

High Levels of Zinc Oxide for Early-Weaned Pigs - Does It Work?

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In previous reports, we have discussed the benefits of feeding high levels of copper sulfate to weanling pigs. Copper is unique in that it stimulates growth rate and feed intake in pigs when included in the diet at high levels (125 to 250 ppm). These levels are considerably higher than the nutritional requirement for copper, which is about 5 ppm. The mechanism that is involved in the action of pharmacological levels of copper is not well understood. However, it is thought to be somewhat like the action of antibiotics in that it modifies the bacterial population in the gastrointestinal tract. Yet copper and antibiotics seem to act independently, because when both are added simultaneously, they give a response that is greater than when they are added singly.

Another trace mineral that seems to have similar properties is zinc. In the early 1990's, reports began filtering into the U.S. from Europe that the use of pharmacological levels of zinc (3,000 ppm zinc), as zinc oxide, was an effective means of treating diarrhea in young pigs. A few experiments were subsequently conducted in the U.S. to test this theory. One of the first series of studies involving high zinc diets was conducted at the University of Illinois. Like most planned experiments, the researchers were unable to test whether zinc oxide was effective in preventing scours because they did not encounter any diarrhea in any of their pigs, including the controls. However, they did find that in each of three experiments, zinc oxide stimulated growth rate of the pigs.

Recently, we participated in a study involving 10 universities to investigate the effects of pharmacological levels of zinc oxide in diets for weanling pigs. We weaned pigs at 3 weeks of age and fed them Phase I diets (mainly corn, soybean meal, dried whey, lactose, dried plasma) for 1 week followed by Phase II diets (mainly corn, soybean meal, dried whey) for 3 weeks. We evaluated four diets: a control diet with typical nutritional levels of zinc and copper, a diet with 3,000 ppm added zinc as zinc oxide, a diet with 250 ppm added copper as copper sulfate, and diet with a combination of 3,000 ppm zinc and 250 ppm copper. All four of the diets contained a high level of chlortetracycline (Aureomycin®) at growth promotion levels (200 grams/ton). Overall, there were over 1,100 pigs in the study (45 replicate pens and 259 pigs per treatment), so it was very well replicated.

The results of our experiment combined with those of the other universities are shown in Table 1. Note that pigs fed the high zinc diet consumed more feed, gained at a faster rate, and were more efficient in converting feed to gain than the controls. Similar responses were noted when the high copper diet was fed. The combination of high zinc and high copper was no more effective than when either zinc or copper was added singly. The responses to zinc and copper were very consistent at each station.

Fecal firmness and fecal color were determined in the study. None of the stations had any problems with diarrhea in their pigs, but there was evidence that stools were firmer when zinc, copper, or the combination was added to the diet. The feces of the copper-fed pigs were a typical black color. Fecal appearance of stools from pigs fed zinc was not different from the controls. Interestingly, when zinc was added to the high copper diet, the zinc negated the black color of the feces.

No one really knows how zinc works to stimulate growth and other performance traits. Zinc sulfate, a source of zinc in which the zinc is about twice as bioavailable as the zinc in zinc oxide, is

ineffective as a growth stimulant. This makes one wonder whether it is the zinc oxide, per se, that is acting somehow in the intestinal tract rather than ionic zinc itself. Interestingly, zinc oxide is one of the major components in baby powder, and most of us know how effective that product is in preventing and controlling rashes and other skin problems in babies. Could it be that zinc oxide is acting similarly in the intestinal tract? No one really knows, but it is an interesting possibility.

One thing is apparent. Zinc oxide and antibiotics do appear to act independently. The results of our study clearly demonstrate the effectiveness of zinc oxide in stimulating growth, even though the diets had a high level of antibiotic. On the other hand, our study indicated that there was no benefit from including both high copper and high zinc in the diet at the same time.

A number of feed companies are now including zinc oxide in their Phase I starter diets which typically are fed to pigs for a week or two following 2- or 3-week weaning. Typically, the Phase II and Phase III starter diets do not contain zinc oxide, but many of them do contain copper sulfate, copper chloride, or some other form of copper at pharmacological levels. Zinc oxide is 72% zinc, so it needs to be included at .42% of the diet (or 8.4 lb/ton) to provide 3,000 ppm zinc. Copper sulfate is 25% copper, so it needs to be included at .10% of the diet (or 2 lb/ton) to provide 250 ppm copper.

Some have expressed concern about the fact that much of the zinc and copper is excreted in the manure when these pharmacological levels are fed to pigs. This could be a potential problem in off-site nurseries where weanling pigs are concentrated year around. Whether or not this presents a problem to the environment has not been proven, but it need to be further explored.

Table 1. High Dietary Zinc and Copper as Growth Promoters for Weanling Pigs^{a,b,c}

	Control	High Zinc	High Copper	Both
Avg daily gain, lb	.78	.90	.88	.89
Avg daily feed, lb	1.35	1.48	1.43	1.47
Feed/gain	1.74	1.66	1.65	1.65
Fecal firmness ^d	2.44	2.16	2.14	2.13
Fecal color ^e	3.25	3.28	4.39	3.54

^aSummary of 10 experiments conducted at 10 universities. Each mean represents 289 pigs (45 pens of 4 to 10 pigs/pen, 1,156 total pigs) initially averaging 22.2 days of age and 14.2 lb body weight. The experiments were conducted for 28 days and the final weight averaged 38.4 lb.

^bThe high zinc diet was 3,000 ppm zinc from zinc oxide; the high copper diet was 250 ppm of copper from copper sulfate.

^cAll diets had Aureomycin® added at 200 grams/ton.

^dScored from 1 to 5 as follows: 1=very firm, 2=medium firm, 3=moderately loose, 4=very loose, 5=thin and watery.

^eScored from 1 to 5 as follows: 1=yellow, 2=yellowish brown, 3=brown, 4=grayish black, 5=very black.