ROLE OF ZINC AND COPPER IN GROWTH PERFORMANCE OF WEANING PIGLETS

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ABSTRACT

Trace mineral supplementation in newly weaned piglets is essential for efficient growth performance. The present experiment was designed to validate the role of zinc and copper during the growing period. A total of fifteen weaned piglets (10.60 ± 0.345 kg body weight; 60 days of age) were divided into three equal groups and were supplemented with 100ppm zinc and 10ppm copper (group A), 200ppm zinc and 20ppm copper (group B) and 300ppm zinc and 30ppm copper (group C) for a period of 4 months. The BWG, ADG and FCR improved significantly (p< 0.01) in groups B and C. Histologically, increase in intestinal thickness, duodenal gland size, hyperplasia and hypertrophy of goblet cells, villi height, crypt depth and peyer patches were observed in group B and C than the corresponding group A. The present study established that above 100 ppm Zn and10 ppm Cu enhanced the growth performances of pigs.

Key words: Copper, Growth, Pig, Zinc.

INTRODUCTION

Zinc plays a significant role in pig production as it regulates 1000 metallo-enzymes Pallauf (2005) that are essential for various biochemical processes in the body. The role of zinc in cellular utilization of oxygen, maintenance of cell membrane integrity and sequestration of the free radicals (Chang et al, 1998), cell proliferation (Mac Donald, 2000) synthesis and repair of DNA (Chesters et al., 1990), RNA (Blanchard and Cousins, 1996) and protein (Hicks and Wallwork, 1987) indicates its importance in the biological system. Copper being the second essential trace mineral after zinc is known to be a component of large number of metallo enzymes. Therefore, it is highly accountable in respect of growth, bone development and reproduction (Underwood and Shuttle, 1999). 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 performance of piglets but, the ratio to Zn and Cu has been kept same i.e. 10 to 1 in all the three treatment groups. 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 farrowing interval. Therefore, the present experiment was designed to establish a suitable dose level of Zn and Cu for optimizing productive performances in the weaning piglets of North Eastern Region (NEH).

MATERIALS AND METHODS

The animal experimentation was conducted at ICAR Research Complex for North Eastern Hill Region, Umiam, Barapani, Meghalaya and all the laboratory work was done in the Department of Veterinary Physiology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati. A total of fifteen weaned piglets (10.60 ± 0.345 kg body weight; 60 days of age) were divided into three equal groups and were supplemented with 100ppm zinc and 10ppm copper (group A), 200ppm zinc and 20ppm copper (group B) and 300ppm zinc and 30ppm copper (group C) for a period of 4 months. In all the groups equal

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amount of feed was provided and left over was recorded prior to next feeding. Body weights of the experimental piglets were recorded from 2 months of age at fortnightly interval until attainment of 6 months of age before feeding. The body weight gain (BWG), average body weight gain (ADG) were recorded and feed conversion efficiency (FCE) was calculated. The pigs were slaughtered at 4 months of experimental feeding. Three portions of the small intestine were collected i.e. duodenum, jejunum and ileum. All the tissue sections were processed and stained by the method described by Dellfield as stated by Luna (1968).

**RESULTS AND DISCUSSION**

The BWG and ADG in three treatment groups are presented in Table-1. Higher BWG and ADG was recorded when the supplemental dietary level of Zn: Cu was increased from 100:10 ppm to 300:30 ppm. At 6 months of age, highest BWG (54.00 ± 0.500 kg) and ADG (0.459 ± 0.046) was recorded in group C and lowest BWG (45.00 ± 0.873 kg) and ADG (0.373 ± 0.026) was observed in group A. Results of the present study clearly indicated that growth performance of the piglets was improved when supplemented with more than 100 ppm of dietary levels of zinc in group B and group C. Earlier studies also indicated that pigs performed well when the dietary Zn level was more than 100 ppm (Heugten et al., 2003; Martinez et al., 2004). The significantly higher Fe content in soil and water of the NER might have reduced the bioavailability of Zn, resulting in higher demand of supplemental Zn in the diet (Sarmah, 2010). Berger (2002) reported beneficial effects of Zn and Cu in promoting growth to the stimulatory affect of gustin and carbonic anhydrase are Zn dependent enzymes causing increase body weight gain. Zn and Cu also have some antibacterial properties (Oatway et al., 2001) which may also explain the growth promoting effect. Beside antibacterial activity Cu is also essential for hemoglobin synthesis and therefore responsible for continuous supply of O₂ and removal of CO₂ to and from the cells. Nato et al. (1995) 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 (Azizzadeh et al., 2005), reproduction (Anderson, 1993; White, 1993), strengthening the immune system (Pamela et al., 2004; Shinde et al., 2006) and maintaining general health (Azizzadeh et al., 2005; Chauhan et al., 2006).

The total feed intake and FCE (Mean ± SE) were 120.33 ± 0.85 kg and 3.49 ± 0.09; 120.32 ± 0.52 kg and 2.97 ± 0.08; 120.53 ± 0.23 kg and 2.78 ± 0.04 in A, B, C groups respectively. The best FCE was recorded in C group followed by B and A group (Fig. 1.). 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 (Heugte et al., 2003; Xilong et al., 2006) has reported that, Zn supplementation at higher dose level led to improve the FCE in pig and was in agreement with the present findings.

Histological studies of the duodenum at 6 months of age revealed that, the Duodenal (Brunner’s) glands in A group are in patches and scattered but, not in a continuous pattern (Fig. 2.a) whereas, in B (Fig. 2.b) and C (Fig. 2.c) the duodenal glands are in continuous pattern and the thickness increased along with increased supplemental level of Zn:Cu. The duodenal glands secrete the digestive enzymes along with mucus. Zinc supplementation increases the enzymes secretion by hyperactive duodenal glands, thereby causing hyperplasia and hypertrophy of the duodenal glands.

In group A (Fig. 4.a) the payer patches were relatively less and scattered in the submucosal layer of ileum whereas, in B (Fig 4.b.) the payer patches increased as the supplemental level of Zn: Cu increased. In group C (Fig. 4.c) the payer patches were in the form of tree like structure. The number of payer patches increased along with increased supplemental level of Zn: Cu. Payer Patches were the first line of defense in the body and zinc helps to provide immunity to the body (Pamela et al., 2004) and maintaining general health (Azizzadeh et al., 2005).
The number of the goblet cells (Fig. 2, 3 and 4) increased as the dose rate of the Zn:Cu increased. The Physiological function of the Goblet cell is to secrete mucus. Zinc is known as a potent regulator of mucin gene expression in the small intestine (Blanchard and Cousins, 1996; Mack et al., 2003). Subsequently, the growth promoting effect of Zn and Cu have been attributed to effect on healthy intestinal microflora (Hojberg et al., 2005).

In duodenum, jejunum and ileum the thickness of the mucosa layer and the villi height increased as the dose rate of Zn:Cu increased. Supplementing Zn in starter diets increased the villus height (Payne et al., 2006). Like Zn, Cu also influenced the physiological activities of the small intestine. Histologically, it was reported that supplementation of additional Cu in the diet resulted in the increased crypt depth of the small intestine as recorded in the histological sections (Shurson et al., 1990). Crypt depth is the indicator of cell proliferation, and less energy may thus be spent on cell renewal in pigs fed high copper (Hedemann et al., 2006).

**CONCLUSION**

The present study established that Zn:Cu plays a significant role in growth by modulating the intestinal histology. Therefore, to enhance the growth performance the dietary level of Zn and Cu is recommended to be 300ppm and 30 ppm respectively particularly in the agro climatic zones of Northeastern region in India.

**REFERENCES**


Sarmah, B.C (2010). Annual Report, AICRP on “Improvement of Feed Resources and Nutrient Utilization in Raising Animal Production” ICAR.


