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Effect of Mineral-vitamin Premix Reduction on Performance and Certain Hemato-biochemical Values in Broiler Chickens

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ABSTRACT

The current study was performed to evaluate the effect of reducing mineral-vitamin (M-V) premix by 50% or substituting it completely with a commercial product (HepatoCare) on broiler performance as well as blood hemato-biochemical parameters. One hundred and twenty, 14-day old unsexed, broiler chickens of Ross 308 strain were used in a randomized complete block design with 3 treatments, 8 replicates per treatment. Chickens were fed on a common starter diet for the first two weeks of age. Three typical corn-soybeans based finisher diets were formulated based on M-V premix level and source and were fed to broilers from 14-35 days. Broilers were assigned to 3 treatments: T1 is commercial M-V premix at the rate of 0.5%; T2 is M-V premix as in T1 but at lower rate of 0.25%; or T3 is HepatoCare Premix (0.1%). Feed intake (FI) and Body Weight Gain (BWG) were measured weekly and Feed Conversion Ratio (FCR) was computed. Results revealed that reduction of the commercial M-V premix from 0.5-0.25% or replacing it with HepatoCare from the finisher diets had no effect on cumulative BWG, FI and FCR ($p>0.05$). On the other hand, treatment did not affect blood hematology or mineral concentrations in serum ($p>0.05$). The premix at the rate of 0.5% (T3) provided more quantities of some minerals and vitamins as compared to the strains recommendation. It can be concluded that it`s possible to reduce the dietary M-V premix up to 50% during the finisher period from 14-35 days without jeopardizing the performance which will decrease the cost of feed and as a result reduce the cost of production.

Key words: Blood hemato-biochemical parameters, broilers, hepatocare, mineral-vitamin premix, performance

INTRODUCTION

The definitive goal of poultry producers is to maximize production and to achieve a satisfactory economic return; therefore, all nutrient requirements must be met particularly for minerals and vitamins. While the NRC (1994) gives smallest levels of mineral-vitamin (M-V) that are necessary for optimum productivity, feed manufacturers use much higher concentrations than those specified by NRC (1994) to avoid deficiencies. According to Inal *et al.* (2001) feed manufacturers use from

2-10 times more of these nutrients than those specified by the NRC. The cost of the premix supplementation may contribute up to 2-3% of the total cost of the feed, however augmenting the feed with higher levels of M-V could lead to nutrient-mineral interactions.

Several efforts had been conducted to reduce or remove minerals, vitamins or both at different stages of production. For instance, Waldroup *et al.* (1968), examined the effect of mineral premix supplementation in a typical diet for broilers during starter period and concluded removing the premix from the ration did not influence the performance. Nilipour *et al.* (1994), concluded that reduction of the M-V premixes up to 50%, had no adverse effects on broiler performance. While others documented that removing M-V premixes from broilers diets during the last two weeks of the finisher period (weeks 4 and 5) reduced BWG (Christmas *et al.*, 1995). In the same way, Patel *et al.* (1997) reported that, 7-day removal of supplemental M-V premixes from broiler diets from 35-42 days decreased BWG in three different broiler strains. The discrepancies between these studies clearly indicate for more oriented studies, to clarify the understanding of how the performance might be affected as a result of the M-V premix levels. Accordingly, the objective of the present study was to investigate the effects of reducing the M-V premix level from 0.5-0.25% or replacing it with another product (HepatoCare) on broiler performance and blood hematology and minerals concentration during the finisher period.

MATERIALS AND METHODS

Animals, treatments and managements: The current study was conducted by utilizing a total of 120 (14 days-old) unsexed Ross 308 broiler chicks obtained from a commercial farm (Al-Wadi Poultry Farm Co., Riyadh, Saudi Arabia). Chicks were allotted to 24 cages in a 4 deck cage system to construct 8 replicates per treatment. Broilers were randomly assigned to 3 treatments: T1 is commercial M-V premix at a rate used by the industry in Saudi Arabia of 0.5% (Arasco feed, Saudi Arabia); T2 is same brand of M-V premix as in T1 but at lower rate of 0.25%; or T3 is HepatoCare Premix at a rate recommended by the manufacture of 0.1% (Varssha Multitech, Banglore, India).

Chicks were maintained at 23 h light schedule and feed and water were provided *ad libitum*. Chicks received the experimental diets in electrically heated battery brooders with raised wire floors. Furthermore, chicks had been vaccinated for Marek's disease, Newcastle and Infectious Bronchitis. A typical finisher diets based on corn and SBM diets were formulated in mashed form according to Table 1. These diets met the recommendations of commercial practice in Saudi Arabia. The study was pre-approved by the faculty ethics committee, King Saud University.

Performance measurements: During the finisher period, BWG and FI were recorded weekly for each pen. Then, FCR was computed. Mortality was checked daily and weights of dead broilers were used to adjust FCR (Mortality-corrected FCR). At 35 days, 10 birds per treatment were selected, after euthanasia, feather, heads and shanks were removed and the remaining carcasses were dissected to breast and leg quarter and were weighed. The percentage of yield of each part was calculated on the basis of dressed weight.

Hematological and biochemical measurements: At 35 days, blood samples were withdrawn from 3 randomly selected chicks of each treatment via brachial venipuncture into EDTA tubes for hematological analysis and into plain tubes for serological analysis. Collected samples were placed

Table 1: Dietary composition of broiler chick finisher diet

	Treatment		
Parameters	T1	T2	T3
Ingredients			
Yellow corn	61.94	62.15	62.30
Soybean meal	31.00	31.00	31.00
Palm oil	3.00	3.00	3.00
Dicalcium phosphate	2.20	2.20	2.20
Ground limestone	0.61	0.61	0.61
Choline chloride	0.10	0.10	0.01
DL-methionine	0.20	0.20	0.20
L-lysine	0.15	0.15	0.15
Salt	0.30	0.30	0.30
Vitamin-mineral premix[1]	0.50	0.25	0.00
Hepato care premix[2]	0.00	0.00	0.10
Total	100.00	100.00	100.00
Calculated analysis			
ME (kcal kg^{-1})	3000.00	3000.00	3000.00
Crude protein (%)	18.50	18.50	18.50
Non phytate P (%)	0.40	0.40	0.40
Calcium (%)	1.00	1.00	1.00
Lysine (%)	1.00	1.00	1.00
Methionine (%)	0.45	0.45	0.45

[1]Vitamin-mineral premix contains in the following per kg: Vitamin A: 2400000 IU, Vitamin D: 1000000 IU, Vitamin E: 16000 IU, Vitamin K: 800 mg, Vitamin B1: 600 mg, Vitamin B_2: 1600 mg, Vitamin B_6: 1000 mg, Vitamin B_{12}: 6 mg, Niacin: 8000 mg, Folic acid: 400 mg, Pantothenic acid: 3000 mg, Biotin: 40 mg, Antioxidant: 3000 mg, Cobalt: 80 mg, Copper: 2000 mg, Iodine: 400, Iron: 1200 mg, Manganese: 18000 mg, Selenium: 60 mg and zinc: 14000 mg. [2]HepatoCare premix is supplied in the following per kg: Tricholine citrate: 800 mg, Protein hydrolysate: 830 mg, Vitamin B_{12}: 800 μg, Biotin: 10.1 mg, Selenium: 0.33 mg, Vitamin E: 80 mg, DL-methionine: 800 mg, Inositol: 1.20 g and yeast: 4.79 g

inside an ice box and transferred to the laboratory. The various blood parameters measured in this experiment were done by using Maxcom Auto Hematology Analyzer (MC-6200, China). Hematological parameters were determined by methods described by Campbell (1988). Meanwhile, sera were prepared by centrifuging plain tubes at 5°C and 3000 rpm for 10 min. Thereafter, sera were used to determine the levels of minerals by specific methods. Sodium (ion-selective method), chlorine (Labtest method), magnesium (Tonks' method), total calcium (Labtest method) and phosphorus (Basques-Lustosa's method) were determined using commercial kits (M di Europa GmbH Wittekamp 30. D-30163 Hannover, Germany).

Statistical analysis: All statistical analysis was performed using the Statistical Analysis System (SAS, 2003). Three treatments were arranged in 8 replications in a randomized complete block design. Means for measurements showing significant differences in the analysis of variance were tested using the PDIFF option. The overall level for statistical significance was set at $p<0.05$. All values were expressed as statistical Mean±SE of the mean (SEM).

RESULTS AND DISCUSSION

Table 2 compares the M-V levels recommended by NRC (1994), Ross 308 guidelines and those provided by diets containing 0.5% premix (T1), 0.25% premix (T2) and HepatoCare (T3). The M-V

Table 2: Mineral and vitamin requirements suggested by the NRC (1994), Ross-308 nutritional guide and those provided by experimental diets

Experimental	Vitamins (mg)										Minerals (mg)				
diets (kg)	A	K	B_1	B_2	B_6	B_{12}	Biotin	Folic[a]	Niacin	P.A[b]	Cu	Fe	Mn	Se	Zn
NRC, 94	1500	0.5	1.8	3.0	3.5	0.007	0.12	0.50	25.0	25.0	8.0	80.0	60.00	0.15	40.0
Ross 308	9000	3.0	2.0	6.0	4.0	0.016	0.20	1.75	55.0	13.0	16.0	40.0	120.00	0.30	100.0
Diet 1	12000	4.0	6.2	9.5	20.9	0.030	0.34	2.65	61.7	22.1	16.5	86.7	107.70	0.35	98.2
Diet 2	6000	2.0	4.7	7.4	14.6	0.015	0.24	1.65	41.8	14.6	11.5	83.7	62.68	0.20	63.2
Diet 3	-	-	3.2	1.5	4.2	0.010	0.14	0.65	21.8	7.14	6.5	80.8	17.70	0.05	28.3

[a]Folic: Folic acid, [b]P.A: Pantothenic acid

levels recommended by Ross 308 guideline are higher than that for NRC (1994) for all M-V except for iron and pantothenic acid. The requirements specified by the Ross guidelines are more accurate and specific for this particular strain to compensate for high growth rate and breast size, while the NRC (1994) requirements are more general and not specific for certain strain. Birds which had received T1 had higher levels of M-V as compared to the Ross guidelines except for manganese and zinc. While birds which had received T2 had lower vitamin A, K, B_{12}, folic acid, niacin, copper, manganese, selenium and zinc as compared to the Ross requirement for this particular period. However, there were no negative effects on the performance of the birds. HepatoCare provides three vitamins (E, B_{12} and biotin) and one mineral (selenium); biotin, B_{12} and selenium provided by T3 did not meet the requirements for Ross stain guidelines but met the NRC requirements except for selenium. However, it is worth mentioning that copper, iron, manganese and zinc were covered by 81, 100, 30 and 71% by providing T3 and the only source for these minerals were dietary ingredients.

Table 3 shows the effect of treatment on broilers performance during the finisher period at 21, 28, 35 and the cumulative period. Performance parameters such as BWG, FI and FCR were not influenced ($p>0.05$) by treatment for the cumulative period (14-35 days of age). The cumulative FCR for T1, T2 and T3 were (1.6263, 1.6342 and 1.6724 g: g, respectively). This came in accordance with the findings of Skinner *et al.* (1992), Nilipour *et al.* (1994), Christmas *et al.* (1995) and Ogunwole *et al.* (2011), Shahrasb and Gerami (2011) and Moravej *et al.* (2012), they all observed that reducing or eliminating of the M-V premix did not cause an adverse effect on the performance. In T2, the amount of the M-V premix level was reduced by 50% as compared to T1 and there was a lack of effect which could be explained by the fact that the premix supplement was higher than the requirement of the birds during finisher period. This agrees with Skinner *et al.* (1992) who suggested that the amount of these supplements usually exceeds two or three times the recommended requirements for broilers. Leeson and Summers (1997) stated that M-V deficiency requires long periods to demonstrate clinical signs on the birds. In opposition, Maiorka *et al.* (2002) indicated that M-V premix withdrawal at 42 days of age significantly affected the FCR but it had no effect on FI or BWG. Similarly, Deyhim and Teeter (1993) reported loss in performance and carcass traits due to the withdrawal of the premix from the diet. Deyhim *et al.* (1995) reported an increase in BWG of broilers when vitamins were added to a basal low vitamin diet.

However, a significant effect for treatment was observed at the second week of the experiment (28 days of age) for BWG, higher BWG was reported for birds which had received T1 (569.7 g) or T2 (545.1 g) a as compared to those which had received T3 (497.3 g) ($p<0.05$). Birds which had received HepatoCare (T3) performed similarly to the other groups for the cumulative period,

Table 3: Body weight gain, feed intake and feed conversion ratio of broiler chickens given experimental diets at different ages

	Treatment				
Parameters	T1	T2	T3	SEM	p-values
Performance at 21 day					
BWG (g)	450.9	467.7	450.9	±6.210	NS
Feed (g)	634.5	643.6	622.3	±6.710	NS
FC (g: g)	1.4081	1.3765	1.3814	±0.014	NS
Performance at 28 day					
BWG (g)	569.7[a]	545.1[a]	497.3[b]	±14.690	*
Feed (g)	912.7	892.0	881.3	±19.710	NS
FC (g: g)	1.6043	1.6449	1.7837	±0.055	NS
Performance at 35 day					
BWG (g)	541.9	554.2	519.2	±24.840	NS
Feed (g)	981.9	1023.6	1016.6	±24.780	NS
FC (g: g)	1.8607	1.8486	1.9847	±0.078	NS
Cumulative 14-35 day					
BWG (g)	1562.5	1566.9	1509.3	±40.900	NS
Feed (g)	2529.0	2559.2	2520.2	±35.060	NS
FC (g: g)	1.6263	1.6342	1.6724	±0.030	NS

[1]BWG: Body weight gain, [2]FI: Feed intake, [3]FCR: Feed conversion ratio, [ab]Means in the row with different superscripts differ significantly (*p<0.05, NS: Not significant)

Table 4: Effect of different treatments on parts yield as percentages of broiler dressed weight at day 35

	Treatment				
Parts yield (%)	T1	T2	T3	SEM	p-values
Dressed yield	74.8	74.8	74.3	±1.07	NS
Breast	35.5	34.8	34.4	±0.36	NS
Leg quarter	38.9	38.4	39.0	±0.46	NS
Abdominal fat	1.91	1.83	1.84	±0.15	NS

[1]Breast and leg quarter were expressed as percentage of the carcass weight

HepatoCare is a combination of lipotropic agents, liver stimulants, antioxidants, mold inhibitors and toxin binders. It contains vitamin B_{12}, Biotin, vitamin E and selenium, nutrients that are necessary for maintaining the liver. The addition of this product did not add any benefits to the performance of broilers at this age above that of T1 or T2. On the other hand, treatment had no effect on dressing percentage, breast muscle yield, leg quarter yield and abdominal fat (p>0.05) (Table 4). The mean values for breast muscle and leg quarter were 35.5, 34.8 and 34.4% for breast; 38.9, 38.4 and 39.0% for leg, for T1, T2 and T3, respectively.

Table 5 shows the effect of treatment on some hematological and biochemical parameters of broiler blood profile. None of the parameters measured were significant (p>0.05), the values of the blood parameters measured in this trail were comparable and treatment had no effect on blood hematological or minerals concentration (p>0.05). This was an indication of the nutritional adequacy of the diets used. Brown and Clime (1972) had reported that serum biochemical constituents are positively correlated with the quality of the diet.

Table 5: Effect of different treatments on blood of broilers at 35 day of age

	Treatment				
Blood parameters	T1	T2	T3	SEM	p-values
Hematology					
WBC ($\times 10^9$ L)	107.4	120.70	114.7	±7.90	NS
RBC ($\times 10^{12}$ L)	3.9	3.20	3.4	±0.40	NS
HGB (g dL^{-1})	36.9	29.40	32.8	±3.60	NS
MCV (fl)	116.5	113.70	119.8	±3.10	NS
MCH (pg)	95.1	93.70	97.0	±2.80	NS
MCHC (g dL^{-1})	81.7	82.30	81.0	±1.90	NS
RDW-CV (%)	10.0	9.10	9.6	±0.60	NS
RDW-SD (fl)	46.7	41.30	46.3	±4.20	NS
HCT (%)	45.3	36.10	40.5	±4.90	NS
PLT ($\times 10^9$ L)	103.3	85.00	46.7	±12.80	NS
MPV (fl)	11.6	11.60	11.0	±0.50	NS
PDW	14.4	15.00	11.2	±1.00	NS
PCT (%)	0.1	0.05	0.1	±0.01	NS
Minerals					
Na (mmol L^{-1})	9.0	6.70	11.3	±0.01	NS
Cl (mmol L^{-1})	97.3	97.30	96.7	±1.60	NS
Mg (mmol L^{-1})	2.4	2.50	2.5	±0.18	NS
Ca (mg dL^{-1})	9.5	10.10	12.0	±0.52	NS
P (mg dL^{-1})	10.4	11.60	10.9	±1.15	NS

WBC: White blood cell counts, RBC: Total red blood cell counts, HGB: Hemoglobin content, MCV: Mean corpuscular volume, MCH: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentration, RDW-SD: Standard deviation in red cell distribution width, RDW-CV: Coefficient variation of red cell distribution width, HCT: Hematocrit, PLT: Platelet count, MPV: Mean platelet volume, PDW: Platelet distribution width, PCT: Plateletcrit, Na: sodium, Cl: Chloride, Mg: Magnesium, Ca: Calcium and P: Phosphorus

CONCLUSION

Based on the presented evidences, it can be concluded that it`s possible to reduce the dietary M-V premix up to 50% from 14-35 days of age in broilers without jeopardizing the performance or hemato-biochemical parameters of blood. Diet with 0.5% M-V premix provided more quantities of some minerals and vitamins in compare to required amounts. Furthermore, birds which had received HepatoCare performed similarly to the other two groups, the addition of this product did not add any benefits to the performance of broilers at this age above the commercial M-V premix.

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