RESEARCH ARTICLE

Effect of Reduction of Trace Minerals from Feed for Seven Days before Marketing the Broilers on their Performance

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Abstract

The trial was conducted to study the effect of reducing trace minerals from the finisher diet for seven days before marketing the broilers on their performance. Day-old commercial broiler chicks were randomly distributed into four treatments, each having 60 birds. Each treatment was further subdivided into four replicates of 15 birds. All 4 groups (A-D) received a similar pre-starter diet for the first 7 days, starter diet for the second and third week, and finisher diet for the fourth and fifth week. The finisher diet was supplemented with a 0.05% trace minerals mixture. During sixth week, Group A continued with a finisher diet supplemented with 0.05% trace minerals, while group B, C and D finisher diets were supplemented with trace minerals @ 75% (0.0375%), 50% (0.025%), and 0%, respectively, as compared to group A diet. The performance parameters were recorded at the end of sixth week. The antibody titers against NDV were performed on the 42nd day. The economics of the production was also calculated at the end of the experiment. The results of the experiment indicated that reduction or removal of trace minerals in finisher diet seven days before the marketing of broilers does not have a significant influence on average BW, WG, FI, FCR, BY, GY, EVSY, R-to-C, thymus, spleen, gait score, footpad score, and mortality, but it had a significant adverse effect on % weight of bursa of Fabricius, NDV titer, and net profit per bird and per kg weight.

Keywords: Broilers, Economics, Growth performance, Immune response, Trace mineral reduction

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Introduction

Trace minerals play an important biological role for optimum growth and performance of broiler birds. The cost of trace premixes is about two to three times more than other feed ingredients. Although trace minerals contribute a small amount of the total feed cost, withdrawal of trace minerals from the diet fed during 7 to 14 days period before the marketing age of broiler birds could reduce production cost significantly because approximately 55% of total feed consumption and 25% of growth is achieved in this period. In commercial practice, feed manufacturers, nutritionists, and producers use 2 to 10 times more trace minerals than NRC (1994) recommended levels (Inal *et al.,* 2001). Therefore, eliminating trace minerals for 7 days before marketing may not affect the broiler performance due to sufficient trace mineral composition of commonly used feed ingredients and body reserves acquired during the first five weeks of broiler feed intake. It is well documented that the withdrawal of trace minerals from finisher broilers diets will not harm birds' performance, especially in temperate conditions (Mohamed *et al.,* 2015; Abudabos and Suliman, 2013; Khajali *et al.,* 2006). However, Abed *et al. (*2018) and Ebrahimnezhad *et al.* (2011) found reduced performance of the heat-stressed broiler birds. Hence, this study was designed to evaluate the effect of reducing trace minerals from feed for seven days before marketing the broilers on their performance.

Materials and Methods

The present experiment was conducted at the Department of Poultry Science, KNP College of Veterinary Science, Shirwal, Dist. Satara (MS) on 240 day-old broiler chicks. The birds were equally distributed into four groups, and each treatment group (n = 60) was further divided into four replicates of 15 birds each. All the treatment groups were subjected to identical feeding practices, *viz.,* pre-starter (I week), starter (II & III weeks), and finisher diet (IV & V week) supplemented with 0.05% trace mineral. In the sixth week, Group A (Control) continued with basal finisher diet supplemented with 0.05% trace minerals, while birds of Group B, C, and D received

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finisher diets supplemented with trace minerals @ 75% (*i.e.,* 0.0375%), 50% (i.e., 0.025% in diet) and 0%, respectively, as compared to Group A diet. The performance parameters, *viz.,* body weight (BW), weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) at weekly intervals, and economics of the production was calculated at the end of the experiment. Dressing parameters, *viz.,* percent eviscerated yield (EVSY) Giblet yield (GY), breast meat yield (BY) and ready-to-cook (R-to-C) yield, and percent weight of immune organs, *viz.,* thymus, bursa of Fabricius and spleen based on live weight were recorded at the end of the sixth week by randomly selecting one male and one female from each replicate. The antibody titers against NDV were checked on the 42nd day as per the method described by Alexander (2009) after collecting two blood samples from each replicate. Gait score was recorded on a zero to five scale as Garner et al. (2002) described on all the birds on 42nd day. Footpad score was recorded on two birds from each replicate on the 21st and 42nd day by using a three-point scale scoring system (score 0- smooth, no lesion, discolored papillae, no ulcers; score 1- minor discoloration, larger discoloration, superficial; score 2- severe lesions, with scab or ulcers). Total footpad score (TFPS) was calculated by using the formula:

$$TFPS = \frac{(0\times n)+(1\times n)+(2\times n)}{\text{Total number of scored broilers}}$$

The data were analyzed using a completely randomized design and one-way ANOVA (Snedecor and Cochran, 1994).

Results and Discussion

Performance Parameters:

The data on overall live body weight, gain in weight, feed intake, and FCR are presented in Table 1. The data indicate that reduction of 25%, 50%, or complete removal of trace minerals from finisher diet before seven days of marketing of broilers did not influence the live body weight significantly, weight gain, feed intake, and feed conversion ratio of broilers at the end of the sixth week. These results agreed with Mohamed *et al.* (2015), who found non-significant differences in feed intake and FCR of chicks by reducing trace mineral content in the finisher diet. Khajali *et al.* (2006) and Abed *et al.* (2018) also found that withdrawal of vitamin and trace mineral mix from finisher diet between 42 to 56 days and 29 to 42 days of broiler rearing, respectively, did not impair weight gain, feed intake or feed conversion efficiency. However, Wang *et al.* (2008) concluded that complete removal of mineral premixes leads to significantly lower final body weight of broilers. Sayadi *et al.* (2005) recorded significantly poor FCR in broilers fed diets supplemented with reduced trace minerals than control between 4th, 5th, or 6th week, while Maiorka *et al.* (2002) reported significantly poor FCR with the withdrawal of vitamin and trace mineral premix from the broiler diet in the last seven days before marketing.

Carcass Parameters

The data on carcass parameters, *viz.,* breast yield, eviscerated yield, giblet yield, and ready-to-cook yield, is presented in Table 3. Statistical data analysis revealed non-significant ($p < 0.05$) differences among the treatment groups in all these traits. The results of the study concurred with the findings of Abed *et al.* (2018) and Mohamed *et al.* (2015) that omitting or reducing premix from finisher diets (from 29 to 42 days, and 23 to 39 days of age, resp.) did not influence dressing percent, carcass weight (g), carcass yield (%), breast yield (%), and giblet yield. Maiorka *et al.* (2002) found that withdrawal of dietary vitamin (VS) and mineral (MS) mix between 42 and 49 days did not influence carcass yield and breast yield.

Immune Organ Weight

The percent weight of the thymus and spleen was not affected by the reduction or complete removal of trace minerals from the finisher diet in the sixth week. However, the percent weight of the bursa of Fabricius in group D was significantly lower than group A, B, and C (Table 1). Abed *et al.* (2018) reported a reduction in the weight of the bursa of Fabricius but no influence on percent spleen weight in birds fed corn soya-based diets deficient in vitamins-minerals premixes. Overall results of the experiment indicate that 50% reduction or complete removal of supplemental trace minerals from finisher diet before seven days of marketing does not influence the carcass parameters and percent weight of thymus and spleen.

NDV Titer

The highest log value of 8.33 for haem-agglutination inhibition (HI) titer against Newcastle Disease Virus (NDV) was recorded in the A and B groups, while lower values were recorded in group C (5.00) and group D (5.33) (Table 1). The mean log values for HI titers in broilers against NDV were significantly higher ($p < 0.05$) in control group A and treatment group B than the treatment group C and D. Mochamat *et al.* (2017), however, reported that withdrawal of vitamin and trace minerals from the finisher diet from 21 days did not adversely affect NDV titer.

Footpad Score

The footpad score recorded on the 21st day and 42nd day of the different groups were in the range of 0.02 to 0.03 and 0.14 to 0.24, respectively (Table 1), and these values were statistically similar between the experimental groups. These results were following Mochamat *et al.* (2017).

Mortality

The percentage mortality of control group A and treatment groups B, C, and D was 3.33%, 5.00%, 5.00%, and 3.33%, respectively. The overall mortality recorded in all experimental birds was 4.17% which was within the acceptable limit.

Following Mochamat et al. (2017), the results were that omitting vitamin and trace mineral premixes from the finisher diet from 21 to 42 days of rearing did not adversely affect mortality. Similarly, Ghalkhanbaz *et al*. (2018) also found that reduction or withdrawal of trace mineral premix from finisher diet from 29 to 42 days of rearing had no adverse effect on mortality.

Gait Score

The statistical analysis of the data on the gait score of broiler birds is presented in Table 2. The zero score indicates the normal walking ability of birds. Gait score zero recorded in birds of group A, B, C and D was 65.72%, 63.13%, 62.26% and 61.19% respectively. The percent of birds with gait score zero decrease with reduction or removal of trace minerals,

Table 1: Effect of reduction of trace minerals for seven days from feed prior to marketing of broilers on various parameters

Parameter	*A*	*B*	*C*	*D*	*p-value*	*CD*
body weight (g/bird)	2623.04 ± 52.62	2481.65 ± 48.08	2532.96 ± 41.49	2547.21 ± 31.07	0.21	NS
Body weight gain (g/bird)	2574.74 ± 52.90	2434.25 ± 47.99	2484.25 ± 41.71	2484.25 ± 41.71	0.21	NS
Feed intake (g/bird)	4379.64 ± 41.00	4219.66 ± 61.63	4300.25 ± 57.50	4273.88 ± 34.62	0.2	NS
FCR	1.70 ± 0.02	1.74 ± 0.02	1.73 ± 0.01	1.71 ± 0.01	0.54	NS
Breast meat yield %%	26.77 ± 1.06	26.46 ± 0.54	27.05 ± 0.47	27.77 ± 3.20	0.72	NS
Eviscerated yield %%	65.28 ± 0.68	63.06 ± 0.60	63.91 ± 0.73	63.53 ± 7.17	0.36	NS
Giblet yield %%	3.70 ± 17.93	3.81 ± 5.88	3.87 ± 0.12	3.88 ± 0.46	0.50	NS
Ready to cook yield %%	69.11 ± 17.82	66.50 ± 6.07	67.78 ± 0.67	68.03 ± 7.61	0.31	NS
Thymus %%	0.47 ± 0.03	0.35 ± 003	0.41 ± 0.03	0.40 ± 0.03	0.14	NS
Bursa of Fabricius %%	0.05 ± 0.00[a]	0.05 ± 0.00 [a]	0.05 ± 0.01 [a]	0.04 ± 0.00 [b]	0.04	0.01
Spleen %%	0.14 ± 0.01	0.11 ± 0.01	0.15 ± 0.01	0.13 ± 0.01	0.09	NS
ND titer	8.33 ± 0.21[a]	8.33 ± 0.21[a]	5.00 ± 0.00[b]	5.33 ± 0.21[b]	0.00	0.54
Footpad score (21 d)	0.03 ± 0.02	0.02 ± 0.02	0.02 ± 0.02	0.02 ± 0.02	0.87	NS
Footpad score (42 d)	0.20 ± 0.00	0.24 ± 0.03	0.14 ± 0.03	0.17 ± 0.02	0.06	NS

Table 2: Effect of reduction of trace minerals for seven days from feed prior to marketing of broilers on gait score

Gait score	*A*	*B*	*C*	*D*	*p-value*	*CD*
Zero	65.72 ± 4.28	63.13 ± 1.48	62.26 ± 5.61	61.19 ± 5.38	0.90	NS
One	29.17 ± 3.91	28.05 ± 2.60	24.05 ± 3.28	30.24 ± 5.54	0.72	NS
Two	3.34 ± 1.93	7.16 ± 2.92	11.90 ± 3.07	5.12 ± 1.71	0.14	NS
Three	0.00 ± 0.00	0.00 ± 0.00	1.79 ± 1.79	1.67 ± 1.67	0.59	NS
Four	0.00 ± 0.00	1.67 ± 1.67	0.00 ± 0.00	1.79 ± 1.79	0.59	NS
Five	1.79 ± 1.79	0.00 ± 0.00	0.00 ± 000	0.00 ± 0.00	0.43	NS

Table 3: Overall economics of broiler production with reduced trace minerals in finisher diet for last one week

	Dietary groups			
Parameters	*A*	*B*	*C*	*D*
Total Feed Intake (kg)	4.380	4.220	4.300	4.274
Average Feed Rate (Rs/Kg)	30.334	30.331	30.323	30.312
Total feed cost per bird (Rs)	132.85	127.99	130.40	129.55
Chick cost (Rs)	20	20	20	20
Miscellaneous cost per bird (Rs)	10	10	10	10
Net cost of production per bird (Rs)	162.85	157.99	160.4	159.55
Avg. BW at the end of 6th week (kg)	2.574	2.434	2.484	2.498
Return on sale of bird @ Rs 65 per kg live BW	167.31	158.21	161.46	162.37
Net profit per bird (Rs)	4.46	0.22	1.06	2.82
Net profit per kg (Rs)	1.73	0.09	0.43	1.13

however statistically non significant. Control group A had recorded 4.53% higher birds in gait score zero than group D. Birds with gait scores of 3 and above faces difficulty in getting resources like feed and water, ultimately affecting growth rate. Such lame birds need to be culled in the early stage of market weight leading to decrease farm profitability (Gransquist *et al.,* 2019). Group D had recorded a greater number of birds in gait score three and above than other groups. The statistical analysis of gait score data revealed non-significant differences between groups. Footpad score and gait score results indicate that reduction of trace minerals for seven days from the feed before marketing of broilers does not adversely affect the walking ability of birds.

Economics of Broiler Production

The economics of broiler production at experiment's end was calculated by considering the market prices of inputs and is presented in Table 3. The actual cost of day-old chicks and feed was considered, while the cost of medicines, vaccines, electricity, litter material, and labor was assumed Rs. 10 per bird. The actual cost of sale (Rs.65/kg) was considered while calculating the return on the sale of birds. Thus the difference between the average live weights of broilers was the only factor accountable for the difference in the returns. The highest profit was realized in control group A than treatment group B, C, and D. In contrast, Mohamed *et al*. (2015) reported slightly improved economic efficiency with reducing dietary trace mineral content.

Overall results of the experiment concluded that reducing trace minerals for seven days from the feed before marketing of broilers does not affect performance parameters, carcass parameters, gait score, footpad score, or mortality. However, they failed to maintain the high NDV titers and profitability, which is economically more important.

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