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EFFECT OF SUPPLEMENTATION OF ZINC: COPPER WITH OR WITHOUT PHYTASE ON BODYWEIGHT GAIN, AVERAGE DAILY WEIGHT GAIN AND FEED CONVERSION EFFICIENCY OF WEANLING PIGLET

Ilakshy Deka[1*], Babul Chandra Sarmah[1], Jeetendra Goswami[1], Suresh kumar[2], Digendra Nath Sarma[3], Devojyoti Dutta[1], Dhireswar Kalita[4]

[1]*Department of Veterinary Physiology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22, INDIA*

[2]*ICAR Research Complex for North Eastern Hill Region, Umiam, Barapani, Meghalaya, INDIA*

[3]*Department of Animal Nutrition, College of Veterinary, Science, Assam Agricultural University, Khanapara, Guwahati-22, INDIA*

[4]*AICRP on "Pig", College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22, INDIA*

ABSTRACT

The present experiment was conducted to study the growth performances of weanling piglets following supplementation of Zinc:Copper with or without phytase for a period of 4 months. A total of 30 numbers of crossbred piglets (Hampshire X Meghalaya local), aged 60 days, maintained under standard feeding and managemental condition were randomly divided into six groups viz. Group A1, A2,B1, B2, C1and C2 allocating 5 (n=5) piglets comprising 3 males and 2 females in each group. The supplementation was done as follows Group A1= 100ppm Zn + 10ppm Cu, Group A2 =100ppm Zn + 10ppm Cu + 500U phytase, Group B1=200ppm Zn + 20ppm Cu, Group B2 =200ppm Zn +20ppm Cu + 500U phytase, Group C1 =300ppm Zn + 30ppm Cu and Group C2 =300ppm Zn +30ppm Cu + 500Uphytase. The higher BWG (P<0.01) and average daily body weight gain (ADG) were recorded in group C2 (56.90 ± 0.332 kg; 0.486 ± 0.062 kg) followed by C1, B2, B1, A2 and lowest in group A1 (45.00 ± 0.873; 0.373 ± 0.026). Addition of phytase further increased in body weight gain and ADG in group A2, B2, and C2. The best Feed Conversion Efficiency (FCE) was recorded in C2 (2.593 ± 0.037) group followed by C1 (2.773 ± 0.039), B2 (2.839 ± 0.046), B1 (2.971 ± 0.080), A2 (3.046 ± 0.036) and A1 (3.498 ± 0.094).

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KEY WORDS

Zinc; Copper; Phytase; BWG; AWG; FCE; Pig

***Corresponding author:** Email: drilakshy_pd@yahoo.com; Tel: +91 98640 40681

[I] INTRODUCTION

As zinc regulates 1000 metallo-enzymes [1] and copper hold the second berth [2] so, they are essential for various biochemical processes of the body. Although, individually both Zn and Cu are essential, for growth, reproduction and better health coverage of livestock. However, the ratio of the two minerals is known to be more important for optimizing the productive and reproductive performances. Under traditional pig management practices, Zinc deficiency is more likely to occur because the pig grow at a rapid rate and reproduces at an early age with larger litter size and shorter inter furrowing interval. Most of the swine feed are plant based containing high phytic acid [3] which hampers the bio-availability of many minerals required for various physiological processes. Therefore, supplementation of phytase offers intensifying opportunity for bioavailability of minerals like phosphorus, calcium, magnesium, manganese, zinc, copper and iron from the dietary source. Therefore, the present experiment was designed to establish a suitable dose level of Zn: Cu with or without phytase for optimizing productive performances in the weaning piglets particularly of North Eastern Region (NER).

[II] MATERIALS AND METHODS

The animal experimentation was conducted at ICAR Research Complex for North Eastern Hill Region, Umiam, Barapani, Meghalaya [Figure–1] and the analytical works were done in the Department of Veterinary Physiology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati -781 022. The pig farm, where the animals were maintain is located at 25º 41'21"N latitude and 91º 55'25"E longitude at an altitude of 1010msl. The agro climatic zone classified for the place is within the subtropical hill agro ecological zone. The maximum and minimum temperature normally ranges from 20.9 to 27.4º C and from 6.7 to 18.1ºC, respectively. The mean annual rainfall is 2399.8 mm with relative humidity between 85 percent and 59 percent. A total of 30 numbers of weaned piglets (10.60 ± Kg body weight; 60 days of age) were used to study the supplemental effect of of Zinc: Copper with and without phytase. The supplementation was done as follows Group A_1= 100ppm Zn + 10ppm Cu, Group A_2 =100ppm Zn + 10ppm Cu + 500U phytase, Group B_1=200ppm Zn + 20ppm Cu, Group B_2 =200ppm Zn +20ppm Cu + 500U phytase, Group C_1 =300ppm Zn + 30ppm Cu

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and Group C_2 =300ppm Zn +30ppm Cu + 500Uphytase. Body weights of the experimental piglets were recorded from 2 months of age at fifteen days interval till attainment of 6 months of age before feeding between 8-10 AM. The average body weight gain (ADG) and feed conversion efficiency (FCE) were calculated. The generated data were statistically analyzed by using SPSS software version 11.5.

Fig: 1. Piglets of one experimental group and measurement of body weigh during experiment.

[III] RESULTS

3.1. Body weight gain

The BWG of the different treatment groups at fifteen days interval from 2 to 6 months of age are presented in **Table–1.** The initial BWG (Mean ± SE) at 2 months of age in A_1, A_2, B_1, B_2, C_1 and C_2 group were recorded as 10.60 ± 0.292, 10.60 ± 0.292, 10.70 ± 0.860, 10.70 ± 0.300, 10.70 ± 0.374 and 10.60 ± 0.400 kg respectively. The final BWG at 6 months of age were recorded as 45.00 ± 0.873, 50.00 ± 0.548, 51.20 ± 1.158, 53.00 ± 0.612, 54.00 ± 0.500 and 56.90 ± 0.332 kg for A_1, A_2, B_1, B_2, C_1 and C_2 groups respectively. The highest BWG at 6 months of age was recorded in C_2 group followed by C_1, B_2, B_1, A_2 and lowest in A_1 group. As the supplemental dose of Zn: Cu increased, the BWG also recorded higher values accordingly. Further, phytase supplementation showed a positive increment in BWG in A_2, B_2 and C_2 groups when compared with corresponding non supplemented groups i.e. A_1, B_1 and C_1. A definite linear trend of increase in BWG was recorded throughout the experimental period, irrespective of the treatment groups. The Critical Difference Test at 6 months of age showed that the BWG was significantly ($P<0.05$) highest in C_2 group when compared to that of other groups (C_1, B_2, B_1, A_2 and A_1). There was no significant difference in BWG between A_2 and B_1 groups and B_2 and C_1 groups

3.2. Average daily weight gain

The ADG of the different treatment groups recorded at fifteen days interval from 2 to 6 months of age are presented in **Figure–2.** The ADG (Mean ± SE) in A_1, A_2, B_1, B_2, C_1 and C_2 groups at 2.5 months of age were recorded as 0.173 ± 0.012, 0.253 ± 0.027, 0.252 ± 0.063, 0.273 ± 0.019, 0.279 ± 0.027 and 0.306 ± 0.034 kg respectively. At 6 months of age the ADG for the above treatment groups were 0.373 ± 0.026, 0.399 ± 0.047, 0.419 ± 0.055, 0.419 ± 0.030, 0.459 ± 0.046 and 0.486 ± 0.062 kg respectively. The highest ADG at 6 months of age was recorded in C_2 group followed by C_1, B_2, B_1, A_2 and lowest in A_1 group. Supplementation of Zn: Cu at higher concentration resulted higher ADG in all the treatment groups. Additional phytase supplementation in A_2, B_2 and C_2 groups resulted higher ADG when compared with corresponding phytase non supplemented groups i.e. A_1, B_1 and C_1. In all the treatment groups the ADG was found to be increased along with advancement of treatment period. Although, the ADG at 6 months of age showed an apparent variation among the different treatment groups the Critical Difference Test at 6 months of age revealed no significant difference between the groups.

3.3. Feed conversion ratio

The FCE of the different treatment groups are presented in **Figure–3**. The values of the FCE (Mean ± SE) were recorded as 3.498 ± 0.094, 3.046 ± 0.036, 2.971 ± 0.080, 2.839 ± 0.046, 2.773 ± 0.039 and 2.593 ± 0.037 in A_1, A_2, B_1, B_2, C_1 and C_2 groups respectively. In the present experiment, the FCE was found to be dependent on the dietary level of Zn:Cu and phytase. The best FCE was recorded in C_2 group followed by C_1, B_2, B_1, A_2 and A_1 groups**.** At 6 months of age showed that the FCE was significantly ($P<0.05$) highest in C_2 group. There was no significant difference in FCE between A_2 and B_1 groups and B_2 and C_1 groups. The C_2 group recorded the best FCE.

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Table-1: Body weight (kg, Mean ± SE) in different treatment groups at fifteen days interval from 2 to 6 months of age

Treatment group	Total body weight gain (kg)								
	Age (months)								
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
A_1	10.60^{a} ± 0.292	13.20^{a} ± 0.255	16.60^{a} ± 0.292	20.90^{a} ± 0.458	25.30^{a} ± 0.663	29.90^{a} ± 0.332	34.50^{a} ± 0.500	39.40^{a} ± 0.678	45.00^{a} ± 0.837
A_2	10.60^{a} ± 0.292	14.40^{b} ± 0.400	18.80^{b} ± 0.374	23.40^{b} ± 0.430	28.20^{b} ± 0.604	33.20^{b} ± 0.374	38.50^{b} ± 0.500	44.00^{b} ± 0.548	50.00^{b} ± 0.548
B_1	10.70^{a} ± 0.860	14.40^{b} ± 0.400	18.90^{b} ± 0.458	23.60^{b} ± 0.510	28.40^{bc} ± 0.400	34.20^{b} ± 0.583	39.80^{bc} ± 0.860	44.90^{b} ± 0.510	51.20^{b} ± 1.158
B_2	10.70^{a} ± 0.300	14.80^{b} ± 0.339	19.40^{bc} ± 0.485	24.20^{bc} ± 0.604	29.40^{cd} ± 0.245	34.70^{c} ± 0.255	40.50^{c} ± 0.758	46.70^{c} ± 0.374	53.00^{c} ± 0.612
C_1	10.70^{a} ± 0.374	14.90^{b} ± 0.332	19.60^{bc} ± 0.292	24.80^{bc} ± 0.374	29.80^{d} ± 0.255	35.20^{c} ± 0.464	41.00^{c} ± 0.612	46.90^{c} ± 0.430	54.00^{c} ± 0.500
C_2	10.60^{a} ± 0.400	15.20^{b} ± 0.374	20.00^{c} ± 0.316	25.20^{c} ± 0.374	31.00^{e} ± 0.447	37.20^{d} ± 0.604	43.60^{d} ± 0.510	49.60^{d} ± 0.696	56.90^{d} ± 0.332

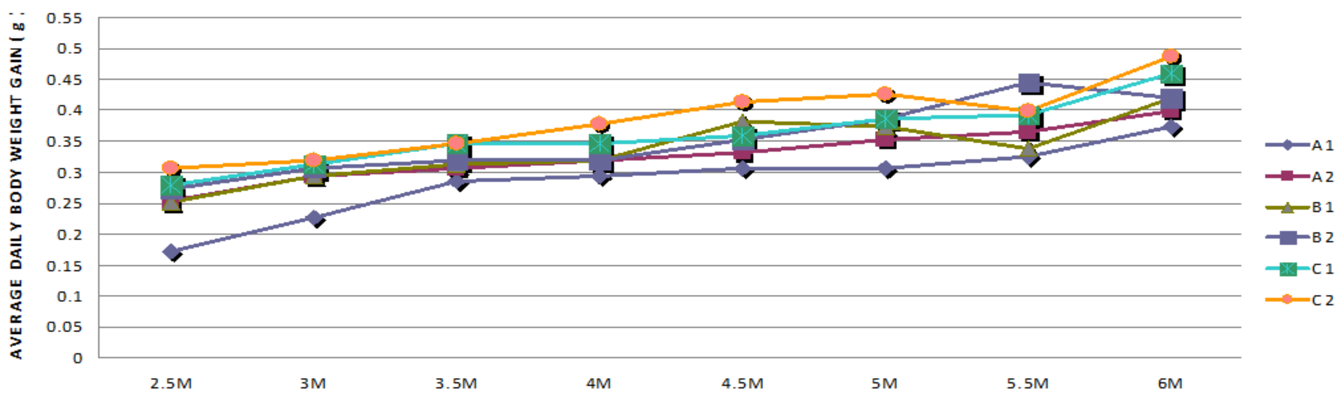

Fig: 2. Average daily body weight gain in different treatment groups at fifteen days interval from 2.5 to 6 months of age

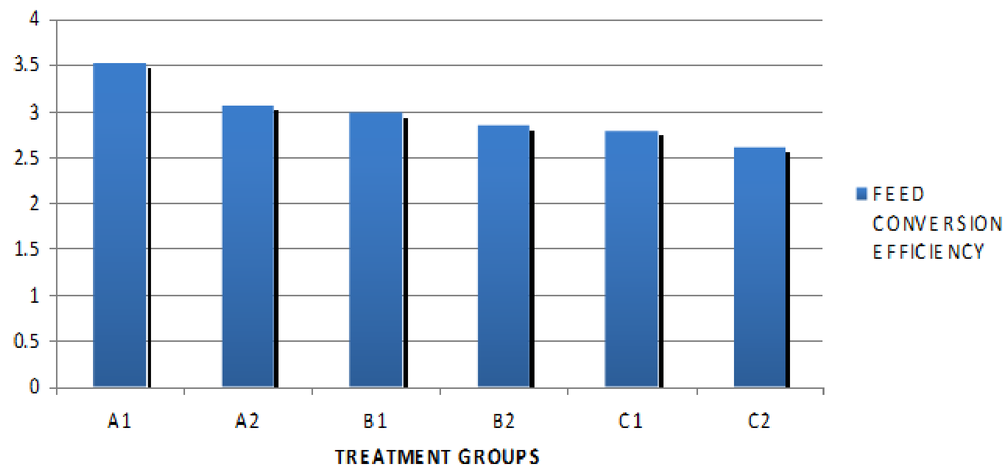

Fig: 3. Feed conversion efficiency in different treatment groups for the whole experimental period (4 months) from 2 to 6 months of age

[IV] DISCUSSION

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The initial BWG and ADG (Mean ± SE) recorded from 2 months of age followed by fifteen days interval until 6 months of age in the experimental animals of group A1, A2, B1, B2, C1 and C2 are presented in the **Table– 1** and **Figure–2.** Irrespective of the treatment group, increase in BWG and ADG was recorded with advancement of age. This indicates that all the experimental animals were maintained properly in respect of feeding, management and health coverage. However, higher BWG and ADG was recorded when the supplemental dietary level of zinc (Zn) :copper (Cu) was increased from 100:10ppm to 300:30ppm. Further increased in BWG and ADG was observed when phytase was added along with the higher supplemental level of Zn:Cu in group A2, B2, and C2. At 6 months of age, highest BWG (56.90 ± 0.332 kg) and ADG (0.459 ± 0.046) was recorded in group C2 and lowest BWG (45.00 ± 0.873 kg) and ADG (0.373 ± 0.026) was observed in group A1.

In the present experiment, A1 and A2 groups received the supplemental Zn as per NRC (1998) requirement. Rest of the experimental animal received higher than NRC (1998) recommendation. Many workers [3-5] opined that dietary requirement of Zn in porcine might be higher than the recommended NRC (1998) level i.e., 80-100ppm in different growing phases. Results of the present study clearly indicate that dietary level of Zn should be more than 100ppm to enhance the growth performances of weaned piglets. Borah (2009) [6] also reported that supplementation of 500 ppm Zn in pig diet resulted better weight gain. The higher requirement of Zn in NER might be due to presence of some mineral present in the drinking water, which might have reduced the bioavailability of Zn. The significantly higher iron content in soil and water of the NER might have reduced the bioavailability of Zn, resulted in higher demand of supplemental Zn in the diet. Brandao (1990) [7] described the involvement of Zn in growth and development of tissues enhancing perception of taste, regulation of appetite, increased food consumption, DNA and RNA synthesis, cell transcription in the synthesis of somatomedin-C, alkaline phosphatase, collagen, oesteocalcin and participating in protein, lipid and carbohydrate metabolism. It was further, confirmed that, adequate dietary level of Zn is essential for optimizing growth [8], reproduction [9, 10], strengthening the immune system [11, 12] and maintaining general health [8, 13]. Berger (2002) [14] also attributed the beneficial effect of Zn and Cu in promoting growth to the stimulatory affect of gustin and carbonic anhydrase are Zn dependent enzymes which are required for development of the taste buds which may enhance the feed consumption ,their assimilation in the biological system and ultimately causing increase body weight gain . Both Cu and Zn have some antibacterial properties [15] which may also explain the growth promoting effect. However, role of Zn controlling about 1000 enzyme activities [1] may be implicated in growth promoting effect of Zn in pig. Beside antibacterial activity of the Cu it is also essential for hemoglobin synthesis and therefore responsible for continuous supply of O_2 and removal of CO_2 to and from the cells at optimum level.

Present experiment also revealed that additional supplementation of phytase further significantly ($p<0.05$) increased the BWG. Earlier workers [16-18] also demonstrated that supplemental phytase resulted in improvements of BWG and ADG. This might be due to the fact that, supplementation of phytase offers intensifying opportunity for bioavailability of minerals like phosphorus (P), calcium (Ca), magnesium(Mg), manganese (Mn), zinc (Zn), copper (Cu) and iron (Fe) from the dietary source besides protein. The main storage form of P in seed is phytate (the salt of phytic acid) which reduce the P utilization in pig. Under normal physiological condition phytate is a negatively charged ion i.e. able to bind cations like Ca, Mg, Zn, and protein [19, 20]. Supplementation of phytase in the diet hydrolyzes the ortho- phosphate group from phytate more efficiently resulting the liberation of phytate bound nutrients and the net result is the greater bioavailability of P, Ca, Mg, Mn, Zn, Cu, Fe and dietary proteins [21] which might have accerelarated the growth process, participating in various biochemical processes of the body systems.

The FCE (Mean ± SE) was 3.498 ± 0.094, 3.046 ± 0.036, 2.971 ± 0.080, 2.839 ± 0.046, 2.773 ± 0.039 and 2.593 ± 0.037 in A1, A2, B1, B2, C1 and C2 group respectively. The best FCE was recorded in C2 group followed by C1, B2, B1, A2 and A1 group **[Figure-2].** Pig is known as excellent converter of feed when compared to other livestock species. However optimization of FCE depends on the interaction of different macro and micro nutrients. Therefore strategic nutrient intervention is essential for better FCE which was supported by the higher BWG and ADG. Many earlier workers [22-24] have reported that, Zn supplementation with different dose level, age group and periods leads to improve the FCE in pig and was in agreement with the present findings. Present finding is also in agreement with improved FCE when pigs were supplemented with phytase [25-27].

[V] CONCLUSION

The present study established that Zn:Cu plays a significant role in growth and addition of phytase may reduced the supplemental level of Zn:Cu in the feed. Since cost of phytase is higher, rather a higher level of zinc can be incorporated. It was also established that 200ppm of Zinc along with 500U phytase or 300ppm of Zinc in the diet of pig showed higher growth and better FCE. Therefore, to enhanced the growth performances the dietary level of Zn must be higher than 100ppm (NRC recommended) particularly in the agroclimatic zones of Northeastern region in India

FINANCIAL DISCLOSURE

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CONFLICT OF INTERESTS

The authors declare no competing interest in relation to work.

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