

collected for olfactometry analysis showed no differences in dilution ratio between HCP and RCPF at week 9 (508 vs. 502; $P > .10$), and hydrogen sulfide readings were lower for pigs fed RCPF diets (.34 vs. .25 ppm; $P < .05$). This research suggests that reducing the dietary CP and adding 10% soybean hulls to diets will lower AAC, aerial hydrogen sulfide, pit nitrogen, and pit pH. The variability in growth performance when pigs were fed high levels of soybean hulls requires further study.

Key Words: Fiber, Ammonia, Pigs

247 Titration of pharmacological doses of zinc in the nursery pig. G. M. Hill*, S. D. Carter, R. C. Ewan, D. C. Mahan, P. S. Miller, G. C. Shurson, and T. L. Veum, *NCR-42 Regional Swine Nutrition Committee.*

High concentrations of dietary zinc (Zn) have been shown to increase growth performance in the weanling pig. Therefore, to determine the optimum pharmacological concentration of Zn oxide (ZnO) necessary to enhance growth in the nursery pig, 7 cooperating experiment stations conducted a 4-wk nursery trial. Utilizing the standard management procedures of each station, 1,069 pigs (11 to 25 d of age, 3.4 to 10.3 kg initial wt.) were randomly allotted by weight and sex to 5 dietary treatments. The complex, two-phase diet sequence contained added Zn from ZnO: 0 (control), 500, 1,000, 2,000 or 3,000 ppm. The study was conducted in a randomized complete block design. A minimum of 2 replications were completed at each station. At 6 stations, blood samples were collected at the end of the trial for determination of plasma Zn and Cu. Pigs fed 3,000 or 2,000 ppm Zn had higher ($P < .05$) feed intakes than pigs fed the 500 ppm or control diets. Feed intakes of pigs fed 3,000, 2,000, 1,000, 500 ppm and control diets were .61, .62, .58, .56 and .57, respectively. Average daily gain was greater ($P < .05$) for pigs fed 3,000 and 2,000 ppm Zn than for those fed 1,000 or 500 ppm or the control diet. Daily gain was .38, .39, .36, .35 and .35 kg for pigs fed Zn from 3,000 ppm to the control diet, respectively. Feed efficiency was improved ($P < .05$) in pigs fed 2,000 or 3,000 ppm Zn compared to pigs fed the control diet. Feed efficiencies (G/F) for pigs fed 3,000, 2,000, 1,000, 500 ppm Zn and the control diet were .65, .66, .64, .64 and .62, respectively. Even though this was only a 4-wk study, plasma Zn was elevated and plasma Cu reduced by feeding 3,000 or 2,000 ppm of dietary Zn. However, because of the difference in magnitude for these traits within station, there was a station x treatment interaction ($P < .0001$). In this experiment, 2,000 ppm Zn (supplied by ZnO) increased feed intake and growth and improved feed efficiency in the nursery pig under diverse management conditions to the same extent as 3,000 ppm Zn. Therefore, 2,000 ppm Zn was the optimum dietary concentration to enhance growth in the nursery pig.

Key Words: Nursery pig, Zinc

248 The effects of different zinc oxide sources on weanling pig growth performance. J. C. Woodworth*, M. D. Tokach, J. L. Nelssen, R. D. Goodband, and J. T. Sawyer, *Kansas State University, Manhattan.*

One hundred ninety-two pigs (6.2 kg and 18 d of age; PIC) were used in a 27 d growth assay to determine the effects of different zinc oxide (ZnO) sources on weanling pig growth performance. The four experimental treatments consisted of a control diet or three diets containing ZnO from one of three different sources. The three ZnO sources were analyzed and found to contain 70, 74, and 73% Zn and wide differences in concentrations of other trace minerals. Pigs were blocked by initial weight and randomly allotted to each of the four dietary treatments with eight pigs per pen and six pens per treatment. All diets contained 165 ppm of Zn (ZnO) from the trace mineral premix, but no feed grade antibiotic. All diets were fed in meal form in three phases: d 0 to 7, d 7 to 14, and d 14 to 27. The three experimental treatments fed from d 0 to 7 and d 7 to 14 contained 3,000 ppm of Zn and those fed from d 14 to 27 contained 2,000 ppm of Zn. There were no differences ($P > .29$) observed between the different ZnO sources for any period of the trial. Additional Zn from any of the ZnO sources improved ($P < .02$) ADG and ADFI from d 7 to 14, d 0 to 14, d 14 to 27 and d 0 to 27. Gain to feed ratio was highest ($P < .04$) for pigs fed diets containing high levels of ZnO from d 0 to 7 and d 0 to 14. These results suggest there were no differences in growth performance of pigs fed different ZnO sources. Adding high levels of Zn from ZnO improved ADG and ADFI from d 0 to 14 and d 0 to 27 compared to the control diet.

Key Words: Weanling pigs, Zinc, Growth

249 The interactive effects of zinc source and feed grade antibiotic on weanling pig growth performance. J. C. Woodworth*¹, M. D. Tokach¹, J. L. Nelssen¹, R. D. Goodband¹, J. T. Sawyer¹, and T. M. Fakler², ¹*Kansas State University, Manhattan, KS*, ²*Zinpro Corp., Eden Prairie, MN.*

Two hundred eighty-eight weanling pigs (5.6 kg and 18 d of age; PIC) were used in a 27 d growth assay to determine the interactive effects of Zn source and feed grade antibiotic on growth performance of weanling pigs. Experimental treatments were arranged in a 2 x 3 factorial design with main effects of antibiotic (none or 55 ppm carbadox) and Zn source (none, 250 ppm Zn from a zinc amino acid complex (ZnAA), or 3,000 ppm Zn from ZnO). Pigs were blocked by initial weight and allotted randomly to each dietary treatment with eight pigs per pen and six replications per treatment. All diets contained 165 ppm Zn (ZnO) from the trace mineral premix. Diets were fed in meal form in three phases: d 0 to 7, d 7 to 14, and d 14 to 27. There were no Zn source x antibiotic interactions ($P < .2$) observed throughout the entire experiment. Antibiotic only increased ($P < .05$) ADG from d 14 to 27. Pigs fed ZnO had greater ($P < .05$) ADG compared to pigs fed other treatments from d 7 to 14 and d 0 to 14. Pigs fed ZnO also had increased ($P < .03$) ADFI compared to ZnAA (d 7 to 14) and no additional Zn (d 7 to 14 and 0 to 14). Gain to feed ratio (G/F) was highest ($P < .004$) for pigs fed diets containing ZnO compared to pigs fed no additional Zn from d 7 to 14 and d 0 to 14. Pigs fed diets containing ZnAA had higher ($P < .04$) G/F compared to pigs fed no additional Zn from d 0 to 14. For the entire trial, pigs fed ZnO had increased ($P < .04$) ADG compared to those fed diets containing no additional Zn, with pigs fed ZnAA having intermediate responses. In addition, pigs fed ZnO from d 0 to 27 had higher ($P < .03$) ADFI compared to pigs fed diets containing either ZnAA or no additional Zn. These results suggest 3,000 ppm Zn from ZnO should be added to diets fed to pigs from d 0 to 14 after weaning. Antibiotic addition tended to influence growth performance toward the end of the experiment.

Key Words: Weanling Pigs, Zinc, Antibiotic

250 Effect of diet complexity and supplemental zinc amino acid complexes on performance of nursery pigs. B. Z. de Rodas*¹, C. V. Maxwell¹, D. C. Brown¹, M. E. Davis¹, Z. B. Johnson¹, and T. M. Fakler², ¹*University of Arkansas, Fayetteville, AR*, ²*Zinpro Corp., Eden Prairie, MN.*

An experiment involving 144 pigs (17 to 22 d of age; 6.1 kg BW) was conducted to determine the interactive effects of diet complexity and added Zn on performance of weanling pigs. Pigs were blocked by weight, penned six/pen in a conventional nursery, and fed a phase 1 diet (1.35% lys) for 10 d, followed by a phase 2 diet (1.15% lys) for 4 wk, and a common phase 3 diet (1.14% lys) for 2 wk. Treatments were arranged in a 3 x 2 factorial with three diets (complex, intermediate, and simple), and two Zn levels [0 and 100 ppm Zn from Availa-Zn zinc amino acid complex (ZnAA), Zinpro Corp., Eden Prairie, MN]. The phase 1 complex diet contained 7% soybean meal (SBM), 10% soy protein concentrate (SPC), 2% plasma protein, 1.5% blood meal, 2% peptide plus, 5% select menhaden fishmeal (FM), and 20% lactose; the intermediate diet contained 15% SBM, 15% SPC, 2% FM, 7% lactose, and 33% the amount of vitamins and trace minerals added to the complex diet; and the simple diet contained 39.5% SBM with no vitamins, minerals or antibiotics added. Diets were pelleted and pigs were allowed access to feed on an *ad libitum* basis. During phases 1, 2 and 3, increasing diet complexity improved (diet effect, $P < .01$) ADG and ADFI. Gain:feed during phase 1 was improved with the addition of ZnAA in the intermediate and complex diet, but not in the simple diet (interaction, $P < .05$). During phase 2, pigs fed the intermediate and complex diets had greater ($P < .01$) G:F than those fed the simple diet. During the overall experiment, there was a tendency for an improvement in ADG (interaction, $P < .1$) and ADFI (interaction, $P = .12$) with the addition of Zn to the intermediate and complex diets, but a decrease with the addition of Zn to the simple diet. In general, the results of this study indicate that complex diets were clearly superior to simple diets in improving performance of weanling pigs, and that 100 ppm Zn from ZnAA improves performance of pigs fed the intermediate and complex diets, but not the simple diet.

Key Words: Pig Performance, Diet Complexity, Zinc