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Effect of supplementing organic source of zinc and manganese on growth performance of broiler chicks

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Abstract
The present study was conducted to evaluate the effect of supplementing organic source of Zinc (Zn) and Manganese (Mn) on growth performances of broilers chicks. One hundred and twenty days old unsexed broiler chicks were randomly assigned to four dietary treatments with three replicates and 10 birds per each replicate. The experimental birds were fed with the following four diets. The control diet (T1) was formulated by incorporating inorganic Zinc and Manganese. For each of the treatments, inorganic Zinc and Manganese diet of the control diet were added by organic (Methionine base) Zinc and Manganese at 100% of the recommended level (T2), 80% of the recommended level (T3) and 70% of the recommended level (T4). There was no significant difference in body weight, feed consumption and feed efficiency between organic and inorganic source fed Zinc and Manganese groups.

Keywords: broiler chicks, organic zinc, manganese, growth performance

Introduction

Trace minerals, such as Cu, Fe, Mn, and Zn, are essential for broiler growth and are involved in many digestive, physiological, and biosynthetic processes within the body. They function primarily as catalysts in enzyme systems within cells or as parts of enzymes. They are also constituents of hundreds of proteins involved in intermediary metabolism, hormone secretion pathways, and immune defense systems (Dieck *et al.* 2003) [6]. 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 and allow the bird to reach its genetic growth potential (Bao *et al.*, 2007) [2]. National Research Council (1994) [8] suggested that trace minerals such as copper, zinc, and manganese are essential elements for development and growth in broiler chicks. They play a key role in the maintenance and development of the skeleton and are essential components of a number of enzymes, vitamins, and hormones, etc. Thecritical role of trace minerals in maintaining skeletal health and skin integrity has been well recognized (Rossi *et*, *al.*, 2007) [10]. Use of organically complexed trace minerals can help prevent these losses, due to increased stability in the upper gastrointestinal tract of the animal. Indeed, a variety of trials have demonstrated greater bioavailability of organically complexed trace minerals, which in turn would allow for lower inclusion rates and reduced excretion (Bao *et al.*, 2009) [3]. In addition, Zinc is a component of the carbonic anhydrase enzyme, chromium is required for activating certain enzymes and which is crucial for supplying the carbonate ions during for stabilizing proteins and nucleic acids **(**Linder MC 1991) [7]. The trace minerals, such as Zn, Mn, and Cu, are involved in a wide variety of physiological processes, making them essential for optimal bird growth and health. They act as catalysts in many enzyme and hormone systems (Suttle, 2010) [12] and, these minerals, such as Zn, Mn, and Cu, play role in growth, bone development, feathering, enzyme structure and function, and appetite (Nollet *et al.*, 2007) [9]. The objectives of the current study were to study the effect of supplementing zinc and manganese through the organic source on the performance of broilers, with respect to body weight gain, feed consumption, and feed efficiency.

Materials and Methods

A total of 120 day-old unsexed broiler chicks were randomly divided into four groups with twelve replicates of teen birds each. The control diet was formulated as per BIS (1992) [5] to meet the requirement allowance of nutrients reported for broiler management flock. An experimental study was carried out to evaluate the effects of supplementing organic source of Zinc (Zn) and Manganese (Mn) in the diets on growth performance, feed consumption and feed efficiency of broilers chicks. The premix was formulated to contain the requirements of trace elements in a combination of either inorganic (Sulphate form) or organic form (Methionine- chelate form). Diets were supplemented with the organic form of Zinc and Manganese (Methionine-chelate at the rate of 50%, 100% and 150% of the total requirements of the elements). The experimental birds were fed with one of the following four diets. The control diet (T_1) was formulated by incorporating inorganic Zinc and Manganese according to BIS (1992) [5]. For each of the treatments, inorganic Zinc and Manganese diet of the control diet were replaced by organic (Methionine base) Zinc and Manganese at 100 % of the recommended level (T2), 80 % of the recommended level (T3) and 70% of the recommended level (T4). All the birds were housed in a deep litter system with the climate control condition. They kept under the similar condition of management throughout the experimental period. Artificial lighting was used to provide chicks with 24 h lighting daily during the whole experimental period. The initial brooding temperature was 33ºC in the first week of age and reduced gradually 2°C per week up to 24°C then remains constant. Diets and water were provided *ad- libitum* throughout the experimental period, which lasted for 35 days of age. The experimental design is summarized in (Table 1). The ingredient and nutrient compositions of experimental basal diets are given in Table 2. The experiment was conducted at the Department of animal production, Faculty of Veterinary science, Nangarhar University, Afghanistan.

Housing and Management

Chicks were housed in deep litter system, fitted with 60 watts electric bulbs. Teen chicks of uniform body weights were randomly distributed to four treatments with each treatment having 3 replicates. Chicks were vaccinated against Newcastle disease on the 7th day of age and Infectious Bursal Disease on the 18th day of age. The chicks were fed with respective assay diets (Starter mash) from day one to 21 days and finisher mash from 22nd to 35th day. The respective assay diets were provided in Circular feeders while potable water was provided in Circular waters to all the bird's *ad libitum*.

Parameter studied

The performances of birds on experimental diets were evaluated for body weight gain, feed consumption and feed efficiency at 35 days.

Fig 1

Experimental design

The experimental design employed for the present study was detailed in (Table 1). Total of 120-day old broiler chicks of approximately uniform body weight was selected. The birds were divided among 4 treatments with each treatment having 3 replicates with 10 birds in each replicate were randomly allotted.

Statistical analysis

The experimental data were analyzed statistically by one-way analysis of variance (ANOVA) under completely randomized design (CRD) and according to the methods described by SPSS Version# 16. The mean differences were compared using Lead Significant difference Test (LSD). Significance was considered at $P \leq 0.05$ levels.

Table 1: Experimental Design

Treatment	Inorganic Source	Organic Source	Percentage (%) of Inclusion
Control	ZnSo4+MnSo4	—	100
T2	—	Zn AA(60mg)+ Mn AA(90 mg)	100
T3	—	Zn AA(48 mg) and Mn AA(72 mg)	80
T4	—	Zn AA(42 mg) and Mn AA(63 mg)	70

Table 2: Percentage Ingredient composition of the experimental control diet

Ingredients	Broiler starter Quantity (kgs)	Broiler Finisher Quantity (Kgs)
Maize- Yellow	56	63
Soybean meal	40	32
*Vegetable oil	-	1
**Mineral mixture	2	2
Dicalcium phosphate	1	1
***VitA, B_2, D_3 and K	0.1	0.1
****Vit, B complex	0.1	0.1
Salt	0.4	0.4
Methionine	0.2	0.2
Liver tonic	0.1	0.1
Antitoxin	0.1	0.1
Total	100	100
Calculated nutrient composition Metabolizable energy: Kcal/kg	2848	2936
Crude protein (%)	23.04	20.07
Lysine (%)	1.35	1.09
Methionine (%)	0.56	0.51
Calcium (%)	1.2	1.2
Phosphorus (%)	0.45	0.45
/Iron (ppm)	120	120
Copper (ppm)	12	12

*Vegetable oil: Palm oil

**Mineral Mixture: Contains calcium- 32%, phosphorus- 6%, copper 12 ppm, cobalt- 60 ppm, manganese-2700 ppm, iodine-100 ppm, zinc- 2600 ppm and iron- 120 ppm

***Vit A, B_2 D3 and K: Per gram contains Vit. A- 82, 500 IU, D_3-12,000 IU, B_2- 50 mg and K-10 mg

****Vit B Complex: Per gram contains Vit B_1- 4 mg, B_6- 8 mg, B_{12}- 40 mg, E- 20 mg, Niacin- 60 mg and calcium panthothenate-12.5 mg

Results and Discussion

The performances of chicks fed experimental diets are summarized in Table (3). The opening live body weights of experimental chicks were almost similar with a little bit difference indicating the good randomization way for distributing chicks within the experimental treatments. Among the organic source, highest body weight gain (146.3 g) was observed in 100 percent supplementation of organic source fed Zn and Mn (T_2) as agonist the lowest body weight gain (136.55 g) was observed in 100 per of inorganic source fed Zn and Mn (T_1).

On the other hand, there was no significant difference in body weight gain among the organic source fed Zn and Mn groups (T_2, $T_{3,}$ and T_4) and between inorganic source fed Zn and Mn group (T_1). During the First week (Starter phase), among the different source of Zn and Mn fed group, the highest suggest body weight gain of 377.4 g was recorded in organic source of Zn and Mn (T_2) and the lowest body weight gain 360.3 g was recorded in control group inorganic source fed Zn and Mn (T_1).

However, there was no significant difference in body weight gain among the organic source fed Zn and Mn groups (T_2, T_3, and T_4) and between inorganic source fed Zn and Mn group (T_1). Among the different source of Zn and Mn fed group, during the second week (Starter phase). The highest mean body weight gain of 791.6 g was observed in organic source of Zn and Mn (T_2) and the lowest body weight gain 763.13 g was recorded in organic source fed Zn and Mn (T_3), fed group and non significantly different from inorganic source fed groups (T_1, T_3, and T_4), during the third week (Starter phase).

Highest body weight gain 1267.5 g was observed in the fourth week on organic source fed Zn and Mn (T_2), there was no significant difference from inorganic source fed groups (T_1, T_3, and T_4), during the (Finisher phase). The body weight (g) at the end of the experimental period (5th week) ranged from 1853 g recorded in 70 percent supplementation of organic source fed Zn and Mn (T_4), there was no significant difference among various source and levels of Zn and Mnfed groups. Among the two phases (starter and finisher) of the experiment, supplementation of an organic source of Zinc and Manganese with inorganic source had no significant effect on body weight of birds. The body weight of birds receiving an inorganic source of Zinc and Manganese was non-significantly better when compared with groups fed organic source of Zinc and Manganese. Among various organic source fed groups, the body weights were comparable with each other and with group fed inorganic source of Zinc and Manganese.

Fig 2

In the present study, no significant differences in body weight gain were determined between groups fed inorganic and organic sources of Zinc (Zn) and Manganese (Mn) during both starter and finisher phases. alike, there were no significant differences in body weight gain among birds fed 60, 48 and 42 mg /kg of an organic source of Zn and 90, 72 and 63 mg /kg of an organic source of Mn. Supplementation of an organic source of Zn and Mn in the diets, to compared with 100 percent supplementation of the inorganic source of Zn and Mn (T_1).

These results were in agreement with the results of Sundert *et al.* (2013) who reported that body weight gain in broiler chicks was not influenced by Zinc- Methionine (Zn - Met) chelate. The present results are in agreement with the findings of Bao *et al.* (2010) [4], Tavares *et al.* (2014) [13] and Yenice *et al.* (2015) [14], who found a nonsignificant effect of body weight gain by feeding chelated Zn, Mn, Cr and Cu in the diets of broilers. The present study was contradictory to the findings of Seo *et al.* (2008) [11] who observed that feeding of an organic source of Trace mineral in broilers diet had a significantly positive effect on body weight gain of broilers. The present study is contradictory to the finding of Abdallah *et al.* 2009 [1].

Table 3: The effect of dietary organic mineral on the performance of broilers in 35 days.*

Treatments	Live Body weight In gram (Mean ± SD)	Live Bodyweight In gram (Mean ± SD)	Live Bodyweight In gram (Mean ± SD)	Live Body weight In gram (Mean ± SD)	Live Body weight In gram (Mean ± SD)
	First week	**Second week**	**Third week**	**Fourth week**	**Fifth week**
T1(Control)	136.55±4.28^b	360.3±17.8^a	774.43±22.9^a	1206.2±33.9^a	1681.7±66.61^a
T_2	146.03±3.7^a	377.4 ± 6.1^a	791.6± 9.42^a	1267.5±20.1^a	1827.9±36.18^a
T_3	141±0.92^b	360.4±1.9^a	763.13±24.9^a	1220.0±27.9^a	1771.4 ±87.7^a
T_4	142.37±1.08^b	372.3±4.47^a	782.25±9.74^a	1220.1±27.9^a	1853 ± 54.93^a

* Mean within the same column with at least one similar letter are not significantly different (LSD)

Conclusion

Organic minerals can be included at much lower levels in the diet, without any negative effect on broiler performance. The current experiment was conducted to find the effect of Zin Meth and Mn Meth on 120 day old broiler chicks. There was no significant at the different phase of Live Body weight between organic and inorganic source fed Zinc and Manganese groups.

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