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Effects of Dietary Mineral Premix Reduction or Withdrawal on Broilers Performance

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Abstract: This experiment was conducted to evaluate the effects of withdrawing or reduction mineral premix from diets at 21 to 42 days of age on broiler performance. Two hundred and eighty day old broiler chickens of Cobb 500 strain used in a completely randomized design with 7 treatments, 4 replicates each. Chickens were fed on a common starter diet with suggested mineral premix level (0.5%) for first three weeks age. Seven corn-soybean meal based grower diets with different mineral premix levels were used at 4 to 6 weeks of age. The dietary treatments were the following: T1) 0.5% mineral premix at weeks 4, 5 and 6 T2) 0.5% mineral premix during weeks 4 and 5, and 0.25% at week 6 T3) 0.5% mineral premix during week 4 and 0.25% during weeks 5 and 6 T4) 0.25% mineral premix at weeks 4, 5 and 6 T5) 0.5% mineral premix at weeks 4 and 5 and omitting it during week 6 T6) 0.5% mineral premix during week 4 and removing it during weeks 5 and 6 T7) using diet without mineral premix during weeks 4, 5 and 6. Feed intake and weight gain were measured at the end of each week and feed conversion ratio was calculated. Results showed that reduction or withdrawal of mineral premix from diets in different weeks of grower period, didn't affect feed intake. In weeks 4 and 5, there was no significant difference in weight gain and feed conversion ratio, but in week 6, weight gain of treatment T1 which fed diet with 0.5% mineral premix at whole the experiment period was significantly higher and its feed conversion ratio was significantly lower than other treatments. The overall results of the present study indicated that it's possible to reduce or remove dietary mineral premix during at least first 2 weeks of grower period but longer withdrawal can negatively affect weight gain and feed conversion of broiler chickens. This decline in dietary mineral premix maybe causes an increase in cost per kg of produced chickens.

Key words: Mineral premix withdrawal, broilers chickens, performance

Introduction

Minerals have important biological functions and their requirements of broiler chickens have to be met for optimum growth and performance. NRC (1994) gives the minimum levels that are necessary for optimum productivity. In practice, food manufacturers use much higher concentrations than those specified by NRC (1994). For this reason, mineral deficiencies are not commonly observed. The mineral requirements are determined in specially selected, appropriately managed and sufficiently fed animals. These are minimal requirement levels for maximal weight gain and performance, however, factors like environmental variation and nutrients–mineral interactions are not considered in the determination of requirements. Thus, in practice, food manufacturers, nutritionists and producers use twice to 10 times more of these nutrients than stated requirements. (Inal *et al*., 2001)

Some mineral requirements are minimal. However, rapid growth may increase the need for supplemental minerals. In addition, food ingredients grown in some regions have trace element deficiencies due to soil conditions. For this reason, to ensure the normal levels of such minerals, premixes are added to the ration. In a review, Pallauf (1979) stated that with the exception of trace minerals, such as manganese and zinc, requirements are met by the raw materials used in poultry rations. With regard to the fact that the premix supplementation may contribute up to 2% to 3% of the cost of the food, it would be useful to determine the mineral requirement of broiler chickens in different stages of raring period. This study was carried out to determine whether mineral contents of food raw materials were sufficient to satisfy the needs of the broiler chickens and to examine the effects of reduction or withdrawal of mineral premixes on broiler chickens weight gain and performance during grower stage of raring period.

Materials and Methods

Two hundred and eighty broiler chickens of Cobb 500 strain used in a completely randomized design with 7 treatments, 4 replicates each. Chicks, 10 in each group, were kept in separated pens on floor and maintained on a 24 h constant light schedule. Chicks were fed on common starter diet with suggested mineral premix level (0.5%) during 1-21 days of age. Experimental diets were used at weeks 4 to 6 of age. Seven grower diets

Table 1: Composition and calculated nutrient content of broiler starter (fed 0 to 21 days) and grower (fed 22-42 days)

Ingredients	Starter	Grower
Corn (%)	61.29	68.67
Soybean meal (%)	34.49	37.85
$CaCO_3$ (%)	1.25	1.29
Di calcium phosphate (%)	1.37	1.04
Common salt (%)	0.46	0.3
Vitamin premix (%)	0.5	0.5
Mineral premix (%)	0.5	0-0.5*
DL- Methionine (%)	0.14	0.05
HCl-Lysin (%)	-	-
ME (Kcal/Kg)	2850	2900
Crud Protein (%)	20.47	18.12
Calcium (%)	0.89	0.815
Available Phosphorus (%)	0.4	0.317
Sodium (%)	0.2	0.134
Lysin (%)	1.08	0.927
Methionine (%)	0.46	0.344
Met + Cys (%)	0.86	0.652

*Based on treatment

based on corn and soybean meal with different mineral premix levels were used as follow:

T1 0.5% mineral premix at weeks 4, 5 and 6
T2 0.5% mineral premix during weeks 4 and 5, and 0.25% at week 6
T3 0.5% mineral premix during week 4 and 0.25% during weeks 5 and 6
T4 0.25% mineral premix at weeks 4, 5 and 6
T5 0.5% mineral premix at weeks 4 and 5 and omit it during week 6
T6 0.5% mineral premix during week 4 and withdrawal it during weeks 5 and 6
T7 withdrawal mineral premix during weeks 4, 5 and 6.

The composition of Mineral premix used in this experiment was: Mn 40000 mg/kg, Zn 37000 mg/kg, Fe 20000 mg/kg, Cu 4000 mg/kg, I 400 mg/kg, and Se 80 mg/kg.

Table 1 show the composition of experimental diets.

Feed intake and weight gain were measured at the end of each week and feed conversion ratio was calculated. The feed cost for each kg live weight gain was determined too. Data was analyzed by the General Linear Model of SAS (SAS, 1988). Pen means served as the experimental unit. Means which were found to be significantly different at the $P<0.05$ level were separated using the least square procedure.

Results

The effects of level of mineral premix on feed intake, weight gain and feed conversion of broilers at weeks 4, 5 and 6 of age are shown in Table 2.

Feed intake did not differ between birds fed diets with different levels of mineral premix.

There were no significant differences in body weight associated with level of mineral premix at weeks 4 and 5 of age; however at week 6, treatment T1 that fed diet with 0.5% mineral premix at the whole of experimental period had a significant higher weight gain ($p<0.05$).

At week 6, Treatment T1 had a better feed conversion ratio too ($p<0.05$), while at weeks 4 and 5 no improvement in feed conversion was noted as dietary mineral premix level increased. No significant differences observed in mortality rate.

Discussion

Table 3 compares the mineral provided by diets containing 0.5% mineral premix or without it with bird's requirements according to NRC (1994). It show that total Fe, Cu and Se, 50% of Zn and 30% of Mn required by birds are provided by diet without mineral premix. Diet with 0.5% mineral premix provided up to 3 times more quantities of some minerals in compare to required amounts.

Bioavailability of minerals is an important factor in this respect, for example Mn in corn and soybean meal has a low bioavailability. In the other hand, this low level of bioavailability is considered in estimating the birds requirements, so that the actual Mn requirement of modern broiler chickens is about 14 mg/kg that with regard to natural antagonisms in feeds like phytic acid, fiber and calcium, the determined Mn requirement in a reference like NRC (1994) is 60 mg/kg (Halpin and biker, 1986).

Quantification of ingredient's minerals contents is expensive and per diet formulation often impossible, then using references like NRC recommends is a common procedure. There maybe high variation in Mineral contents of different samples of an ingredients, for example scott, 1973 reported 0.1 to 0.54 mg/kg selenium in soybean meals of different geographical zones.

Most of the previous studies in this area reduced or removed both mineral and vitamin premixes and some of them carried out under environmental stress condition. The results of the present study indicated that reduction or Removal of trace mineral supplements from the diets fed to 21 to 35 days old Broiler chickens caused no significant effect on performance, however, extension of this restriction to last 3 weeks of raring period (21-42 d), affected negatively weight gain and feed conversion. Then it seems that it is possible to reduction or withdrawal of mineral premix from at least part of the grower stage of broilers raring period.

The results of current study are supported by the findings of Skinner *et al.* (1992), Durand and Gernt (1997), Christmas *et al.* (1994). However, longer withdrawal times reported too. In a study by Deyhim and Teeter (1993), removing mineral premix at 28-49 days

Table 2: Performance of Broilers Fed Different levels of mineral premix in the Diet

	Feed intake			Weight gain			Feed Conversion Ratio		
	Week			Week			Week		
	4	5	6	4	5	6	4	5	6
T1	94.3	130.5	152.2	46.7	60.1	76.5[a]	2.02	2.10	1.99[a]
T2	94.2	130.9	152.7	46.9	61.5	70.2[b]	2.01	2.13	2.18[b]
T3	95.1	131.5	152.6	47.6	61.1	72.5[b]	2.00	2.15	2.13[b]
T4	94.8	131.2	153.3	48.1	62.1	72.5[b]	1.97	2.11	2.11[b]
T5	94.9	131.9	153.9	47.1	62.1	70.6[b]	2.01	2.12	2.18[b]
T6	95.1	131.8	154.1	48.8	63.9	70.2[b]	1.95	2.09	2.19[b]
T7	95.3	131.2	153.7	48.1	3.8	69.3[b]	1.98	2.08	2.21[b]
S.E.M	3.94	5.51	6.23	2.55	3.24	3.84	0.12	0.17	0.18

[a, b] Means in a column with no common superscripts differ significantly (P<0.05)

Table 3: Comparison between minerals amounts provided by diets containing 0.5% mineral premix or without it with bird's requirements according to NRC (1994)

	Mn	Zn	Fe	Cu	Se
Requirement (mg/kg) NRC (1994)	60	40	80	8	0.015
Provided by diet without mineral premix (mg/kg)	19.9	28.74	172.19	8.6	0.048
Provided by diet with 0.5% mineral premix (mg/kg)	220	215	270	28	0.45

old did not cause a decline in broilers performance.

Christmas *et al.* (1995), showed that removing both mineral and vitamin premixes from broilers diets during last 2 weeks of raring period (weeks 4 and 5) significantly reduced weight gain but their removing at just 1 last week had no adverse effect on performance and they suggest that its possible to remove mineral and vitamin premixes from commercial broiler diets at last week of production period. Waldroup *et al.* (1968), reported that mineral premix usage in corn - soybean meal based diets didn't have any significant effect on body weight, feed intake or feed conversion of broiler chickens at 0-28 days old. Nilipour *et al.* (1994), in a study used mineral and vitamin premixes at 0, 25, 50, 75 and 100 percent of recommended level and concluded that reduction of this premixes up to 50%, didn't have any adverse effect on broiler chickens.

Deyhim *et al.* (1995), suggest that under heat stress bird's requirements for mineral premix is higher than normal conditions.

Zapata *et al.* (1996), in a study removed mineral and vitamin supplements during 2 or 3 weeks of raring period and measured minerals contents of broilers meat. They observed that the levels of Ca, P, Mg and K were decreased but Na, Fe, Cu, Zn and Mn didn't affect.

In current study, in despite of the statistically insignificant differences observed in production trails following mineral premix reduction or withdrawal at weeks 4 and 5 of age, determining the cost of each kg live weight gain during 3 weeks of experiment period showed that using recommended level of mineral premix (0.5% in treatment T1) reduced production costs. With considering the T1 as a base, the cost per kg live weight for other treatments was 2.5%, 1.6%, 0.2%, 2.3%, 0.2% and 0.6% higher for treatments T2, T3, T4, T5, T6 and T7 respectively.

The overall results of the present study indicated that it's possible to dietary mineral premix reduction or withdrawal during most part of the growth stage of raring period but its maybe cause an increase in cost per kg of produced broilers.

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