RESEARCH NOTE:

PERFORMANCE OF NURSERY PIGS FED DIETS WITH COATED OR POTENTIATED ZINC OXIDE

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ABSTRACT

A 30-d experiment was carried out to compare the effects of two zinc oxide sources on performance of nursery pigs. Four hundred sixty-one mixed-sex weanling pigs (5.34 ± 0.16 kg) were randomly allotted to two dietary treatments. Pigs were fed basal diet added with either 500 g/ton coated zinc oxide (cZnO) or 300 g/ton potentiated zinc oxide (pZnO). Each treatment was replicated three times with 76-77 pigs per replicate. Weighing was done three times at 15-d interval. Average daily gain of pigs fed diets supplemented with pZnO tend to be higher than those fed diets supplemented with cZnO at d 1-15 (0.16 vs 0.11 kg; p=0.09), d 16-30 (0.53 vs .41 kg; p=0.05), and at d 1-30 (0.34 vs 0.26 kg; p=0.06). There were no differences on ADFI (p=0.43) for each feeding phase and for the overall period. Feed conversion ratio (FCR) at d 1-15 did not differ between treatments (p=0.12), but pigs fed diets with pZnO improved by 22.07% at d 16-30 (1.73 vs 2.22; p=0.07) and for the overall period by 25.40% (1.88 vs 2.52; p=0.07). Furthermore, mortality was lower in pigs fed diets with pZnO (6.57 vs 15.86 %; p=0.01) than those fed with cZnO. Results indicated the advantages of pZnO over cZnO on growth and survivability of pigs.

Key Words: potentiated Zinc Oxide, coated Zinc oxide

INTRODUCTION

Zinc oxide usage in swine production has been practiced worldwide to improve growth performance and as alternatives to antibiotic growth promoters. Zinc oxide is included in piglet diets to regulate gut microflora by suppressing pathogenic bacterial load in the small intestine. It helps in addressing post-weaning diarrhea brought by Enterotaxaemic *Escherichia coli* (ETEC) resulting to better growth of piglets. Experimental evidence showed that zinc oxide inhibits cultured enterocytes from damage induced by *E. coli* (Roselli *et al.*, 2003). Inclusion of 3,000 ppm of zinc from standard zinc oxide, two weeks after weaning resulted to improved body weight gain (Pluske *et al.*, 2003). Dietary supplementation of zinc oxide leads to improved body weight gain, feed conversion efficiency and increased villi height in the small intestine of pigs (Li *et al.*, 2006).

Fat microencapsulated zinc oxide can be included in piglet diet as an inorganic zinc source at lower inclusion. According to Jang *et al.* (2014), lipid coating prevents chemical change of ZnO in the stomach prolonging antibacterial effect towards the small intestine can help control post-weaning diarrhea. In addition to coated ZnO (cZnO), potentiated zinc oxide (pZnO) is also another zinc source.

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Potentiated zinc oxide is a feed grade zinc source with 15 times larger surface area than standard zinc oxide and is effective at 150-300 ppm. Supplementation of pZnO at 300 mg/kg improved body weight gain and increased Immunoglobulin A (IgA) levels in *E. coli* challenged piglets. Improvements in ADG and FCR of newly weaned piglets were also observed (Trevisi *et al.*, 2014).

Supplementation of pZnO improved body weight, average daily gain (ADG) and gain to feed (G:F) ratio of piglets and had reduced pig-MAP serum concentration, thus indicating better health status than control pigs (Morales *et al*, 2012). Potentiated ZnO also reduced ex vivo growth of intestinal bacteria in weaned piglets as shown in another trial by Vahjen *et al* (2012).

However, no local data has been generated on comparing the effects of pZnO and cZnO on performance of nursery pigs. Conducting a local feeding trial that will compare these zinc oxide sources will help in choosing the appropriate ZnO to use.

MATERIALS AND METHODS

The experiment was conducted on September 13 to November 22, 2015 in a commercial swine farm in General Santos City, Mindanao.

Four hundred sixty-one mixed-sex weanling pigs (5.34 ± 0.16 kg of average weight) were randomly allotted to two dietary treatments. Pigs were fed basal diet (Table 1: Composition of experimental diets) added with either 500 g/ton coated zinc oxide as recommended by its supplier (cZnO) or 300 g/ton potentiated zinc oxide (pZnO). Each treatment was replicated three times following the minimum number of replications (t+1) with 76-77 pigs per replicate. Pigs were fed ad libitum and water was provided via nipple drinker. Dimension of pens was 10 x 6 m.

A negative control was not included since several studies already showed the importance of ZnO inclusion with significant improvement in the performance of nursery pigs.

Feed intake per pen and body weight per stage were recorded at the start and end of booster (Day 1-15) and pre-starter (Day 16-30) stage. Percent mortality was also determined.

Gathered data were checked for outliers, normality (Wilk-Shapiro test) and equality of variance (F-test). Count data expressed in percentage (mortality) were transformed using arcsin function. All gathered data were subjected to T-test using MS excel. The α-level used to determine significance and tendencies between means were considered at $p<0.05$ and $0.05 \leq p<0.10$, respectively.

RESULTS AND DISCUSSION

Studies conducted by Roselli *et al.* (2003) and Li *et al.* (2006) showed improvement in body weight gain and feed efficiency with zinc oxide supplementation. Thus, the

Table 1. Composition of experimental diets (as-fed basis).

Item	Composition
Ingredients (%)	
Yellow corn	56.52
Soybean meal (US, 46 %)	10.00
Milk replacer	7.50
Soy protein concentrate (60 %)	7.50
Pea protein	5.00
Sweet whey powder	5.00
Coco oil	2.50
MDCP	1.30
Limestone (fine)	1.10
Others[1]	3.58
Total	100.00
Calculated nutrient contents	
ME (Mcal/kg)	3.34
CP (%)	17.28
EE (%)	4.53
CF (%)	3.10
Ca (%)	0.85
Avail. P (%)	0.45
Total Lys (%)	1.46
Total Met + Cys (%)	0.89
Total Thr (%)	0.94
Total Trp (%)	0.28

[1]Micro-ingredients. Supplied per kilogram of feed: Vitamin A (12,500 IU), Vitamin D_3 (2,500 IU), Vitamin E (50 IU), Vitamin K_3 (2.5 mg), Vitamin B_1 (2.5 mg), Vitamin B_2 (6.25 mg), Vitamin B_6 (17.5 mg) Vitamin B_{12} (0.025 mg), Niacin (42.5 mg), Pantothenic Acid (42.5 mg), Folic Acid (5 mg), Biotin (0.25 mg), Antioxidant (25 mg), Iron (115 mg), Manganese (50 mg), Iodine (0.85 mg), Selenium (0.15 mg), Zinc (50 mg), Copper (10 mg).

importance of using zinc oxide was already established. Therefore, the discussion will focus on the comparison of cZnO and pZnO on the growth performance of nursery piglets.

The performance of nursery pigs fed diets with different zinc oxide sources is presented in Table 2. Piglets fed diets with pZnO tend to have increased body weight gain by 2.53 kg (p=0.06). Average daily gain of nursery pigs fed pZnO at d 1-15 (0.16 vs 0.11 kg; p=0.09) and at d 16-30 (0.53 vs 0.41 kg; p=0.05) tend to be higher than those fed with diets supplemented with cZnO. At d 1-30 (0.34 vs 0.26 kg; p=0.06), there was a 30.77% overall improvement in ADG. This result agrees with the 21-day trial conducted by Morales

Table 2. Performance of pigs fed diets with different zinc oxide sources

Variable	cZnO	pZnO	SEM	P-value
BW (kg)				
Day 1	5.16	5.51	0.16	0.15
Day 15	6.80	7.88	0.35	0.04
Day 30	12.93	15.81	1.20	0.04
BWG (kg)				
Day 1-15	1.64	2.37	0.25	0.09
Day 16-30	6.13	7.93	0.89	0.05
Day 1-30	7.76	10.29	1.12	0.06
ADG (kg)				
Day 1-15	0.11	0.16	0.02	0.09
Day 16-30	0.41	0.53	0.06	0.05
Day 1-30	0.26	0.34	0.04	0.06
ADFI (kg)				
Day 1-15	0.32	0.36	0.02	0.13
Day 16-30	0.86	0.88	0.05	0.42
Day 1-30	0.61	0.63	0.03	0.43
FCR				
Day 1-15	3.08	2.32	0.25	0.12
Day 16-30	2.22	1.73	0.20	0.07
Day 1-30	2.52	1.88	0.24	0.07
Mortality (%)				
Day 1-15	8.69	4.67	1.95	0.01
Day 16-30	7.98	2.01	1.82	0.03
Day 1-30	15.86	6.57	3.27	0.01

SEM (standard error of mean); **BW** (body weight); **BWG** (body weight gain); **ADG** (average daily gain); **ADFI** (average daily feed intake); **FCR** (feed conversion ratio).

et al. (2012) showing 18.26% ADG improvement in piglets fed with pZnO compared to other zinc oxide source.

There were no differences on ADFI (p=0.43) for each feeding phase and for the overall period. Feed conversion ratio (FCR), at d 1-15 did not differ between treatments (p=0.12), but pigs fed diets with pZnO improved by 22.07% at d 16-30 (1.73 vs 2.22; p=0.07). At d 1-30, a 25.40% improvement in FCR improvement was derived for the F:G (1.88 vs 2.52; p=0.07).

Furthermore, piglet mortality was reduced at d 1-15 (4.67 vs 8.69; p=0.01) and at d 16-30 (2.01 vs 7.98; p=0.03) in pigs fed diets with pZnO than those fed with cZnO. At d

1-30 (6.57 vs 15.86; p=0.01), there was a 58.58% overall improvement in survivability with pZnO supplementation.

Improvement in performance may be attributed to the patented production of pZnO. Increasing the surface area contributes to its better antimicrobial property than other ZnO sources. Increased antibacterial activity leads to lower diarrhea incidence and healthier piglets allowing better digestion and absorption of nutrients for better growth and survivability. In addition, contamination by heavy metals (e.g. Cadmium, Lead, Arsenic, etc.), nutritional antagonism (e.g. copper, phytase, and acids), zinc toxicity, environmental concerns and microbial resistance were avoided due to lower inclusion and better quality zinc oxide. On the other hand, lower growth performance of piglets supplemented with cZnO may be attributed to the delay of zinc oxide availability due to the coating technology. As a zinc inorganic source, performance of piglets with cZnO may be comparable with piglets given standard zinc oxide. In a study conducted by Hill *et al.* (2001), increased growth response of weanling pigs was observed at increasing concentration up to 2,000 mg/kg.

In summary, results indicated the advantages of potentiated zinc oxide at 300 g/ton over coated zinc oxide at 500 g/ton on growth and survivability of nursery piglets. For future studies, it is recommended to include other parameters such as *E. coli* count in feces, scouring incidence and heavy metal accumulation in several tissues. Usage of potentiated zinc oxide at varying levels can also be done.

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