

608 Influence of added zinc from zinc oxide on starter pig performance. J. C. Woodworth¹, M. D. Tokach¹, R. D. Goodband¹, P. R. O'Quinn¹, and T. M. Fakler², ¹Kansas State University, Manhattan, and ²Zinpro Corp., Eden Prairie, MN.

A total of 360 early-weaned barrows (3.9 kg and 12 d of age; Newsham Hybrids) was used in a 36 d growth trial to determine the influence of added zinc from zinc oxide on starter pig performance. Pigs were blocked by weight and randomly allotted to each of nine dietary treatments with five pigs per pen and eight replications per treatment. The nine treatments consisted of a control diet containing no added zinc, and eight diets containing increasing levels of zinc from zinc oxide (50, 100, 200, 400, 800, 1,600, 2,400, and 3,200 ppm zinc). Zinc oxide replaced corn starch in the control diet to form the dietary zinc levels. There was no additional zinc in the trace mineral premix. All diets were fed in meal form in four phases: d 0 to 5, 5 to 11, 11 to 21, and 21 to 36. Dietary zinc concentrations were maintained throughout the 36 d trial. From d 0 to 5 and d 5 to 11, no differences ($P > .05$) were observed, however, pigs fed 100 ppm of zinc had numerically the highest ADG, ADFI and feed efficiency (G:F). From d 11 to 21, ADG was highest (linear and quadratic, $P < .03$) for pigs fed 3,200 ppm of zinc, with pigs fed 100 ppm of zinc having the second best performance. Average daily feed intake was highest (linear, $P = .0001$) for pigs fed 3,200 ppm of zinc. From d 21 to 36 ADFI was highest (linear, $P = .0004$) for pigs fed 3,200 ppm of zinc, while pigs fed 100 ppm of zinc had the best (linear, $P = .004$) G:F. From d 0 to 36, ADG and ADFI was highest (linear, $P = .06$ and $.0002$, respectively) for pigs fed 3,200 ppm of zinc. Gain to feed ratio was best (linear, $P = .03$) for pigs fed 100 ppm zinc. These results suggest that 3,200 ppm of zinc from zinc oxide can be added to starter pig diets to achieve maximum growth performance, but only 100 ppm of zinc from zinc oxide is required to meet the basal requirement for zinc.

Key Words: Weanling Pig, Zinc, Growth

609 Influence of pharmacological zinc supplementation and diet particle size on growth, and nutrient availability in young pigs. B. V. Lawrence¹, D. B. Anderson², T. R. Cline¹, and O. Adeola¹, ¹Purdue University, West Lafayette, IN, and ²Elanco Animal Health Research and Development, Greerfield, IN.

Forty-eight barrows (8.88 ± 1.76 kg) were used to evaluate the influence of feeding 750 μ m or 550 μ m diets, and 100 or 3,000 mg/kg Zn from ZnO or 3,000 mg/kg Zn from ZnSO₄ on growth, plasma mineral concentrations, and nutrient availability in young pigs. Upon weaning, pigs were housed in .83 m x .71 m stainless steel metabolism cages and were fed 200, 400, 600 and 800 g/d of their respective diet during weeks 1, 2, 3, and 4 of the experiment respectively. Urine and feces were collected from d 15 to 20 of the 28 d experiment. Apparent DM and energy digestibility was lower ($P < .0001$) for pigs fed diets with 3,000 mg/kg supplemental Zn. Apparent nitrogen digestibility was also lower ($P < .05$), however, apparent nitrogen retention was similar across treatments. Apparent P retention was reduced ($P < .05$) for pigs fed diets containing pharmacological levels of Zn. Supplementing the diet with 3,000 mg/kg Zn from ZnSO₄ had a greater negative impact on apparent DM and energy digestibility than did a similar level of Zn from ZnO. Additionally, apparent Ca, Zn, and Cu retention were adversely affected by 3,000 mg/kg Zn from ZnSO₄ but were unaffected by ZnO supplementation. Plasma Zn concentration at d 14 was higher ($P < .05$) for pigs fed diets containing 3,000 mg/kg supplemental Zn. On d 28, plasma Zn concentrations remained elevated ($P < .05$) for pigs fed Zn supplemented diets, with ZnSO₄ supplementation elevating plasma Zn compared with ZnO supplementation. Plasma Cu was reduced ($P < .05$) at d 28 for pigs fed diets containing 3,000 mg/kg supplemental Zn, with the greatest reduction detected when ZnSO₄ was the source of supplemental Zn. The 11.6 percent reduction in apparent P retention with Zn supplementation during the collection period from d 15 to 20 was not reflected in an alteration in plasma P concentration. These results suggest a major impact of pharmacological Zn supplementation on total nutrient availability and utilization with ZnSO₄ supplementation having a greater effect than supplementing the diet with ZnO.

Key Words: Zinc, Pigs, Particle Size

610 Influence of zinc and diet particle size on growth, and stomach morphology in young pigs. B. V. Lawrence¹, D. B. Anderson², T. R. Cline¹, and O. Adeola¹, ¹Purdue University, West Lafayette, IN, and ²Elanco Animal Health Research and Development, Greenfield, IN.

Fasting and finely ground diets are implicated in ulcer development of older pigs. Zinc is known to be a gastroprotective agent in humans. The influence of these factors has not been documented in young pigs. A total of 72 barrows ($8.34 \pm .17$ kg) were used to evaluate the influence of a 24-h fast following weaning, feeding 750 μ m or 550 μ m diets, and feeding 3,000 mg/kg Zn from either ZnO or ZnSO₄ on weaning/fasting induced damage to the pars esophageal tissue of the pig stomach. A total of 12 pigs were euthanized immediately after weaning. An additional 12 pigs were euthanized following weaning and a 24-h fast. Eight additional barrows were assigned to each of six diet particle size and Zn treatments consisting of 750 μ m or 550 μ m diets formulated with 100 mg/kg or 3,000 mg/kg supplemental Zn from ZnO or 3,000 mg/kg supplemental Zn from ZnSO₄. Pigs were fed 200, 400, 600 and 800 g/d of their respective diet in two equal meals during weeks 1, 2, 3, and 4 of the experiment respectively. Growth rate tended ($P < .10$) to be greater for pigs fed diets containing 3,000 mg/kg supplemental Zn and for pigs fed 550 μ m diets. Stomach morphology of the newly weaned pig appeared normal. Fasting induced keratinization resulting in a higher ($P < .05$) ulcer index score. Feeding a 750 μ m diet resulted in a lower ($P < .05$) ulcer index score than was observed for pigs fed the 550 μ m diets. Pharmacological levels of Zn in the diet from ZnO or ZnSO₄ did not promote healing of the pars esophageal tissue in pigs fed 550 μ m diets. This experiment indicates newly weaned pigs are susceptible to the same initiators of ulceration as older pigs, that feeding a 750 μ m diet may allow the pars esophageal tissue to undergo repair while feeding a 550 μ m diet maintains fasting-induced tissue damage. Additionally, pharmacological levels of Zn in the diet of the young pig did not appear to promote pars esophageal tissue repair.

Key Words: Zinc, Ulcers, Pigs

611 Influence of timing and dosage of intraperitoneal zinc sulphate injection on plasma mineral concentrations and development of fasting-induced ulceration in young pigs. B. V. Lawrence¹, T. R. Cline, and O. Adeola, ¹Purdue University, West Lafayette, IN.

Intraperitoneal (i.p.) injection of ZnSO₄ has been shown to effectively inhibit gastric ulcer formation in various rat models. Sixty-eight barrows were used in two experiments to evaluate the influence of i.p. Zn injection on plasma mineral concentrations and inhibition of fasting-induced ulceration in pigs. In Exp. 1, twelve newly weaned barrows were injected with 0, 22, or 88 mg ZnSO₄/kg BW and individually housed in .86 m x .38 m pens. Injection volume was 1 ml. Plasma samples were obtained via jugular veinipuncture at 0, 3, 6, 12, 24, and 48 h post-injection for subsequent mineral analyses. Pigs were offered a corn-soy diet which contained 100 ppm of Zn. Plasma Zn concentration of pigs injected with 22 mg/kg ZnSO₄ was similar to those of pigs injected with 0 mg/kg in .9% saline ($P > .10$). However, pigs injected with 88 mg/kg ZnSO₄ had higher plasma Zn concentrations at most sampling periods ($P < .05$). In Exp. 2, a total of 48 suckling barrows were randomly selected and injected i.p. with 22 or 88 mg/kg ZnSO₄ either 12, 24, or 48 h prior to weaning. A total of 8 barrows were euthanized immediately following weaning. Upon weaning, the 48 barrows which had been injected with ZnSO₄ were placed 2/pen in .86 m x .38 m pens and fasted for 24 h. Following the 24-h fast, all pigs were euthanized. Plasma samples for mineral analyses were collected at weaning and following the 24-h fast. A reduction in the ulcer index score from .90 to .40 was observed for pigs injected with 88 mg/kg ZnSO₄ 12 h prior to weaning. The reduction in ulcer index score was associated with a higher weaning plasma Zn concentration (1.72 vs. .90 vs. .52) than observed for pigs injected with 22 mg ZnSO₄ 12 h prior to weaning or compared with suckling pigs respectively. These studies suggest that injection of 88 mg/kg ZnSO₄ prior to weaning may partially alleviate weaning/fasting induced ulceration in newly weaned pigs.

Key Words: Zinc, Pigs, Ulcer