plus balancer resulted in significantly better egg production, egg weight and DMI in comparison to the other feed forms investigated.

Key Words: Particle Size, Feed Form, Laying Hen

### Production, Management and the Environment: Dairy and Livestock Management


An eight year study was conducted to determine the effects of three different rearing environments on growth performance of growing and finishing pigs (from 28 to 107 kg avg. body wt.) reared during the summer or winter in north Florida USA (31°N latitude). The three rearing environments were 1) concrete-floored pens in a semi-confine building or outside dirt lots with minimal shelter that 2) have (“old”) or 3) have not (“new”) been occupied previously by pigs. Two trials were conducted each year (summer and winter) and each involved 36 crossbred pigs. All pigs were routinely dewormed. Overall, pigs reared during the summer on average grew 3% slower (0.83 vs. 0.86 kg/d; P<0.001) but required 3% less feed (3.32 vs. 3.41 kg; P<0.001) per kg of weight gain than pigs reared during the winter. Rearing environment influenced ADG (P<0.001; 0.82, 0.85, and 0.86 kg/d for “old”, “new”, and concrete pens, respectively) and F/G (P<0.001; 3.48, 3.35, and 3.26). A pen x season interaction (P<0.01) was noted for F/G in that pigs reared on dirt had poorer F/G compared to pigs reared on concrete during winter but during summer, F/G was similar. Average backfat thickness (mean = 2.5 cm) was influenced by rearing environment (P = 0.01) and somewhat by season (P = 0.08). Results indicate that growing-finishing pigs can be effectively reared in outside dirt lots under the environmental conditions of the southeastern USA, in particular if the lots are periodically rotated to “new” ground. However, pigs reared outside will require slightly more feed per unit of weight gain than pigs reared in confinement, especially during the winter.

Key Words: Pigs, Housing, Season

#### 496 Postpartum productivity of suckled beef cows supplemented with the fibrolytic enzyme Cattle-Ase™, L. Jonovich, D. Neundorff, A. Lewis, T. Welsh, Jr., and R. Randel, Texas Agricultural Experiment Station, College Station, Texas Agricultural Experiment Station, Overton.

The effect of Cattle-Ase™ (Loveland Industries Inc., Greeley, CO) supplementation on postpartum productivity was studied in suckled multiparous Brahman (B, n=44) and Romosinuano crossbred (R, n=39) cows. Within 24 hours after calving cows were weighed, body condition scored, calves identified and weighed and the cow-calf pair randomly allotted to either a control (C) or Cattle-Ase™ (A) ration. The pairs were maintained in a dry-lot 7d after calving and then moved to pasture for the remainder of the trial. While in pens the diet consisted of free choice Coastal Bermudagrass hay and 3:1 corn:soybean meal supplement (1.8 kg/hd/d). Once moved to rye-ryegrass pasture the diets included 4:1 corn:soybean meal supplement (0.9 kg/hd/d). Cattle-Ase™ was supplemented at a rate of 2.5 g/3d/0.5 kg. Data were analyzed using SAS’s ANOVA procedures. Cow ADG to the end of supplementation was affected by treatment (C=4.8±3.84; A=5.0±3.62; P<0.01), though ADG until weaning was not affected (P=0.61). Calf ADG to weaning was affected by breed of calf (BXAngus=952.3±35.3 kg; B=861.8±12.5 kg; R=845.8±15.7 kg; P<0.01) and sex of calf (M=889.2±16.0 kg; F=844.9±12.7 kg; P<0.01) but not treatment (P=0.95). Calf ADG to the end of supplementation was also affected by sex of calf (M=1027.3±23.1 kg; F=953.8±16.8 kg; P<0.04) but not treatment (P=0.13). Cow BCS change to the end of the trial was not affected by treatment (P=0.82) but was affected by breed (B=0.07±0.10, R=0.51±0.15, P<0.01). Cow BCS through the end of supplementation was also affected by breed (P=0.32±0.08, R=0.39±0.12, P<0.01) but not treatment (P=0.37). Calf weaning weight was not affected by treatment (P=0.89) but was affected by breed calf (BXAngus=203.4±6.9 kg; B=189.7±2.3 kg; R=214.4±4.5 kg; P<0.01). Calf weaning weight was not affected by treatment (P=0.89) but was affected by breed calf (BXAngus=203.4±6.9 kg; B=189.7±2.3 kg; R=214.4±4.5 kg; P<0.01). Postpartum interval was not affected by treatment (P=0.30) but was affected by breed (B=62.3±3.5 d; R=80.2±3.5 d; P<0.01). Number of days to conception was also affected by breed (B=78.5±3.2 d; R=100.6±3.5 d; P<0.01) but not treatment (P=0.52). It was determined that Cattle-Ase™ supplementation only affected cow ADG during the supplemental feeding portion of the trial while all other parameters were unaffected.

Key Words: Fibrolytic Enzyme, Postpartum, Cattle