EFFECT OF ZINC AT DIFFERENT LEVELS ON GROWTH AND FEED CONVERSION EFFICIENCY OF CROSS BRED PIGS*

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Abstract

An investigation was carried out for a period of 122 days using thirty six weaned (18 castrated male and 18 female) Large White Yorkshire X Desi piglets to find out the effect of different levels of zinc on growth and digestibility of nutrients in growing cross bred pigs. Three different levels of zinc (50, 100 and 150 ppm) were added respectively to the control and treatment rations (T1, T2 and T3) and all the rations were isocaloric and isonitrogenous. The final body weight, total body weight gain and average daily gain with all the three rations were assessed and were statistically similar in all fortnights. The cumulative weight gain of pigs maintained on three dietary treatments were similar in different fortnights except fourth fortnight when it was higher (P<0.05) for T2 than that of T1. The average daily gain of pigs under the three dietary treatments T1, T2 and T3 were 425, 466 and 455 g, respectively. There was no significant difference between animals in the three dietary treatments with regard to their average daily gain. The feed conversion efficiency of pigs maintained under the three dietary treatments was also statistically similar. The overall results of the study indicated that all the three dietary treatments were statistically similar in various factors such as body weight gain, Feed conversion efficiency (FCR) and that the NRC (1998) recommendations of 50ppm of Zn was sufficient for the normal growth and development of the animals. However, T2 ration containing 100 ppm of Zn had a lower feed cost per kg body weight gain when compared to T1 containing 50 ppm of Zn and T3 containing 150 ppm of Zn and it showed a trend towards better body weight gain and FCR.

Key words: *Zinc, pigs, feed conversion efficiency*

Swine rearing is an enterprising livelihood of farmer sector in Kerala. A technical and scientific feeding regime to meet the nutritional requirements of the animals according to their management conditions will invariably add to the efficiency of production. Minerals play a vital role in the growth and well being of animals although required in small quantities. Zinc is an essential micro mineral which is required for the various physiological processes in the body. According to NRC (1998), the requirement of zinc for growth of pigs is 100ppm for growers and 50ppm for finishers. The availability of dietary zinc is influenced by the phytate content, concentration of other minerals such as calcium, phosphorus, copper and iron and the interactions between them. At present cross breeding among exotic and indigenous pigs is practiced in our state. Studies on the micro mineral requirements of these cross breds are scanty in literature. Hence, the effect of three different levels of zinc on the growth and feed conversion efficiency in cross bred pigs was

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Table 1. Chemical composition of grower and finisher rations*, %

Parameter	Grower rations			Finisher rations		
	T1	T2	T3	T1	T2	T3
Dry matter	91.55	91.85	91.55	90.55	90.81	90.89
Crude Protein	18.31	18.57	18.68	16.11	16.29	16.16
Ether Extract	2.82	2.85	2.50	3.10	3.00	3.20
Crude Fibre	3.31	3.16	3.18	3.28	3.02	2.80
Total ash	5.77	5.67	5.85	5.12	5.20	5.70
Nitrogen free extract	69.79	69.75	69.79	72.39	72.49	72.14
Acid insoluble ash	1.10	1.04	1.40	1.30	1.70	1.87

* *On dry matter basis*

Table 2. Mineral composition of grower and finisher rations*

Rations	Calcium, %	Phosphorus, %	Magnesium, %	Copper, ppm	Zinc, ppm
Grower					
T1	0.81	0.62	0.18	5.16	60.00
T2	0.80	0.64	0.14	4.62	111.00
T3	0.82	0.61	0.19	5.10	165.00
Finisher					
T1	0.85	0.16	0.59	10.91	59.00
T2	0.86	0.14	0.54	9.77	113.00
T3	0.89	0.12	0.63	10.55	166.00

* *On dry matter basis*

observed in the present study and thus the dietary requirement of zinc in growing cross bred pigs

Materials and Methods

Eighteen castrated male and female weaned crossbred (Large White Yorkshire X Desi) piglets belonging to the Centre for Pig Production and Research, Mannuthy were used as the experimental animals. The piglets were randomly divided into three groups (T1, T2 and T3) and animals of each group were randomly allotted to six pens with two animals in each pen, forming six replicates for each treatment. The experimental ration consisted of grower ration containing 18 per cent crude protein and 3265 kcal of metabolisable energy per kg feed, up to 50 kg body weight and finisher ration with 16 per cent crude protein and 3265 kcal of metabolisable energy per kg feed from 50 Kg onwards (NRC, 1998). The three experimental rations were formulated as given below: T1 – Control ration containing 50 ppm of added zinc, T2 – Ration containing 100 ppm of added zinc and T3 – Ration containing 150 ppm of added zinc as ZnO. All the rations were is caloric and isonitrogenous. Feeding trial was carried out for a period of 122 days. Animals were allowed to consume as much feed as they could, within a period of one hour. Balance of feed if any, was collected and weighed before the next time of feeding. Records of daily feed intake and fortnightly body weight were taken throughout the experimental period.

Chemical composition of feed was analysed as per methods described in Association of Official Analytical Chemists (AOAC, 1990) and are given in Tables 1 and 2. Minerals such as Ca, P, Mg, Cu and Zn of feed were analysed using atomic absorption spectrophotometer (Perkin-Elmer model 3110) after wet digestion. Phosphorus content of feed was analysed by colorimetric method (Vanadomolybdate method) using spectrophotometer (Table 3). Data on body weight of pigs maintained on the three dietary treatments were analysed by Completely Randomised Design (CRD) method as described by Snedecor and Cochran (1994). Means were compared by Duncan's Multiple Range Test.

Results and Discussion

Chemical and mineral composition of rations

Data on chemical composition of the experimental grower and finisher swine rations are given in Table 1. The percentage of dry matter in grower rations varied between 91.55 and 91.85, ether extract between 2.5 and 2.85 per cent and crude fibre between 3.16 and 3.31 per cent. The total ash, NFE and acid insoluble ash fraction varied between 5.67

Table 3. Fortnightly average of cumulative body weight gain of pigs maintained on three dietary treatments

Fortnight	Average cumulative body weight gain (kg)†			
	T1	T2	T3	P value
1	4.40 ± 0.36	4.62 ± 0.42	4.55 ± 0.70	0.82
2	10.34 ± 0.42	10.53 ± 0.52	10.80 ± 0.95	0.62
3	16.34 ± 0.53	17.26 ± 1.01	17.28 ± 1.11	0.29
4	21.50^{a} ± 0.68	23.55^{b} ± 1.03	22.64^{ab} ± 1.29	0.04
5	29.00 ± 1.07	31.22 ± 1.57	30.83 ± 2.01	0.15
6	36.49 ± 1.15	39.33 ± 1.7	38.97 ± 2.44	0.09
7	42.99 ± 1.60	46.49 ± 2.40	45.83 ± 3.51	0.17
8	50.30 ± 1.97	53.93 ± 3.06	53.40 ± 3.85	0.23
9	51.83 ± 1.98	56.26 ± 2.89	55.50 ± 4.10	0.13

†Mean of twelve values with SE

a, b – Means with different superscripts within the same row differ significantly (P< 0.05).

and 5.85, 69.75 and 69.79 and 1.04 and 1.40 per cent, respectively. In the finisher ration the percentage of dry matter varied between 90.55 and 90.89, ether extract between 3.00 and 3.20 and crude fibre between 2.80 and 3.28 per cent, respectively. The total ash, NFE and acid insoluble ash content varied between 5.12 and 5.70, 72.14 and 72.49 and 1.30 and 1.87 per cent, respectively in the finisher rations.

The crude protein of the grower ration ranged from 18.31 to 18.68 per cent and that of the finisher ration from 16.11 to 16.29 per cent. As per NRC (1998) the grower and finisher ration should contain 18 and 16 per cent crude protein, respectively. The calculated ME value of the grower and finisher rations were 3275.85 and 3289.10 kcal / kg, respectively which is in accordance with NRC (1998) recommendations of 3265 kcal / kg ration. Data on mineral composition of the grower and finisher rations are given in Tables 2. The Ca, P and Mg content of the grower ration ranged from 0.80 to 0.82, 0.61 to 0.64 and 0.14 to 0.19 per cent respectively. The Cu and Zn content of the grower ration ranged from 4.62 to 5.16 and 60.00 to 165.00 ppm, respectively. The Ca, P and Mg content of the finisher ration ranged from 0.85 to 0.89, 0.54 to 0.63 and 0.12 to 0.16 per cent, respectively. The Cu and Zn content of the finisher ration ranged from 9.77 to 10.91 and 59.00 to 166.00ppm, respectively.

Body Weight

From the average fortnightly cumulative weight gain it could be seen that the cumulative weight gain of pigs maintained on dietary treatment T2 was higher (P<0.05) than that of T1, in the fourth fortnight while it was similar for all other fortnights for pigs maintained on the three dietary treatments (Table 3). Average final body weight at the end of 122 days of feeding trial recorded in pigs of the three dietary treatments T1, T2 and T3 were 65.14, 69.88 and 69.08 kg, respectively and the corresponding average total body weight gains were 51.82, 56.26 and 55.49 kg, respectively(Table.4). Yin *et al.* (2009) reported that adding Zn to a basal diet with 100 ppm of Zn enhanced growth in young pigs while Roberts *et al.* (2002) obtained similar results as that of the present study suggesting that body weight gain was unaffected by dietary Zn concentration

Average Daily Gain

The average daily gain (425, 466 and 455 g, respectively) of pigs maintained on the three dietary treatments T1, T2 and T3 were statistically similar (Table 4). Revy *et al.* (2004), Williams *et al.* (2005) and Martin *et al.* (2011) observed linear increase in ADG with increasing levels of supplemental Zn in rations of pigs whereas results of the present study indicate that ADG of pigs was not affected by different levels of dietary Zn.

Rincker *et al.* (2005) reported that there were no differences in ADG (178.60, 170.90 and 113.60 g) in nursery pigs fed diets with 214 ppm and 2000 ppm of Zn. Similarly Hedemann *et al.* (2006) reported that ADG was not affected by dietary concentration of Zn which

Table 4. Average daily gain of pigs maintained on three dietary treatments†

Parameter	Treatments†			
	T1	T2	T3	P value
Initial body weight, kg	13.32 ± 0.43	13.62 ± 0.58	13.59 ± 0.71	0.92
Final body weight, kg	65.14 ± 1.38	69.88 ± 1.38	69.08 ± 2.69	0.19
Total body weight gain, kg	51.82 ± 0.99	56.26 ± 1.45	55.49 ± 2.05	0.14
Average daily gain, g	425.00 ± 0.01	466.00 ± 0.01	455.00 ± 0.02	0.07

†*Mean of twelve values with SE*

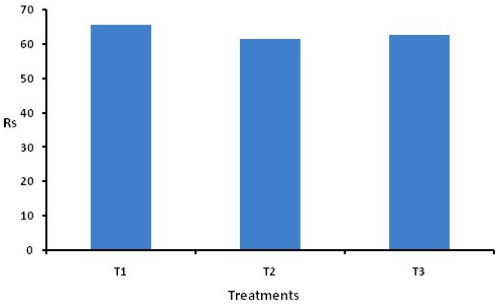

Fig.1 Feed cost per kg gain of pigs maintained on the three experimental rations

is in agreement with the results obtained in the present study.

Feed Conversion Efficiency

The cumulative feed conversion efficiency of pigs maintained on the three dietary treatments T1, T2 and T3 were statistically similar (Table 5). Hill *et al.* (2000) reported that 22 day old piglets when fed diets containing 3000ppm of added Zn for an experimental period of one month had higher average daily feed intake and gain : feed of 611 g/kg when compared to pigs fed control diets containing 200ppm of Zn Mavromichalis *et al.* (2000) reported that when pigs were fed with increasing concentrations of Zn from 100ppm to 3000ppm, the feed intake increased linearly, whereas gain-feed ratio of pigs were variable but Van heugten *et al.* (2003) observed that gain efficiency increased linearly with Zn supplementation. Similarly higher feed conversion efficiency was reported by Revy *et al.* (2004) and Yin *et al.* (2009) with increasing levels of Zn where as Creech *et al.* (2004) reported that no difference in average daily feed intake and gain- feed ratio was observed when pigs were fed with control diets containing 167ppm of Zn, and two other diets containing 83.30 and 79.10ppm of added Zn, which agrees well with the results of the present study. Economics of incorporation of different levels of zinc in the ration of pigs was estimated by calculating feed cost per kg gain of body weight as given in Fig.1. It was observed that T2 ration containing 100ppm of Zn had a lower feed cost per kg body weight gain when compared to T1 containing 50ppm of Zn and T3 containing 150 ppm of Zn.

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Table 5. Fortnightly average of cumulative feed conversion efficiency† of pigs maintained on three dietary treatments

Fortnight	Average cumulative feed conversion efficiency			
	T1	T2	T3	P value
1	2.59 ± 0.08	2.55 ± 0.13	2.65 ± 0.14	0.84
2	2.63 ± 0.05	2.59 ± 0.07	2.59 ± 0.07	0.90
3	2.78 ± 0.05	2.65 ± 0.09	2.69 ± 0.08	0.46
4	3.06 ± 0.05	2.86 ± 0.07	2.96 ± 0.07	0.12
5	3.07 ± 0.05	2.93 ± 0.08	2.93 ± 0.08	0.33
6	3.12 ± 0.04	2.99 ± 0.07	2.98 ± 0.08	0.22
7	3.40 ± 0.05	3.24 ± 0.09	3.25 ± 0.10	0.34
8	3.52 ± 0.05	3.38 ± 0.10	3.38 ± 0.10	0.43
9	3.68 ± 0.05	3.50 ± 0.09	3.51 ± 0.10	0.23

†*Mean of twelve values with SE*

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