EFFECT OF DIETARY ZINC SUPPLEMENTATION ON THE PRODUCTIVE PERFORMANCES, CARCASS TRAITS AND BLOOD PROFILE OF BROILER

A THESIS

BY

MD. FIROJUL ISLAM
Registration No. 1505036
Session: 2015-2016
Semester: July-December, 2016

MASTER OF SCIENCE (M S)

IN

ANIMAL NUTRITION

DEPARTMENT OF GENERAL ANIMAL SCIENCE AND NUTRITION
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY
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[Submitted to the Department of General Animal Science and Nutrition, Faculty of Veterinary and Animal Science, Hajee Mohammad Danesh Science and Technology University, Dinajpur for partial fulfillment of the requirement of the degree]

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DEPARTMENT OF GENERAL ANIMAL SCIENCE AND NUTRITION
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December, 2016

Dedicated to..........

My father who insisted me the value of my education and my mother whose unending love and sacrifices inspired and encouraged me.

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The Author

ABSTRACT

This study was conducted to determine the effect of zinc on the productive performances, carcass yield and blood profiles of broilers. Experiment was done for a period of 35 days with a number of 60 day old broiler chicks. Birds were divided into four dietary treatment groups with 3 replications each having 5 birds per replication. The dietary treatment groups were; T_0 (basal diet; no zinc), T_1 (basal diet + 50 mg zinc/kg feed), T_2 (basal diet + 100 mg zinc/kg feed), T_3 (basal diet + 150 mg zinc/kg feed). Results indicated that body weight and body weight gain were increased significantly ($P<0.05$) in the zinc supplemented group compared to the control group. Higher ($P<0.05$) feed intake and better ($P<0.05$) FE were also observed in the zinc supplemented group than control group and best performance was observed in the group fed 150mg zinc/kg feed (T_3). Carcass yield was significantly higher ($P<0.05$) in the groups fed dietary zinc. Net profit was slightly higher in the T_3 group but not significantly (P.0.05) differed with the control group. However, T_1 and T_2 showed less profit even than the control group. Blood profile of the experimental birds including Hb, PCV and ESR did not significantly differed ($P>0.05$) among the groups. The results indicate that addition of zinc in the broiler diet improves productive performances, carcass yield and increases net profit without affecting health status of broiler. So, zinc can be used as an effective and useful micronutrient to improve the performances of broiler.

Key words: Zinc, Productive performances, Carcass yield, Blood profile, Net profit and Broiler.

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INTRODUCTION

CHAPTER I

INTRODUCTION

Poultry sector is one of the most emerging and feasible sector for Bangladesh. Poultry industry can contribute to the GDP growth rate by managing food security as well as ensuring employment and reducing poverty at a large scale. Large proportion of daily human intake of animal protein comes from livestock products. Poultry industry provides quality protein to the people of Bangladesh at the lowest price. Poultry meat especially chicken meat is the most desirable animal protein and is acceptable to most of the people belonging to all castes and religions. Per capita requirement for meat in Bangladesh is 120 g meat/day but per capita consumption is only 16.5 day with a deficiency of 50.15% (Amin, 2015). The availability is quite inadequate for normal growth and development of the body. Whereas, world per capita consumption of poultry meat is 30.14 g /day, which is 95.89 g/day for USA (Farrell *et al.*, 2003). Per capita meat consumption in Bangladesh was 5.1, 5.2 and 5.3 kg for the years 2008-2009, 2010-2011 and 2011-2012 respectively (BBS, 2012).

Broiler is one of the most important poultry used for fulfilling the protein demand. The broiler industry in Bangladesh is developing rapidly and its success depends on how rapidly a chick attains maximum marketable weight. Broiler raisers are always interested to different approaches for attaining better growth and economic production. Unfortunately, farmers are using antibiotics with broiler feed to improve growth and feed efficiency, which adversely affects on human health. Antibiotics used as growth promoters tend to be given in feed at sub-therapeutic levels over extended periods to entire herds and flocks. Until recently, the major concerns about incorporation of antibiotics in animal feeds related to antibiotic residues in products from treated animals. Now there is mounting evidence that the antibiotics are widely used on farm animals are also diminishing the power of important antibiotics to help people. As a result, each and every chicken is becoming a depot of antibiotics and other inorganic substances. When these chickens are consumed by human these antibiotic and other inorganic residue enters into human body and causes serious human health hazards with drug resistance (Kibria *et al.*, 2009). For this reason European Union has banned regulation the use of antibiotics in animal production from 2006 and its use has become limited in other developed countries.

Due to the ban of antibiotic growth promoters in poultry diets in different countries, it is of high interest to investigate potential alternatives to maintain good growth performance of broilers.

Zinc (Zn) is the essential trace element for growth, enzyme structure and function, appetite, normal immune function, maintenance and with particular importance for fast-growing of poultry. Trace mineral, such as Zn is essential for broiler growth and are involved in many digestive, physiological, and biosynthetic processes within the body .It function primarily as catalysts in enzyme systems within cells or as parts of enzymes. It is the also constituents of hundreds of proteins involved in intermediary metabolism, hormone secretion pathways, and immune defense systems (Dozier *et al.*, 2003). Traditionally, these trace minerals are supplemented in the form of inorganic salts; such as sulfates, oxides, and carbonates, to provide levels of minerals that prevent clinical deficiencies, allow the bird to reach its genetic growth potential, or both.

Zinc plays multiple roles in poultry metabolism. At low concentrations, it serves as an essential nutrient and functions as a metal cofactor for several enzymes. Zinc also appears to be directly involved in immune cellular functions and zinc deficiencies might also have indirect consequences on the immune system by failure to limit bacterial infections. Zinc can be taken up by biological systems, and bacterial transport and efflux systems have been identified that are energy dependent and highly regulated. Intestinal uptake is carrier-mediated facilitated diffusion and the mechanism is not well understood. Zinc uptake is also influenced by the form because it is fed some forms that are less bioavailable. High concentrations of zinc are relatively nontoxic (Park *et al.*, 2004).

A few researches showed that supplemental Zn could improve carcass traits of animal. Organic Zn could increase carcass quality grade, marbling, and the fat of pelvis and heart in animals (Greene *et al.*, 1988). Zinc consumption also increase body weight of chicken and increase in abdominal fat deposit in female chickens (Butler and Curtis, 1973). Zinc has numerous biological roles including protein metabolism (Blamberg *et al.*, 1984), DNA synthesis (Lieberman *et al.*, 2001), cell division and multiplication (Rubin, 1972 and Rubin and Koide, 1973) Zinc has also roles in the cell mediated immune response (Fraker, 1977 and Bertuzzi, 1998) and performance (Sadoval *et al.*, 1999), carbohydrate metabolism, and basic functions in growth performance (Mohanna, 1999). Zinc boost immune system (Luecke *et al.*, 2001) and it is the only metal essential for at least one enzyme in all six enzyme classes; Oxidoreductase (4 enzymes), transferase (3 enzymes), hydrolase (3 enzymes), ligase (one enzyme), isomerase (one enzyme) as well as ligase (one enzyme) (Kidd *et al*., 1996). As zinc has a direct effect on improving body condition of broiler present study was conducted by using Zis-Vet® that contains zinc sulphate monohydrate.

Despite enormous advances in poultry production and technology, research into trace mineral nutrition has lagged behind than other areas of nutrition. Although zinc has a lot of feasibility to be used as a harmless trace mineral as well as growth promoter for broiler a very few number of researches have been conducted to see the effect of different level of zinc on the broiler diet and there has not been any definite conclusion was drawn regarding its effect on broiler productive performances as well as on their carcass traits. Therefore was conducted with the following objectives-

- To know the effect of dietary zinc on the productive performances of broiler.
- To know the effect of dietary zinc on the carcass traits and blood profile of broiler.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

Zn is an essential trace element for all organisms (Bannister *et al.,* 1971). It is an important micro-nutrient and takes part in a wide variety of metabolic processes by virtue of its diverse catalytic roles in over 200 enzymes (Falchuk and Vallee, 1985). Its deficiency arrests cell proliferation and results in abnormal differentiation. Some researchers reported the supply of zinc on feed conversion, feed intake, immunity and such other concluded in different ways also. This chapter focuses on some of the findings of the research conducted in different parts of the world on use of zinc on the broiler birds.

2.1 Zinc biochemistry

Zinc is ubiquitous in all living organisms and acts both structurally and catalytically in metalloenzymes (Del *et al*., 1992*).* Zinc metalloenzymes are recognized in all six enzyme types, which include oxidoreductase (catalyzing oxidoreductions between two substrates), transferase (catalyzing transfer of a group other than hydrogen), hydrolase (catalyzing hydrolysis of esters, ether, peptide, glycosyl, acid anhydride, C–C, C–halide, or P–N bonds), lyase (catalyzing removal of groups from substrates by mechanisms other than hydrolysis, leaving double bonds), isomerase (catalyzing inter conversion of optical, geometric, or positional isomers), and ligase (catalyzing the linking together of two components coupled to the breaking of a pyrophosphate bond in ATP or a similar compound) (Keilin *et al*., 1940). Carbonic anhydrase plays a role in the transport of carbon dioxide from tissues to lungs and the zinc component is responsible for coordinating three imidazole groups (Keilin *et al*., 1940; Österberg *et al*., 1983). Superoxide dismutase plays an important role in protecting cells and tissue from damage by superoxide radical ($2O_2^- + 2H^+ \rightarrow O_2 + H_2O_2$) (Bannister *et al*., 1971; McCord *et al.,* 1971). Alcohol dehydrogenases catalyze the oxidation of ethanol, vitamin A, alcohol, and steroids using NAD as a cofactor and the reduction of aldehydes and ketones in the presence of NADH ($CH_3CH_2OH + NAD \rightarrow CH_3CHO + NADH + H^+$) (Vallee *et al.,* 1955; von Wartburg *et al*., 1964). Each subunit of this enzyme contains two zinc atoms and binds one molecule of NAD (H). One zinc atom is essential for the catalytic activity and the other atom is involved in stabilizing the polymeric structure (Drum *et al*., 1967). The catalytic zinc atom is liganded in tetrahedral geometryto two cysteinyl sulfurs, the imidazole group of histidine, and a watermolecule (Riordan *et al*., 1976).

2.2 Zinc in poultry nutrition

Zinc is a trace element that is necessary for normal growth and maintenance and includes among other functions bone development, feathering, enzyme structure and function, and appetite regulation for all avian species (Batal *et al*., 2001). Zinc at 0.012–0.018% on a total-weight basis is commonly added as a supplement to all formulated poultry diets (Batal *et al*., 2001; Leeson *et al*., 1997). Currently, there are two inorganic feed-grade zinc sources commercially used by the poultry feed industry (1997) (Batal *et al*., 2001; Wedekind *et al*., 1990): zinc oxide (ZnO: 72% Zn) and zinc sulfate monohydrate ($ZnSO_4$•H_2O: 36% Zn). Of the supplemental zinc feed, 80–90% is ZnO, which is less bioavailable for poultry than reagent-grade or feed-grade Zn sulfate (Sandoval *et al*., 1997; Fosmire *et al.,* 1990). However, the sulfate (acid salt) is highly water soluble, allowing reactive metal ions to promote free-radical formation, which can facilitate reactions that lead to the breakdown of vitamins and ultimately to the degradation of fats and oils, decreasing the nutrient value of the diet (Batal *et al.,* 2001). Oxide is less reactive, but also less bio-available (Batal *et al*., 2001). Dietary zinc is relatively nontoxic to animals and humans; both exhibit considerable tolerance to high intakes of zinc (Fosmire *et al*., 1990). However, high levels of zinc in the diet can result in reduced growth rates in chicks (Dewar *et al.,* 1983), lesions of the gizzard and pancreas in laying hens (Dewar *et al*., 1983), high mortality in chicks (Hermayer *et al.,* 1977), and reduced feed intake and egg production in laying hens (Cox *et al*., 1960). Zinc toxicity is responsive to supplemental copper, and both iron and zinc interfere with copper and iron metabolism (Cox *et al.,* 1960; Rama *et al*., 1981). Two-tenths of 1% zinc fed to chicks caused reduced tissue iron and copper concentrations (Stahl *et al*., 1989). Although zinc interferes with iron metabolism in chicks, iron-deficient chicks are more susceptible to the effects of zinc toxicity than are iron adequate chick. This is because iron might induce the synthesis of metallothione in the liver (Cormick *et al*., 1984). Metallothionein is a nonspecific metal buffering ligand to sequester or displace zinc from normal sites (Richards *et al.,* 1975).

2.3 Effect of zinc supplementation on growth performance of broiler

Ezzati *et al*. (2013) conducted a study on 200 Ross-308 broilers divided in 5dietary and supplemental groups. In group1, 2, 3 and 4: 50, 75, 100 and 125 ppm Zinc, respectively for two weeks. In group5: was mentioned as a control group. This study was performed in 42 days period and concluded that Dietary Zn significantly affected daily body weight gain of broiler birds.

Abhishek *et al*. (2016) reported the lowest live weight of birds in control group then the other 4 treatment groups which are treated with different form of zinc sulfate prove that zinc sulfate is essential for growth. The authors reported with an irrespective source of zinc sulfate has a significant effect on increase in live weight in groups fed with 80 mg/ kg from 21-45 days of age.

Lai *et al*. (2010) conducted an experiment aimed to investigate the effects of dietary zinc (Zn) on growth, feathering score and mineral composition of broilers. A total of 256 d-old Avian male broiler chicks were randomly allocated to a 4×2 factorial arrangement with four corn-soybean meal basal diets (containing 44 mg Zn/kg) supplemented with 0, 40, 60 mg/kg Zn and non-Zn supplementation. All birds were given feathering coverage scores for back, breast, wing, under-wing and tail. The wing and tail were further evaluated for the occurrence and severity of defect feathers. Feathers were then pooled for mineral composition analysis. The results showed that in high temperature conditions, broilers fed Zn-un supplemented, 0.8% Ca ration (Diet 1) had significantly ($P<0.05$) lower ADFI and ADG (wk. 1-6) than birds under low temperature conditions. However, when the birds were fed 40 and 60 mg/kg Zn supplementation (Diets 2 and 3), the ADFI and ADG in both temperature conditions were not significantly different. In low temperature conditions, the ADFI, ADG ($P<0.05$), all feather coverage ($P<0.01$) and tail defect scores ($P<0.001$) of birds fed Diet 4 (excess Ca) were significantly poorer than those fed Diet 1.

Mohanna and Nys (1999) reported that up to 25 mg/kg of zinc sulfate supplementation on diet has the effect to increase the live weight and feed intake. But another author reported that diet with supplementation of copper sulfate at the rate of 350 mg/kg leads to significant decrease in live weight gain as well as reduced the production performance of broiler. The authors stated that due to nutrient absorption decreased in gastro-intestinal tracts, the performance was reduced (Zia-Ur-Rahman and Akhtar, 2001).

Liu *et al*. (2012) conducted a study to investigate the effects of dietary supplemental Zn on growth performance, carcass traits, and meat quality of broilers. Dietary treatments included the corn–soybean meal-based diet (control) and the basal diet supplemented with 60, 120, or 180 mg of Zn/kg as ZnSO4, Zn amino acid A, Zn proteinate B, or Zn proteinate A. The results showed that birds fed diets supplemented with Zn had higher average daily weight gain. ADFI, ADG.

The effect of supplementing diets with zinc on growth performance and carcass quality of broiler chickens were investigated by Sahin *et al.* (2005). A total of 3,200 day old broiler chicks assigned to 4 dietary groups. A corn, wheat, soybean meal basal diet was control and supplements zinc at the rate of 20 ppm, 40 ppm and 80 ppm were added to the basal diet to form 4 dietary treatments. During the 5 weeks of experimental period, feed and water were provided ad libitum. Body weight, feed intake, feed conversion and mortality were measured. They found that dietary zinc does not affect growth performance of broilers but increasing level increased the survivability of broilers.

2.4 Effect of zinc on feed intake of broilers

Dardenne and Bach (1993) found that as birds became zinc deficient their eating behavior changed. It is hypothesized that the reduction in enzyme activity leads to the accumulation of one or more metabolites causing a marked change in eating behavior. Liu *et al*. (2012) reported that zinc supplementation significantly increases the feed intake of birds. Mohanna and Nys (1999) reported that up to 25 mg/kg of zinc sulfate supplementation on diet has the effect to increase feed intake. Anil *et al*. (2012) concluded as the supplementation of zinc in the form of inorganic and organic at 20, 40, 60, 80 mg/kg of diet did not influence much with regard to the feed intake.

Chester and Katouli (1999) reported that broiler at which zinc- deficient respond to zinc supplementation is amazing. *Kennedy et al.* (1998) stated that reduced appetite is one of the first zinc deficiency signs observed in broilers, in broilers, zinc deficiency often reduces feed intake by 30%.Zinc deficient broiler change their dietary preferences; avoid carbohydrates and seek protein and fat Key enzymes required for carbohydrate metabolism may be lacking because the zinc dependent messenger RNA is needed to synthesize these enzymes has reduced expression. Salabi *et al.* (2011) found improves feed intake when they added zinc sulfate at the level of 90 mg/kg of diet. The authors also suggest that the requirement for early chick growth is satisfied when chicks are fed diets containing 40 mg of zinc sulfate per kg as recommended by the (NRC, 1994).

2.5 Effect of zinc on meat yield of broiler

Sarvari *et al.* (2015) conducted an experiment to evaluate the effect of different dietary supplementation levels of zinc oxide and of an organic acid blend on broiler performance, carcass traits, and serum parameters. They used a total of 2400 one-day-old male Ross 308 broiler chicks, with average initial body weight 44.21±0.19g, was distributed according to a completely randomized design in a 2 x 3 factorial arrangement. Six treatments, consisting of diets containing two zinc oxide levels (0 and 0.01% of the diet) and three organic acids blend levels (0, 0.15, and 0.30%) wereapplied, with eight replicates of 50 birds each. They found that there were significant performance differences among birds fed the different zinc oxide and organic acid blend levels until 42 d of age ($P<0.01$). The organic acid blend reduced serum cholesterol and triglyceride levels ($P<0.05$). No interactions were found between zinc oxide and the organic acid blend for none of the evaluated parameter. Carcass traits were not influenced by the experimental supplements. Zinc oxide supplementation increased serum alkaline phosphatase level ($P<0.01$). Kidd *et al.* (1993) reported that zinc influence the meat yield of broilers. Sanford, (1976) reported that the incorporation of Zinc methionine complex and Zinc-amino acids complex into standard dietary formulation improved broiler growth, reduce mortality, improved breast meat yield and reduced skin lesions. An in-depth study was undertaken by Quarles *et al.* (1997) to assess the effect of Zincmethionine complex to improve breast meat yield and zinc-amino acids complex had remarkable potentiality to improve the meat yield.

2.6 Effects of zinc on feed efficiency of broiler

Mansoub *et al.* (1987) reported that zinc supplementation significantly decreases the FCR of broiler birds. Broilers assigned to Zn Met supplemented diets improved feed conversion. It appeared that the better feed conversion appeared when broilers took zinc for a long time. The essential amino acids lysine, methionine, and cystine incorporation with zinc stimulated feather and feed conversion in broiler (Rojas *et al.,* 1995). Major nutrients such as protein, many vitamins and trace elements are essential for muscle growth. Zinc functions directly in the process of feather growth; thus, Zn deficiencies can seriously affect feather growth (Saenmahayak *et al.,* 2007). Higher bioavailability of organic zinc sources may supply zinc and essential amino acids (Met and Lys) requirements for rapid feathering and, in turn, decrease maintenance requirements because of insulating action of feathers. The lack of improvement in feed conversion efficiency by dietary inclusion of organic zinc sources may be due to the higher feed consumption from organic zinc- supplemented diets. Sandoval *et al*. (1998) observed that feed conversion from day 15 through day 21 was not affected by the dosing method or Zn source. It appeared that Zn contained in non-supplemented control diet not sufficient for proper body function, while exceeded levels of added zinc are not also needed for body growth. Dietary zinc source tended to affect feed conversion of broiler.

Increasing Zn level improved breast meat percentage. Midilli *et al.* (2014) found an increasing feed efficiency while they supplied inorganic and organic form of zinc alone or combination with microbial phytase.

Dukic *et al.* (2015) treated broilers with inorganic and organic form of zinc and found no significant difference in finisher and feed efficiency in whole 6 period of experiment.

Henry *et al.* (1987) reported that dietary inclusion of organic zinc caused to favor breast meat yield and carcass efficiency and they also suggested that Zn-Met and Cu-Lys complexes are essential for survivability of broilers and also responsible for maintaining optimum feed conversion.

2.7 Effect of zinc on digestibility of feed

Apart from indigestible trace minerals and cell abrasion, the excreta mainly contain excess trace minerals which cannot be absorbed (Underwood and Suttle, 1996). The apparent absorption of Mn and Zn based on excreta does not provide a suitable measurement of the bioavailability of trace minerals (Ammerman, 1995). Most study on organic trace minerals for broilers have used conventional diets, tending to exceed the bird’s requirement (Lee and Paik, 2001) and a negative digestibility of trace minerals. However, using a special control diet (Bao *et al.,* 2007), deficient in, Mn and Zn, may provide a means for determining the digestibility of trace minerals in different parts of the gastro-intestinal tract (GIT) as it becomes possible to avoid trace mineral excess in the GIT. Thus, it was concluded that zinc has a strong effect on digestibility of feed.

2.8 Effect of zinc on blood parameters

Daraji *et al.* (2011) conducted a study to evaluate the effect of zinc as feed additive on some the blood plasma traits of males and females of broiler breeder chickens. A total 132 (96 females and 36 males) of Cobb 500 broiler breeder chickens, 45 weeks old were used in this study. These birds were randomly distributed into four dietary treatment groups with three replicates each. Each treatment group constituted of 24 females and 9 males. Treatment groups were as following: T_1: Birds fed the basal diet without any addition of zinc (0 Zn) (Control), T_2: Birds fed diet supplemented with 50 mg Zn (pure zinc) /kg of diet, T3: Birds fed diet supplemented with 75 mg Zn (pure zinc)/kg of diet and T4: Birds fed diet supplemented with 100 mg Zn (pure zinc) / kg of diet. Results indicated that dietary zinc supplementation (T_2, T_3 and T_4) resulted in significant (P<0.05) increase in blood plasma cholesterol, protein, calcium and phosphorus concentration and Alkaline Phosphatase (ALP) activity in broiler breeders males and females during 58 and 66 weeks of age and as regards the total means of these traits as compared with control group (T_1). However, adding different levels of zinc to the diet (T_2, T_3 and T_4) resulted in significant (P<0.05) increase in blood plasma glucose in broiler breeders males and females during 54, 58, 62 and 66 weeks of age and concerning the total mean of this trait. In conclusion, supplementing the diet of broiler breeder chickens with zinc caused significant increase in blood plasma traits included in this study.

2.9 Zinc and immunity

Sajadifar *et al.* (2011) performed a study to evaluate the high levels of zinc can improve different aspects of broilers' immune system. One hundred and forty- four 1-d old broiler chicks were used in the current study with three dietary zinc (40, 120 and 200 mg/kg). At 2, 22, 32, 42 days of age, the blood serums were tested for antibody titer against Newcastle disease vaccination, using the standard hem agglutination Inhibition test. On day 42 the sum of nitrite and nitrate (based on the reduction of nitrate to nitrite by cadmium) were measured and the weights of spleen and bursa of fabricius were recorded on a relative live weight basis. At 42 d, antibody response of level 200 mg/kg diet was significantly higher than control. Adding levels of 120 and 200 mg Zn/kg diet significantly increased the weight of bursa and spleen respectively (P< 0.05) compared with the control. Also level of 200 mg Zn/kg diet showed the highest amount of nitrite and nitrate in compare with other levels. The use of 200 mg Zn/kg diet in broilers diet could be considered as a natural promoter of cell-mediated immunity. The nutritional–immunological mechanistic relationship between zinc deficiency and immune response has been extensively examined in humans (Fraker *et al.,* 1993). The effects of zinc supplementation on the poultry immune system and infectious disease resistance have not been thoroughly studied although zinc nutrition has been identified with changes in immune system responses and implicated in infectious disease resistance. In particular, zinc-methionine, (Zn-Met) and cellular poultry immunity have been studied. Zn-Met is more bioavailable than Zn-Sul (sulfate) and Zn-O when fed to chicks in corn–soybean diets (Kidd *et al*., 1996). Dietary Zn-Met supplementation (80 mg/kg for old broilers and 40 mg/kg for young broilers) in the broiler diet improves immunity in the progeny of old (Kidd *et al*., 1992) and young broiler breeders (Anthony *et al*., 1993). The nonspecific cellular immunity of the progeny can be enhanced as a result of Zn-Met sup-plementation (Kidd *et al*., 1993; Anthony *et al*., 1993). Antibody responses to Salmonella pullorum were not different between Zn-Met and Zn-O supplementation (Kidd *et al*., 1993). Zn-Met supplementation enhances in vitro macrophage phagocytosis of Salmonella enteritidisin young turkeys (Kidd *et al.,* 1994). Dietary Zn-Met supplementation in the turkey diet increases activity of macrophage phagocytosis in young turkeys (Ferket *et al*., 1994). Dietary Zn-Met supplementation (40 or 80 mg/kg) in the layer diet improves survival of E. coli challenged in old laying hens (Flinchum *et al*., 1989).

CHAPTER III

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

3.1 Experimental site and birds

This experiment was conducted with 60 day old (Cobb 500) broilers for a period of 35 days (from 7th May to 10th June, 2016) at the commercial poultry farm of Mr. Mostakim, Karnai, Baserhat, Dinajpur. The aim was to investigate the effect of supplying different level of zinc with the feed to improve the production performances of broilers.

Photo 1. Experimental birds before start of the experiment

3.2 Experimental preparation

Zinc solution used in this experiment was purchased from local market named Zinc-Vet® (1ml solution contain 2mg zinc sulphate monohydrate USP) which was manufactured and marketed by Navana Bangladesh, Anmal health division (a reputed veterinary drugs company), Bangladesh. For the free of cost support, experimental solution was collected from Navana Bangladesh, Anmal health division.

3.3 Experimental layout

The day old broilers were randomly assigned into 4 dietary treatment groups having 3 replications in each treatment. The treatments were 0, 50, 100 and 150 mg zinc in each kg of feed. There were 5 broilers in each replication. The layout of the experiment is presented in Table 1.

Table 1. Layout showing the distribution of broilers to treatments and replications

Replication	Zinc level (mg/kg feed)				Total
	0 (T_0)	50 (T_1)	100 (T_2)	150 (T_3)	
1	5	5	5	5	20
2	5	5	5	5	20
3	5	5	5	5	20
Total	15	15	15	15	60

Photo 2. Birds separated in four dietary treatment group

3.4 General management

3.4.1 Preparation of the experimental house and equipment

Experimental house was divided into 4 parts for four dietary treatment group and each part was subdivided with three parts to facilitate the accommodation of 5 birds in each sub group. Afterr15 days the room was disinfected with PPM solution. The experimental room was thoroughly brushed, swiped and properly washed by water after that bleaching powder @ 1kg/500sq.ft was spread over the floor and it was kept 24 hours without any further attention. The bleaching powder was cleaned by using forced tap water. After that the room was disinfected by TH4+ solution (Manufactured by Sogeval, France, Marketed by-Century Agro Ltd, Bangladesh). Feeders, waterers, buckets and all other necessary equipments were also properly, washed and disinfected by TH4+ solution. Subsequently dried them and left empty for a week before arrival of chicks. Fresh dried sow dust was used as litter at a depth of 2 cm. All birds were reared under same care and management.

3.4.2 Feed management

For the first seven days the feed was given in paper and then in small trays. After that feed was supplied in the round feeder. Zinc solution was at first taken by the measuring syringe than mixed with the pellet feed. After mixing the experimental zinc solution to the feed in required amount, feed was supplied to the different group of birds according to their age. Feed was purchased from the Nourish feed company. Feed contains following ingredients-

Table 2. Feed ingredients of the supplied pellet

Ingredient	Amount
Moisture (maximum)	12%
Protein (minimum)	20%
Fiber (maximum)	5%
Calcium (minimum)	o.95%
Phosphorus (minimum)	0.45%
Lysin (minimum)	0.45%
Metheonin (minimum)	1.05%
Metabolic Energy (minimum)	3000 kcal/kg

Phot 3. Mixing of zinc with pellet and giving to the birds.

3.4.3 Water management

All birds were supplied all time with *ad libitum* clean, cool natural drinking water. Water was supplied through the waterer.

3.4.4 Rearing system

Experimental birds were reared under bamboo made floor which was 2 feet above the ground. Feces were passed through the space between the bamboo strides.

3.4.5 Lighting

The birds were exposed to a continuing lighting of 23 hours and 1 hour dark in 24 hours. Supplementary light at night was provided by electric bulb at a height of 2.8 meter to provide necessary lighting.

3.4.6 Brooding management

At the beginning of the first week of age brooding temperature was kept 32 ^{0}C and decreased gradually in subsequent week @2.5 ^{0}C/week until the birds were adjusted to environmental temperature. The broilers were exposed to 23 hours of continuous light and a dark period of 1 hour per day throughout the experimental period. Fresh and dried rice husk was used as a litter at a depth of about 3cm. Floor space given to each broiler was 960cm^2. During 35 days of experimental period, the following parameters were recorded and calculated.

Photo 4. Birds under brooder

3.4.7 Hygiene and sanitation

During the experimental period proper sanitary measures were taken. Foot bath were placed in front of the farm. No visitors were allowed in the farm. Feed wastes and feces were regularly cleaned.

3.4.8 Record keeping

All events of the experiment like amount of feed given, feed leftover, body weight etc. are regularly taken and properly maintained in the record book.

3.5 Measurements and methods of interpreting results-

Different parameters of the experimental bird were calculated by the following way-

3.5.1 Live body weight (LBW)

Birds were individually weighed to the nearest gram in the early morning before providing any food and water at the initial weight and weekly during the experimental period.

Photo 5. Weighing of birds

3.5.2 Live weight gain of birds

It was calculated by using following formula-

$LWGR_X = LWR_X – LWD_0$

Where:

LWD_0 = Initial weight of the birds at the time of start of experiment.

LWD_x = Final weight of the birds at the x time period.

(x = Specific weeks when body weight is calculated)

3.5.3 Feed Intake

Weekly feed intake was taken by deducting the feed leftover.

3.5.4 Feed efficiency (FE)

Feed efficiency was calculated using the following formula (according to Ensmingar, 1980):

$$FE = \frac{\text{Total weight gain (g)/birds during a certain period}}{\text{Feed Consumption (g) / birds during the same period}}$$

3.5.5 Meat yield characteristics

At the end of the experimental period, one broiler weighing average of the pen weight from each replication was selected, slaughtered and dissected. The broilers were dissected and meat was separated from carcass following the procedure of Jones (1984). Records were kept on the weight of dress yield, breast meat, thigh meat, drumstick meat, wing meat, abdominal fat, liver, heart, gizzard, spleen weight, thigh bone, drumstick bone, wing bone, skin, head, neck, shank, feather and blood.

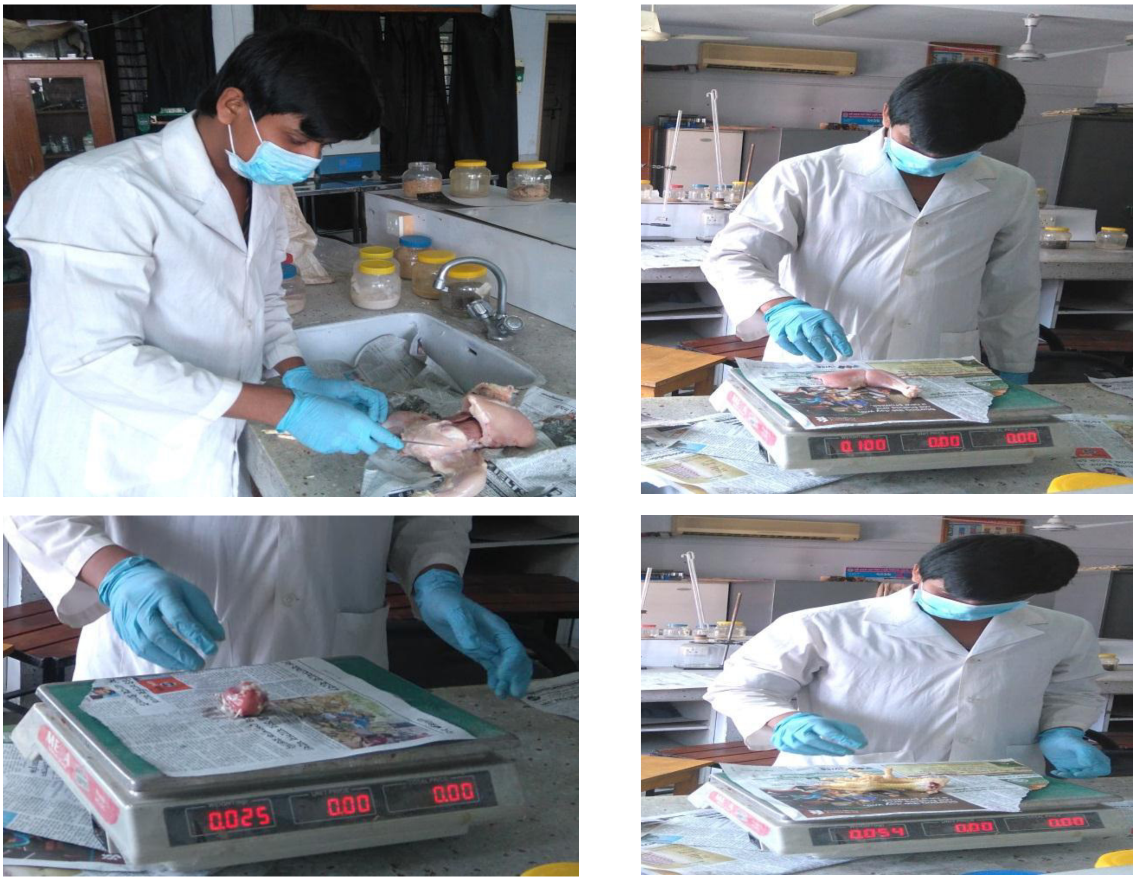

Photo 5. Birds dissecting and determining carcass yield.

3.5.6 Blood parameters

3.5.6.1 Determination of packed cell volume (PCV)

The citrated well mixed blood sample was drawn into special loading pipette (Wintrobe pipette). The tip of the pipette was inserted up to the bottom of a clean, dry Wintrobe hematocrit tube. Then the Wintrobe tube was filled from the bottom by pressing the rubber bulb of the pipette. As blood came out, the pipette was slowly withdrawn but pressure was continued on the rubber bulb of the pipette so as to exclude air bubbles. The tip of the pipette was tried to keep under the rising column of blood to avoid foaming and the tube was filled exactly to the 10 cm mark. Then the Wintrobe hematocrit tube was placed in the centrifuge machine and was centrifuged for 30 minutes at 3000 rpm. Then, the hematocrit or PCV was recorded by reading the graduation mark; the percent volume occupied by the hematocrit was calculated by using the following formula as described by Lamberg and Rothstein (1977).

$$PCV\% = \frac{\text{Height of the red cell volume in cm}}{\text{Height of total blood in cm}} \times 100$$

3.5.6.2 Determination of Hemoglobin Concentration (Hb) %

The N/10 hydrochloric acid was taken in a graduated tube up to 2 marks with the help of a dropper. Well-homogenized blood sample was then drawn into the Sahli pipette up to 20 cm. mark. The tip of the pipette was wiped with sterile cotton and the blood of the pipette was immediately transferred into the graduated tube containing hydrochloric acid. This blood and acid were thoroughly mixed by stirring with a glass stirrer. There was a formation of acid hematinic mixture in the tube by hemolysing red blood cells by the action of hydrochloric acid (HCL). The tube containing acid hematin mixture was kept standing in the comparator for 5 minutes. After that distilled water was added drop by drop. The solution was mixed well with a glass stirrer until the color of the mixture resembled to the standard color of the comparator. The result was read in daylight by observing the height of the liquid in the tube considering the lower meniscus of the liquid column. The result was then expressed in gm %. The above procedure was matched by the Helligehemo meter method as described by Lamberg and Rothstein (1977).

3.5.6.3 Determination of Erythrocyte Sedimentation Rate (ESR):

The fresh anticoagulant blood was taken into the Wintrobe hematocrit tube by using special loading pipette exactly up to 0 marks. Excess blood above the mark was wiped away by sterile cotton. The filled tube was placed vertically undisturbed on the wooden rack for one hour. After one hour the ESR was recorded from the top of the pipette. The result was expressed in mm in 1st hour.

Photo 6. Performing different blood tests

3.6. Statistical analyses

The birds were assigned to different experimental groups under Completely Randomized Design (CRD). The data were analyzed by the Statistical Package for Social Science (SPSS) program. The data were expressed as the mean±SEM and significance level were calculated under 5 % level of significance.

CHAPTER IV

RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Live weight

Live weight of birds during the experimental period is presented in Table 3. Present experiment was started with day old chicks with the average live weight of45±0.19 g. At the 7th day live weight of birds were not significantly differed ($P>0.05$) among the groups but it was significantly ($P<0.05$) differed at the 14th, 21st and 28th day of experimental period where higher live weight was observed in the bird fed 150 mg zinc/ kg of feed than the birds of control group (0 mg Zinc/kg feed). Although birds fed 50 and 100 mg Zinc/kg feed showed higher live weight gain but not significantly differed with the control group. At the end of the experiment significantly higher live weight was observed in the birds fed 100 and 150 mg Zinc/kg feed (1494.3 and 1758.53 g, respectively) than the control group (1376.8 g).

It was nay be due to the critical importance of Zinc in maintaining the structure of metalloproteins such as insulin and growth hormone. Zinc deficiency primarily affects protein metabolism in fast-growing animals (Swinkels *et al*., 1994). Results from the growth performance of this study showed that supplemental Zn promoted growth of broilers. Present findings supports the findings of the Ezzati *et al*. (2013) in which they found supplementation of 125 ppm zinc had a significantly higher live weight (2734 g) than the un-supplemented group (2680 g). Liu *et al.* (2012) also found a significant effect in live weight of broiler birds by supplying different level of zinc. Midilli *et al.* (2014) found increasing live weight, while they supplied inorganic and organic form of zinc alone or combination with microbial phytase. Abhishek *et al.* (2016) reported with a significant effect on increase in live weight in groups fed with 80 mg/ kg of zinc from 21-45 days of age, the author found the lowest live weight of birds in control group then the other 4 treatment groups which prove that zinc was essential for growth. Bartlett and Smith (1998) found that a significant increase in live weight of zinc fed broiler occurs than the control group (1576 g vs 1387 g avg. live weight in birds fed adequate and no zinc). Another author Mohanna and Nys (1999) reported that up to 25 mg/kg of zinc supplementation on diet has the effect to increase the live weight.

Table 3. Live weight of birds fed different level of Zinc

Live weight (g) in different time period	Dietary Treatments*				Level of Significance
	T_0	T_1	T_2	T_3	
0 day (day old)	45±0.12	44.8±0.18	45.1±0.21	45.3±0.16	NS
7th day	203^{a}±1.42	202.5±1.91^{a}	202±2.31^{a}	204±2.57^{a}	NS
14th day	385.8±4.54^{a}	467.4±3.48^{b}	442.7±2.21^{ab}	489.4±2.89^{b}	*
21st day	667.8±6.87^{a}	646.8±4.21^{a}	691.7±4.15^{a}	901.13±0.4^{b}	*
28th day	1078.3±6.18^{a}	1163.6±7.4^{a}	1176.5±1.63^{a}	1439.3±5.35^{b}	*
35th day	1376.8±11.42^{a}	1320.3±7.23^{ab}	1494.3±9.14^{b}	1758.53±6.16^{c}	**

The above values represent the mean ± standard error (SE) of the live weight of broiler in different weeks of the experimental period. Mean values with the same superscripts within the same row are statistically non-significant (P>0.05) and Mean values with the different superscripts within the same row are statistically significant (P<0.05)

*Here, T_0= 0 mg Zinc/ kg of feed (Control group), T_1=5 0 mg Zinc/ kg of feed, T_2 = 100 mg Zinc/ kg of feed and T_3= 150 mg Zinc/ kg of feed.

4.2 Live weight gain

Weight gain of the experimental birds at the day of 35 is shown in Figure 1. It was observed that weight gain at the day of 35 was significantly (P<0.05) higher in the birds fed 100 and 150 mg Zinc/kg feed (1249.3g and 1513.53 g, respectively) than the control group T_0 (1131.8 g). However, higher weight gain was also observed in the birds fed 50 g zinc/ kg feed (1175.3 g) but was not significantly different (P>0.05) than the control group (1131.8 g). This significant difference in total weight gain is might be due to the association of zinc in protein metabolism of broiler birds. Present findings supports the findings of the Ezzati *et al.* (2013), Liu *et al.* (2012) and Bartlett and Smith (1998), they also found significantly higher live weight gain in the zinc supplemented birds but does not support the findings of the Sahin *et al.* (2005) who had not found any significant differences in the live weight gain of broiler birds by supplying 20 ppm, 40 ppm and 80 ppm dietary zinc to the broiler birds. Midilli *et al.* (2014) and Salabi *et al.* (2011) found improved live weight gain when they added zinc at the level of 90 mg/kg of diet. Ao *et al.* (2007) also reported that chicks fed as the inorganic form had lower (P<0.01) live weight gain.

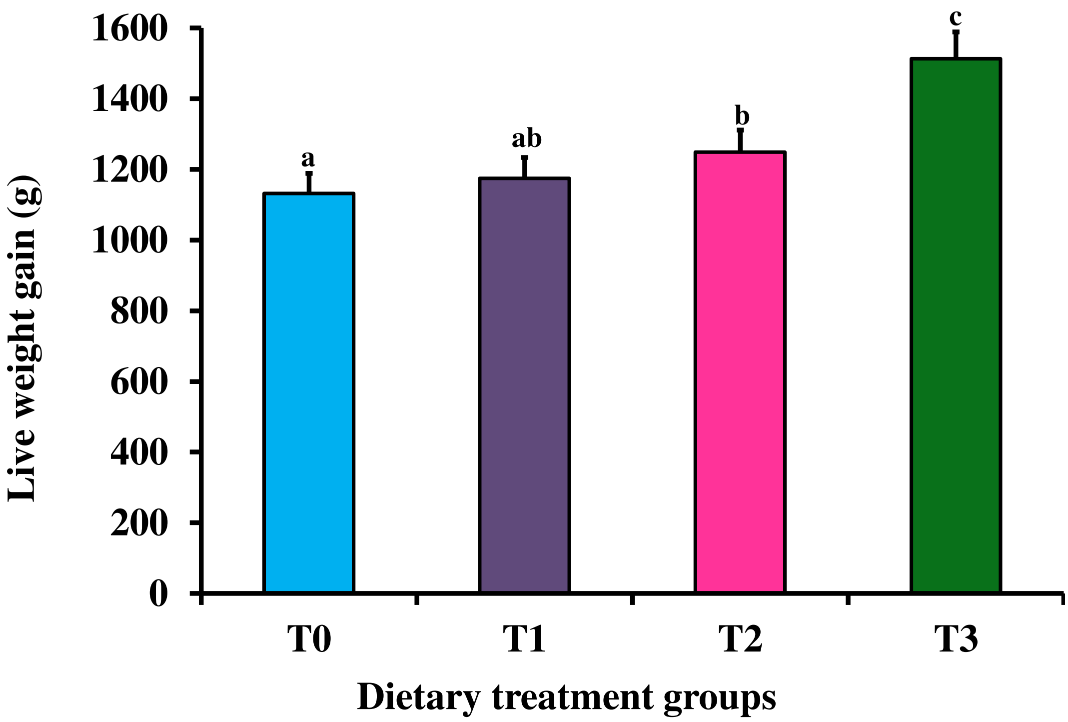

Figure 1. Live weight gain (g) of broiler birds fed different levels of Zinc (T_0= 0 mg Zinc/ kg of feed (Control group), T_1=50 mg Zinc/ kg of feed, T_2 = 100 mg Zinc/ kg of feed and T_3= 150 mg Zinc/ kg of feed). Each bar with error bar represents Mean ± SEM value. Differences were significant ($P<0.01$) among the groups.

4.3 Feed consumption

Feed consumption of birds during the experimental period is shown in Figure 2. It was observed that feed consumption was significantly ($P<0.05$) higher in the birds fed 100 mg Zinc/kg feed (2717 g/broiler) and 150 mg Zinc/kg feed (2816 g/broiler) than the control group T_0 (2512g). However, higher feed consumption was also observed in the birds fed 50g zinc/ kg feed (2634 g/broiler) but was not significantly differed ($P>0.05$) than the control group (2512 g/broiler). Present findings supports the findings of the Ezzati *et al.* (2013) in which they found supplementation of 125ppm zinc had a significantly higher feed intake (6030 g) than the un-supplemented group (5878 g).

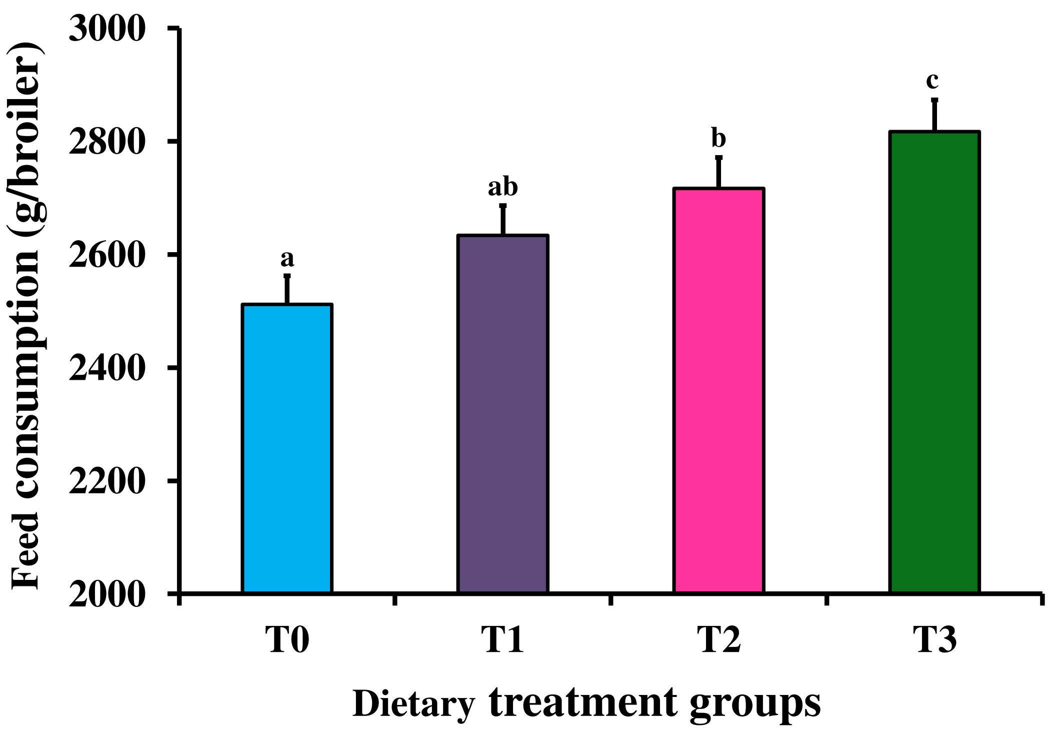

Figure 2. Feed consumption (g/bird) of broiler fed different levels of Zinc (T_0= 0 mg Zinc/ kg of feed (Control group), T_1=50 mg Zinc/ kg of feed, T_2 = 100 mg Zinc/ kg of feed and T_3= 150 mg Zinc/ kg of feed). Each bar with error bar represents Mean ± SEM value. Differences were significant (P<0.01) among the groups.

4.4 Feed efficiency (FE)

Feed efficiency (FE) of birds during the experimental period is presented in Figure 3. It was observed that FE was significantly (P<0.05) differed between the birds fed 150 mg Zinc/ kg feed (1.79) and control group T_0 (2.13). Birds fed, 50 mg Zinc/kg feed showed slightly higher FE (2.15) than the control group (2.13) but this difference is not statistically significant (P>0.05) . However, birds fed150 mg Zinc/kg feed also showed lower FE (2.09) but was not significantly (P>0.05) differed that of the control group (2.15). Present findings supports the findings of the Hosseini-Mansoub *et al.* (2010) in which they found zinc supplemented bird had a lower FE than the un-supplemented zinc group. Present findings does not supports the findings of the Ezzati *et al.* (2013) in which they found supplementation of 125ppm zinc had a FE 2.15 which was not significantly lower than the un-supplemented zinc group FE (2.15). Huang *et al.* (2007) also found highest FE when zinc was added at the level of 20 mg/kg in diet. Another form of zinc is reported to beneficial for broilers that is zinc-methionine which improves the feed efficiency significantly rather than zinc oxide (Sanford and Kawchumnong, 1972).

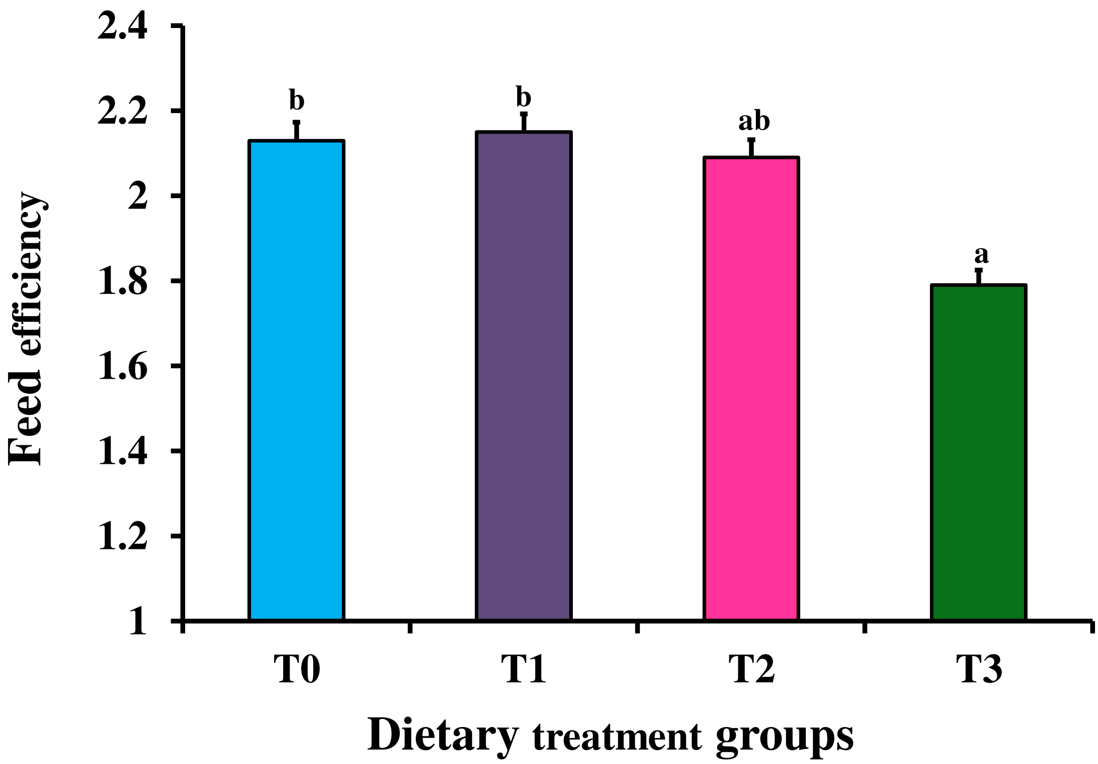

Figure 3. Feed efficiency of broiler birds fed different levels of (T_0= 0 mg Zinc/ kg of feed (Control group), T_1=50 mg Zinc/ kg of feed, T_2 = 100 mg Zinc/ kg of feed and T_3= 150 mg Zinc/ kg of feed). Each bar with error bar represents Mean ± SEM value. Differences were significant (P<0.05) among the groups.

4.5 Carcass yield

Weight of different internal organs such as heart, gizzard, liver, spleen, pancreas of the birds of T_0, T_1 and T_2 are shown in the Table 4. Statistical analysis of the data did not show any difference between the relative organs weight of the birds of different feeding groups using feed with or without supplementation of Zinc.

Table 4. Carcass characteristics of broiler birds fed different level of Zinc

Parameter (%)	Control	Dietary treatment groups			Level of Significance
	T_0 (n=5) Mean±SE	T_1 (n=5) Mean±SE	T_2 (n=5) Mean±SE	T_3 (n=5)	
Dressing yield	55.90^{a}±1.73	57.45^{ab}±1.35	58.10^{ab}±1.19	61.75^{b}±1.41	*
Breast meat	14.62±1.73	14.81±1.73	14.67±1.73	14.03±1.73	NS
Thigh meat	8.15±0.73^{a}	8.25±0.13^{a}	8.85±0.81^{ab}	9.33±0.95^{b}	*
Drumstick meat	5.27±0.31^{a}	5.78^{ab}±0.41	5.91^{ab}±0.38	6.43^{b}±0.41	*
Drumstick bone	1.81±1.05	1.93±0.10	1.87±0.12	1.91±0.09	NS
Wing meat	3.22±0.21	3.24±0.38	3.72±0.37	3.79±0.12	NS
Abdominal fat	1.21±0.11	1.19±0.05	1.75±0.03	1.82±0.02	NS
Gizzard	1.44±0.02	1.46±0.05	1.46±0.11	1.51±0.15	NS
Head	2.49±0.16	2.43±0.21	2.48±0.15	2.46±0.17	NS
Heart	0.47±0.005	0.46±0.02	0.47±0.04	0.49±0.09	NS
Liver	2.20±0.12	2.24±0.15	2.18±0.13	2.19±0.08	NS
Neck wt.	1.74±0.03	1.51±0.05	1.86±0.07	1.82±0.07	NS
Wing bone	2.09±0.11	2.25±0.16	2.16±0.12	2.31±0.17	NS
Blood	4.07±0.09	4.09±0.17	4.36±0.12	4.65±0.18	NS
Thigh bone	1.27±0.11	1.24±0.07	1.38±0.09	1.42±0.11	NS
Spleen	0.15±0.002	0.14±0.004	0.12±0.007	0.15±0.002	NS
Skin	8.21±0.53	8.19±0.36	7.96±0.75	8.39±0.81	NS

The above values represent the mean ± standard error (SE) of the live weight of broiler in different weeks of the experimental period. Mean values with the same superscripts within the same row are statistically non-significant ($P>0.05$) and Mean values with the different superscripts within the same row are statistically significant ($P<0.05$)

*Here, T_0= 0 mg Zinc/ kg of feed (Control group), T_1=50 mg Zinc/ kg of feed, T_2 = 100 mg Zinc/ kg of feed and T_3= 150 mg Zinc/ kg of feed.

For evaluating carcass yield characteristics dressing yield, breast meat, thigh meat, drumstick meat, drumstick bone, wing meat, abdominal fat, gizzard, head, heart, liver, neck wt., wing bone, blood, thigh bone, spleen and skin were taken as variables. It was observed that except dressing yield, thigh meat and drumstick meat all other variables are not significantly differed among the groups. Dressing yield was highest at birds fed 150 mg zinc/ kg feed while it was 55.90, 57.45 and 58.10 g in T_0, T_1 and T_3 group, respectively. Thigh meat weight was also significantly higher in the birds fed 150 mg zinc/ kg feed while it was 8.15, 8.25and 8.85 g in T_0, T_1 and T_2 group, respectively. Drumstick meat was also significantly higher in weight in the birds fed 150 mg zinc/ kg feed (6.43 g). Thigh meat contains more protein less fat, has less tendon, ligaments, myoglobin and blood vessels than that of dark meat. As a result, digestibility of thigh meat is higher than other meat. The demand is higher for thigh meat than the dark meat.

Thus, thigh meat is the one of the valuable part of broiler. So, difference in thigh and drumstick meat yield is manically important. It is very difficult to explain the mechanism of increasing trend of thigh and drumstick meat yield for groups receiving zinc in feed. Most probably this effect was due to the comparative increase in the live weight of broiler birds fed zinc. Present findings support the findings of the Ezzati *et al.* (2013) in which they also found a significantly higher carcass yield in zinc supplemented birds than the un-supplemented group. But Liu *et al.* (2012) had not found any significant effect in carcass yield characteristics of broiler birds by supplying different level of zinc

4.6 Blood profile

Hematological parameters of the experimental birds were shown in Table-5. It was found that hemoglobin (g/dl) was not significantly differed (P>0.05) among the different groups of broiler birds (6.50, 6.65, 6.80 and 6.91g/dl respectively in T_0, T_1, T_2 and T_3 group, respectively). Packed cell volume (PCV) was 16.80, 17.10, 17.40 and 17.38 % in T_0, T_1, T_2 and T_3 group, respectively which was not significantly (P>0.05) differed among the groups. Erythrocyte sedimentation rate (ESR) was not significantly differed (P>0.05) among the treatment and control groups and it was 6.67, 6.45, 6.45, 6.65 and 6.67 mm in T_0, T_1 and T_2 group, respectively. Present findings do not supports the findings of the Zia-

Ur-Rahman and Akhtar (2001) who found increased packed cell volume, and hemoglobin when birds were treated with copper sulfate.

Hb, PCV and ESR value of the birds of different groups does not differ significantly among the groups and it was within the normal range. That indicates that supplementation of zinc has no negative effect on the blood profile of broiler birds that means broiler birds was physically sound and healthy during the experimental period and experimented zinc supplementation was safe for the broiler birds.

Table 5. Hematological parameters of broiler fed different level of dietary zinc.

Blood Parameters	Dietary treatment groups*				Level of Significance
	T_0	T_1	T_2	T_3	
Hemoglobin (g/dl)	6.50±0.12	6.65±0.06	6.80±0.07	6.91±0.07	NS
PCV (%)	16.80±0.67	17.10±0.49	17.40±0.50	17.38±0.30	NS
ESR (mm in 1st hour)	6.67±0.76	6.45±0.68	6.65±0.63	6.73±0.87	NS

The above values represent the mean ± standard error (SE) of the live weight of broiler in different weeks of the experimental period. Mean values with the same superscripts within the same heading are statistically non-significant (P>0.05) and Mean values with the different superscripts within the same headings are statistically significant (P<0.05)

Here, T_0= 0 mg Zinc/ kg of feed (Control group), T_1=50 mg Zinc/ kg of feed, T_2 = 100 mg Zinc/ kg of feed and T_3= 150 mg Zinc/ kg of feed.

4.6 Cost-benefit analysis of production

The average rearing costs, live weight and net profit of birds are shown in the Table 6. The average rearing costs of broiler kept under different treatment groups were not significantly ($P>0.05$) differed among the groups. But the feed cost was slightly higher in treated groups due to the high feed intake in the treated groups and it was 103Tk, 108 Tk. and 111.39 Tk. and 115.51, respectively in T_0, T_1, T_2 and T_3 group respectively. Total rearing cost of broiler was significantly higher ($P<0.05$) in the birds fed 100 and 150 mg Zinc/kg of feed (204.3 and 223.5 Tk., respectively) than the control group (166 Tk.). Although birds fed 50 mg Zinc/kg of feed had a higher rearing cost (186.0 Tk.) but did not significantly differed than the control group. This difference between the groups was due the variation of feed intake and cost of zinc. As live weight of broiler was significantly differed among the groups total sale price/broiler was also significantly differed between the birds fed 150 mg Zinc/kg feed (270 Tk.) and birds of control group (207 Tk./broiler). Sale price/broiler in T_1 (210 Tk. /broiler) and T_2 group (225 Tk. / broiler) was slightly higher but not significantly differed from the control group. Net profit/broiler) highest in the birds fed 150 mg Zinc/kg feed (46.48 Tk. / broiler) was not significantly ($P>0.05$) differed than the control group (40.99 Tk.).

However, birds fed 50 and 100 mg Zinc/kg of feed showed significantly lower profit (23.98 and 20.60 Tk., respectively). This was due to comparatively lower weight gain of these groups' birds in spite of high feed and zinc intake.

Table 6. Cost-benefit analysis of broiler production among different groups.

Description	T0 (Control)	T_1 (50g/kg Zinc)	T_2 (100g/kg Zinc)	T_2 (150g/kg Zinc)	Level of signi.
Cost/chick (Taka)	55	55	55	55	NS
Average feed consumed (g)/chicks	2512 ± 17.1^{a}	2634 ± 21.5^{ab}	2717 ± 35.3^{b}	2817 ± 19.4^{c}	**
Feed price/Kg (Tk.)	41	41	41	41	-
Cost of zinc (Tk.)	0	15	30	45	*
Feed cost (Tk.)	103.00	108.01	111.39	115.51	NS
Miscellaneous (Tk.)	8	8	8	8	-
Total cost/broiler (Tk.)	166.0 ± 5.1^{a}	186.0 ± 4.3^{ab}	204.3 ± 3.8^{b}	223.5 ± 7.9^{c}	**
Average live weight (Kg)	1.38 ± 0.011^{a}	1.4 ± 0.072^{ab}	1.5 ± 0.0914^{b}	1.8 ± 0.0616^{c}	**
Sale price/Kg live wt. (Taka.)	150	150	150	150	-
Sale price/broiler (Taka)	207 ± 5.4^{a}	210 ± 3.1^{a}	225 ± 2.0^{ab}	270 ± 1.9^{b}	**
Net profit/broiler (Taka.)	40.99 ± 5.1^{b}	23.98 ± 5.1^{a}	20.60 ± 5.1^{a}	46.48 ± 5.1^{b}	*

The above values represent the mean ± standard error (SE) of the live weight of broiler in different weeks of the experimental period. Mean values with the same superscripts within the same row are statistically non-significant ($P>0.05$) and Mean values with the different superscripts within the same row are statistically significant ($P<0.05$), *= ($P<0.05$) and **= ($P<0.01$). *Here, T_0= 0g Zinc/ kg of feed (Control group), T_1=5 0g Zinc/ kg of feed, T_2 = 100g Zinc/ kg of feed and T_3= 150g Zinc/ kg of feed.

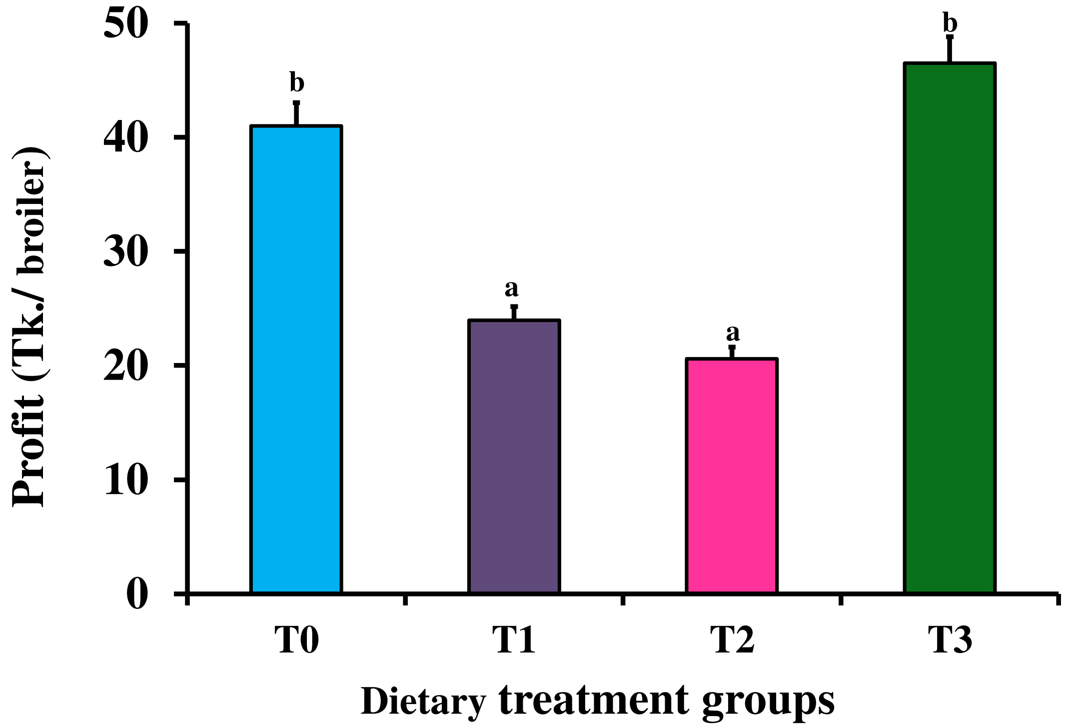

Figure 4. Final profit from experimental broiler birds fed different levels of Zinc ((T_0= 0 mg Zinc/ kg of feed (Control group), T_1=50 mg Zinc/ kg of feed, T_2 = 100 mg Zinc/ kg of feed and T_3= 150 mg Zinc/ kg of feed). Each bar with error bar represents Mean±SEM value. Differences were significant (P<0.05) among the groups.

CHAPTER V

SUMMARY AND CONCLUSION

CHAPTER V

SUMMARY AND CONCLUSION

An experiment was conducted with 60 day-old Cobb 500 broiler chicks for a period of 35 days of age at a Poultry Farm in Karnai, Dinajpur to study the effect of zinc on productive performances, carcass traits and their cost-effectiveness in broiler. The day old broiler chicks were randomly distributed by using CRD into 4 dietary treatment groups each having 15 birds with 3 replications in each treatment and the treatments were 0, 50, 100 and 150 mg zinc/ kg of feed in 1^{st}, 2^{nd}, 3^{rd} and 4^{th} group of birds, respectively. Live weight, weight gain, feed intake, feed efficiency, edible meat yield, blood profile and production cost of broilers in different dietary treatment groups was recorded. The live weight of broiler among different dietary groups was significantly different ($P<0.05$) and highest live weight was observed in the birds fed 150 mg Zinc/kg feed (1758.53 g). Zinc supplementation improved the feed intake as well as weight gain of the birds. Feed efficiency also was better in the birds fed dietary zinc supplementation and birds fed 150 mg Zinc/kg feed showed best FE (1.79). Although net profit was lower in birds fed two zinc supplemental diets (50 and 100 mg zinc/ kg feed) about 5.50 Tk. more net profit was obtained in each broiler birds of the group supplied with150 mg Zinc/Kg feed than the control group. Dressing yield, weight of thigh meat and breast meat was higher in the zinc treated groups. However, zinc supplementation does not negatively affected the blood constituents of the experimental birds which indicates the healthy condition of birds during the experimental period as well as safety level of the zinc incorporation in the broiler diet.

At the end it can be sum up that, zinc can be safely and beneficially used in the broiler diets to improve their productive performances, carcass yield and economic benefit. Present research findings may be useful for the small and large scale poultry farmers to earn more profit through improving broiler performances by using zinc and can contribute in the minimization of national protein need and health hazards by supplying tasty, healthy and antibiotic free broiler meat.

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