

Original Research Article

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## Effect of Dietary Minerals Supplementation on Growth and Carcass Yield in Broiler Chicken

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### ABSTRACT

An experiment on 120 day old Ross 308 broiler chicken was conducted to study effect of dietary supplementation of minerals (Se + Zn + Cr) on growth performance and carcass yield. Chicks were divided into three groups of 40 chicks in each and dietary treatments consisted of minerals (Sodium selenite, Chromium picolinate, Zinc-methionine) in three levels. Group T<sub>1</sub> was without additional supplementation minerals, group T<sub>2</sub> was supplemented with minerals Se + Zn + Cr @ 0.15 + 25 + 0.30 ppm and group T<sub>3</sub> was supplemented with minerals Se + Zn + Cr @ 0.20 + 50 + 0.50 ppm, respectively. In T<sub>3</sub> group, cumulative feed intake was significantly ( $p < 0.05$ ) low compared to T<sub>1</sub> during 42 days of experiment. However, cumulative intake was significantly ( $p < 0.05$ ) lower in T<sub>3</sub> compared to T<sub>2</sub> upto 28 days, but later the value remained similar. Weight gain in T<sub>3</sub> was significantly ( $p < 0.05$ ) higher on day 28<sup>th</sup> and 42<sup>nd</sup> as compared to other groups. The T<sub>3</sub> group had best feed: gain ratio as compared to other groups ( $p < 0.05$ ). Weight of dressed meat, wing piece, thigh and breast were significantly  $p < 0.05$  higher compared to other groups. Thus, minerals supplementation improved growth performance, dressing percentage and total carcass yield in T<sub>3</sub> group as compared to T<sub>1</sub> and T<sub>2</sub>.

#### Keywords

Dietary minerals, Growth, Carcass yield, Broiler chicken.

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### Introduction

Poultry industry is now witnessing series of problems such as various disease outbreaks, harsh climatic conditions and high cost of feed. The success of broiler production depends on maximum weight gain within minimum period, hence the poultry industry relies on the application of antibiotics to increase disease resistance. However, this practice has accompanied the prevalence and establishment of antibiotic-resistant species within the human populations (Phillips *et al.*,

2004). Thus appropriate alternatives for antibiotics maintain accessible markets for poultry products (Abdukalykova and Ruiz-Feria, 2006). Minerals play a vital role in various metabolic, enzymatic and biochemical reactions ultimately leading to better growth rate, egg production and feed efficiency and are gaining importance as dietary growth promoters. Thus the current experiment was designed to study the effect of two levels of dietary supplementation of Selenium + Zinc +

Chromium in combination on growth performance and carcass characteristics in broiler chicken.

## Materials and Methods

**Birds, Treatment and Management:** The experiment was conducted in the Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Anjora, Durg (Chhattisgarh) on 120 day old unsexed Ross 308 broiler chicks. Chicks were randomly allocated to 3 groups of 4 replicates in each group (10 chicks/replicate) in deep litter system under standard managerial conditions. The chicks were vaccinated against Marek's disease, New castle disease.

A typical diet based on feed ingredients like maize, soybean meal deoiled rice bran and fishmeal, dicalcium phosphate, and limestone powder were formulated for starter phase (0-14 day), grower phase (15-28 days) and finisher phase (29-42 days) and presented in table 1.

The starter, grower and finisher's diets contained 23, 21.5 and 20% CP and 2900, 3000 and 3100 kcal ME/kg, respectively. Dietary treatments consisted of minerals (Sodium selenite, Chromium picolinate, Zinc-methionine) in two levels. Group T<sub>1</sub> was without additional supplementation of minerals. Group T<sub>2</sub> was supplemented with minerals Se + Zn + Cr @ 0.15 + 25 + 0.30 ppm Group T<sub>3</sub> was supplemented with minerals Se + Zn + Cr @ 0.20 + 50 + 0.50 ppm respectively.

**Data Collection:** Weekly live body weights were individually recorded for each chick and the average live body weights were calculated for each replicate and treatment during the five week of experimental period. Cumulative and weekly body weight gains were calculated for each chick, replicates and treatments. Feed consumption, feed

conversion ratio were also recorded weekly for each replicate. Birds were slaughtered at the end of the experiment and carcass yield was recorded.

For interpretation of the result the data were subjected to Completely Randomized Design as suggested by Snedecor and Cochran (1994) and analyzed by ANOVA one way classification using SPSS package (SPSS ver. 10.0).

## Results and Discussion

### Feed intake

The feed intake during 0-14 days was significantly ( $p < 0.05$ ) lower in group T<sub>3</sub> supplemented with mineral as compared to control T<sub>1</sub> (Table 2). During 0-28 day the feed consumption was lowest in group T<sub>3</sub> as compared to T<sub>2</sub> and T<sub>1</sub>. On day 42 the cumulative feed consumption showed significant ( $p < 0.05$ ) reduction in group T<sub>3</sub> as compared to its control group T<sub>1</sub>.

### Body weight gain

In the present study, during 0-14 days no significant difference was observed in average weekly body weight gain in mineral supplemented group (T<sub>2</sub>, T<sub>3</sub>). On 28<sup>th</sup> day a significant ( $p < 0.05$ ) increase in weight gain was observed in T<sub>3</sub> as compared to control T<sub>1</sub> (Table 2).

### Feed: gain ratio

Birds in T<sub>3</sub> group supplemented with mineral showed best feed: gain ratio as compared to T<sub>2</sub> and T<sub>1</sub> on 28<sup>th</sup> day of the experiment ( $p < 0.05$ ). Similarly, best feed: gain ratio was observed in the finisher phase also i.e. on 42<sup>nd</sup> day (Table 2,  $p < 0.05$ ).

The present findings are in agreement with other researchers (Toghyani *et al.*, 2006; El-

Hommosany, 2008; Tawfeek *et al.*, 2014; Huang *et al.*, 2016), who reported that supplementation of Se, Zn and Cr increased body weight gain, feed: gain ratio and reduced feed intake in broiler chicken.

The probable reason for better feed: gain ratio in this study in supplemented group might be attributed to efficient nutrient digestibility. Oxidative damage of pancreatic tissue is protected by Zn and Se which may maintain secretory functions of digestive enzymes needed for efficient nutrient digestibility (Tawfeek *et al.*, 2014). Supplemented dietary Cr in broilers enhances biological activity of insulin (Huang *et al.*, 2016). Cr being an essential element for carbohydrate, fat and protein metabolism and modifies glucose

metabolism through an oligopeptide known as chromodulin (Sun *et al.*, 2000). Chromodulin consists of glycine, cysteine, aspartate, and glutamate, and binds with high affinity to 4 chromic ions. This enables Cr to be involved in the auto amplification of insulin signaling to maintain the active conformation of insulin receptors and cause greater glucose uptake (Vincent, 2000, 2001). The dietary supplementation of organic and inorganic selenium (Deniz *et al.*, 2005; Sevcikova, 2006) improved the feed: gain ratio and the feather score of broilers. Due to the better feathering ability and the effect of Se on thyroid hormone activation there was reduction in the energy requirement of broilers for maintenance, which consequently improved the feed utilization efficiency.

**Table.1** Ingredient and chemical composition of the experimental diet

Feed Ingredient	Starter (0-14 d)			Grower (14-28 d)			Finisher (29-42 d)		
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
<b>Yellow maize</b>	53.0	53.0	53.0	56.40	56.40	56.40	59.7	59.7	59.7
<b>Deoiled soybean meal</b>	36.40	36.40	36.40	33.40	33.40	33.40	26.3	26.3	26.3
<b>Deoiled rice bran</b>	2.50	2.5	2.50	0	0	0	0	0	0
<b>Fish meal</b>	2	2	2	2	2	2	5	5	5
<b>Soyabean oil</b>	2.40	2.40	2.40	4.60	4.60	4.60	5.5	5.5	5.5
<b>Di calcium phosphate</b>	1.70	1.70	1.70	1.60	1.60	1.60	1.30	1.30	1.30
<b>Limestone powder</b>	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
<b>DL-methionine</b>	0.28	0.28	0.28	0.26	0.26	0.26	0.22	0.22	0.22
<b>Lysine</b>	0.02	0.02	0.02	0	0	0	0.17	0.17	0.17
<b>Sodium bicarbonate</b>	0.17	0.17	0.17	0.16	0.16	0.16	0.23	0.23	0.23
<b>Common salt</b>	0.28	0.28	0.28	0.33	0.33	0.33	0.26	0.26	0.26
<b><sup>1</sup>Se (ppm)</b>	-	0.15	0.20	-	0.15	0.20	-	0.15	0.20
<b><sup>2</sup>Zn (ppm)</b>	-	25	50	-	25	50	-	25	50
<b><sup>3</sup>Cr (ppm)</b>	-	0.30	0.50	-	0.30	0.50	-	0.30	0.50
<b>CP (%)</b>	22.95	22.95	22.95	21.46	21.46	21.46	19.76	19.76	19.76
<b>ME kcal/kg</b>	2900	2900	2900	3000	3000	3000	3100	3100	3100
<b>Ca (%)</b>	1	1	1	1	1	1	1	1	1
<b>Available P (%)</b>	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

<sup>1</sup>Sodium selenite, <sup>2</sup>Zinc-methionine, <sup>3</sup>Chromium picolinate

**Table.2** Effect of dietary mineral supplementation on growth performance of broiler chicken

Particulars	Period (Days)	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Feed intake (g)	14	507.28 <sup>b</sup> ±17.20	507.56 <sup>b</sup> ±9.04	464.43 <sup>a</sup> ±6.01
	28	2070.72 <sup>b</sup> ±9.5	2032.16 <sup>b</sup> ±55.17	1841.96 <sup>a</sup> ±21
	42	4069.63 <sup>b</sup> ±15	3738.96 <sup>a</sup> ±83.60	3704.8 <sup>a</sup> ±53.80
Weight gain (g)	14	410.70 <sup>a</sup> ±6.48	404.3 <sup>a</sup> ±8.5	422.35 <sup>a</sup> ±8.85
	28	1320.22 <sup>a</sup> ±6.89	1317.07 <sup>a</sup> ±1.89	1357.91 <sup>b</sup> ±3.88
	42	2273 <sup>a</sup> ±2.87	2242.92 <sup>a</sup> ±10.6	2401.38 <sup>b</sup> ±21.5
Feed: gain ratio	14	1.23 <sup>b</sup> ±0.04	1.20 <sup>b</sup> ±0.01	1.09 <sup>a</sup> ±0.02
	28	1.56 <sup>b</sup> ±0.02	1.54 <sup>b</sup> ±0.04	1.35 <sup>a</sup> ±0.02
	42	1.79 <sup>c</sup> ±0.02	1.65 <sup>b</sup> ±0.03	1.54 <sup>a</sup> ±0.03

T1: Se: 0, Zn: 0, Cr: 0 (ppm); T2: Se: 0.15, Zn: 25, Cr: 0.3 (ppm); T3: Se: 0.2, Zn: 50, Cr: 0.5 (ppm)

**Table.3** Effect of dietary mineral supplementation on carcass characteristics of broiler chicken

Particulars	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Live wt (g)	2216.66 <sup>a</sup> ±42.4	2316.66 <sup>a</sup> ±123	2567.66 <sup>a</sup> ±123.6
Dressed meat (g)	1589 <sup>a</sup> ±70.93	1759 <sup>ab</sup> ±77.98	1997.83 <sup>b</sup> ±109.2
Liver (g)	78.36 <sup>a</sup> ±3.72	73.07 <sup>a</sup> ±1.12	71.86 <sup>a</sup> ±4.15
Gizzard (g)	68.7 <sup>a</sup> ±3.32	64.74 <sup>a</sup> ±4.37	59.1 <sup>a</sup> ±2.90
Heart (g)	10.63 <sup>a</sup> ±0.23	10.83 <sup>a</sup> ±0.52	9.86 <sup>a</sup> ±0.31
Wing piece (g)	388.53 <sup>a</sup> ±10.54	457.66 <sup>a</sup> ±39.95	563.93 <sup>b</sup> ±32.36
Thigh (g)	390.26 <sup>a</sup> ±23.92	448.86 <sup>a</sup> ±10.39	515.3 <sup>b</sup> ±18.80
Breast (g)	184.27 <sup>a</sup> ±9.73	185.9 <sup>a</sup> ±9.33	231.6 <sup>b</sup> ±14.10
Back and neck (g)	304.83 <sup>a</sup> ±23.43	341.86 <sup>a</sup> ±11.88	351.86 <sup>a</sup> ±22.41
Giblet (g)	141.74 <sup>a</sup> ±9.10	149.56 <sup>a</sup> ±8.36	140.83 <sup>a</sup> ±7.29

T1: Se: 0, Zn: 0, Cr: 0 (ppm); T2: Se: 0.15, Zn: 25, Cr: 0.3 (ppm); T3: Se: 0.2, Zn: 50, Cr: 0.5 (ppm)

### Carcass yield

The weight of dressed meat, wing piece, thigh and breast was significantly ( $p < 0.05$ ) higher in T<sub>3</sub> group as compared to other two groups (T<sub>1</sub> and T<sub>2</sub>). However, the different cuts of meat like liver, gizzard, back and neck and giblet did not show any significant ( $p < 0.05$ ) difference in their weight due to dietary supplementation of minerals.

The results are in agreement with the previous findings (Sahin *et al.*, 2003; Onderci *et al.*, 2004; Toghyani *et al.*, 2006). These workers reported that Cr supplementation at varying levels increased carcass yield as well as weight of internal organs. It can be explained by the fact that Cr increases glucose and amino acid uptake into muscle cells and thus regulates muscle tissue formation leading to

improve carcass quality. Rossi *et al.*, (2007) reported improved carcass quality of broiler chicken due to supplementation of organic zinc (0, 15, 30, 45, 60 ppm) in the diet. In the present study supplementation of Zn-methionine in the diet at 50 ppm improved carcass quality and dressed meat of broiler. The reason might be as Zn plays role in epithelial cell layers and collagen synthesis, thus affecting susceptibility of skin to tearing therefore improving carcass quality. Further, Zn enhances biological activity of body endocrine function particularly secretion of those hormones which play significant role in growth as well development of bones and growth (Yang *et al.*, 2017). The dietary supplementation of organic and inorganic Se (Deniz *et al.*, 2005; Sevcikova, 2006) improved the feed: gain ratio and the feather score of broilers (Table 3).

Based on the present findings it was concluded that mineral supplementation in the ratio of Se 0.20 + Zn 50 + Cr 0.50 ppm influences growth performances, carcass yield as evident by decreased feed intake, feed: gain ratio, while increased weekly body weight gain, dressed weight, wing, thigh and breast weight.

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