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Pharmacological Levels of Zinc in Nursery Diets - A Review

Duane Reese
University of Nebraska-Lincoln, dreese1@unl.edu

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Zinc plays significant roles in pig nutrition and health. A zinc deficiency is manifested by skin lesions known as parakeratosis; poor feed intake; slow growth; diarrhea; and atrophy of the thymus, a gland important in immunological competence. Zinc ions may interact with *E. coli* by inhibiting the ability of *E. coli* to respire and therefore reducing its activity. In addition, recent University of Nebraska research indicates that zinc ions cause the organism responsible for swine dysentery (*S. hyodysenteriae*) to produce less toxin. On the other hand, too much zinc in the feed will cause growth depression, arthritis, and ultimately death.

Nutritionists typically add 100 to 150 ppm of zinc to nursery diets to meet requirements for growth. Recently there has been interest in feeding nursery pigs diets containing 2,000 to 4,000 ppm of zinc to combat postweaning stress and diarrhea.

A summary of research studies that have evaluated the response of nursery pigs to pharmacological levels of zinc is presented in Table 1. Added zinc levels ranged from 2,400 to 3,200 ppm. In all cases zinc oxide supplied the supplemental zinc. Percent changes in daily gain, daily feed intake, and feed/gain due to the pharmacological levels of zinc are shown along with the significance level.

This summary indicates that the response to pharmacological levels of zinc is highly variable. For example, sometimes daily gain was increased by 25% whereas at other times gain was decreased by 28% compared to the control diets containing normal zinc concentrations. Similar wide ranges in response to zinc are evident with feed intake. When the incidence of diarrhea was measured, the additional zinc seemed to reduce the frequency of diarrhea.

The level of copper in the diet does not seem to have a consistent effect on the response to zinc. Large positive responses to zinc were observed at all levels of added copper, but more frequent positive responses were observed when dietary copper was low (8 to 22 ppm). Moreover, all the poor responses to zinc were observed when 200 to 250 ppm copper was added to the feed.

These results indicate that the decision to use pharmacological levels of zinc in nursery diets should be made on a case-by-case basis. Careful monitoring of pig performance when high levels of zinc are added to feed is warranted to be sure the right conditions exist for a response. Unfortunately, it is currently not possible to describe the conditions under which a positive response to extra zinc is likely.

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Table 1. Pharmacological Levels of Zinc (Zn) in Nursery Diets—A Summary

Reference	Added Zn, ppm	Zn source	No. pigs	No. pens/treatment	% change from control: Duration, d	% change from control: Daily gain	% change from control: Daily feed	% change from control: Feed/gain	Comments
Poulsen, 1989	2500	ZnO	72	36	7 to 21	+16[A]	+10	-6	Reduced incidence of diarrhea; 10 and 180 ppm Cu added
Holm, 1990	2400	ZnO	120		14	+2	+2	0	Herd diagnosed with E. coli; No. pigs with severe diarrhea reduced
Holm, 1990	3200	ZnO	544		14	+16[A]	+13	-3	Herd diagnosed with E. coli; Mortality reduced from 2.2 to .7%
Tokach, 1992	3110	ZnO	180	5	14	0	+2	+4	200 ppm Cu added
Tokach, 1992	3110	ZnO	168	3	14	-1	+3	+6	200 ppm Cu added
Fryer, 1992	3000	ZnO	18	3	21	+25	+26	0	22 ppm Cu added
Fryer, 1992	3000	ZnO	18	3	21	+25	+21	-7	284 ppm Cu added
Hahn, 1993	3000	ZnO	60	6	21	+14[B]	+13[B]	0	8 ppm Cu added
Hahn, 1993	3000	ZnO	60	6	14	+12[B]	+13[B]	-1	8 ppm Cu added
Master Mix, 1993	3000	ZnO	70	7	14	-13[C]	-3	+11[C]	250 ppm Cu added
Master Mix, 1993	3000	ZnO	70	7	14	+12[C]	+6	-8	12 ppm Cu added
Master Mix, 1993	3000	ZnO	70	7	14	-28[B]	-26[B]	+3	200 ppm Cu added

[A]P<.01
[B]P<.05
[C]P<.06
Results within the boxes are from the same test. Cu = copper.

It is important to know whether positive responses to zinc are occurring on the farm. Otherwise, the practice of feeding extra zinc should be stopped because producers may be taking unnecessary risks, including causing pig performance to decline. Zinc is a heavy metal and it is not known how long-term application of manure from animals fed extra zinc will affect plants or the environment in general. Also, the effect on lagoon function is uncertain. Furthermore, high levels of zinc may interfere with iron metabolism so it is not clear what changes, if any, in iron fortification of diets is necessary.

Recommendations

There obviously can be benefits to feeding pharmacological levels of zinc to nursery pigs. However, until further research is conducted to determine the conditions under which a positive response to pharmacological levels of zinc is likely, the performance of pigs fed high zinc levels be closely monitored. The best way to do this is to conduct an on-farm trial. Details on how to conduct an on-farm feed trial properly are available in the University of Nebraska publication *Conducting Pig Feed Trials on the Farm* (EC 92-270-B). Single copies are available for $.50 at any extension office in Nebraska. Out of state residents should contact Bulletins, P.O. Box 830918 Lincoln, NE 68583-0918.

It is important that the extra zinc be supplied by zinc oxide until further research with other sources is reported. Add 2,500 to 3,000 ppm (7.0 to 8.3 lb of zinc oxide/ton of complete feed assuming the zinc oxide contains 72% zinc) to feed for 14 d postweaning only. Add 6 to 15 ppm copper to the diet.

[1]Duane E. Reese is an Extension Swine Specialist in the Animal Science Department, University of Nebraska, Lincoln.