

Effects of Omitting Vitamin-Trace Mineral Premixes from Finisher Ration on Performance, Carcass Parameters and Blood Characteristics of Broilers Fed Corn- or Wheat-Based Diets

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Abstract

Objective: An experiment was conducted to investigate the effect of cereal sources (corn or wheat) and omitting premix from finisher diets (from 29 to 42 days of age) on broiler performance, carcass measurements, and blood biochemical properties.

Methodology: Before starting an experiment, chicks were fed on two dietaries (240 chicks/corn-soybean meal and 240 chicks/wheat-soybean meal diets) from one-day-old to 28 d of age. Four hundred and eighty day-old Ross-308 male broiler chicks were used in a 14-day trial (from 3/11/2016 to 16/11/2016). The experiment consisted of 4 treatments as follows: Treatment 1, no withdrawn of premix from corn-soybean meal diets, treatment 2, withdrawal premix from corn-soybean meal diets, treatment 3, no withdrawn of premix from wheat-soybean meal based diets and treatment 4, withdrawal premix from wheat-soybean meal diets. Each dietary treatment consisted of 8 replicates (15 birds/ pen).

Results: Body weight, body weight gain, feed intake, feed conversion ratios, carcass parameters, blood biochemical properties were not affected by the withdrawal of vitamin and trace mineral premixes from corn-based diets, but the reduction in BWG, relative weight of heart, bursa of Fabricius and abdominal fat was noticed in birds fed wheat-based diets deficient in VT and TRM. Blood biochemical properties were not affected by cereal type and VIT and TRM premix withdrawal.

Conclusion: the current results suggested that the broiler dietary grain sources influenced the weight gain with respect to VIT and MRT premixes withdrawal from finisher rations. Whereas, the omission of VIT and MRT might be applied to birds fed a corn-based diet.

Keywords: Blood Parameters; Broilers; Carcass Traits; Corn; Performance; Premix Omitting; Wheat

Introduction

The feed cost is about 70% of broilers production. The cost of premixes is about two to three times of another ingredient. Although vitamins and trace minerals consist a small part of the total feed cost, their withdrawal from the diet fed during the 7 to 14 days period prior to marketing could reduce production costs significantly because of approximately of 55% of total feed consumption and 25% of growth are occurring in this period [1]. NRC [2] gives the minimum requirements that are necessary for optimal productivity, whereas, food manufacturers use twice to tenfold more of these nutrients recommended as reported by Inal *et al.* [3]. Therefore, the eliminations of vitamins (VIT) and/or trace mineral (TRM) for 14 days before slaughtering it is not an issue due to food ingredients and body reserves can overcome any deficiencies in these nutrients [4]. It is well documented that the omitting of vitamins (VIT) and/or trace mineral (TRM) from finisher broilers diets could not cause negative impact on performance especially in temperate conditions, but in heat stressed broilers conflict may found, some researchers found the reduction in performance, whereas others they not found any adverse effects on performance [4-11]. Broilers are routinely fed diets contain corn or wheat as the main source of cereal grains and soybean meal as a major protein source. Corn and wheat are two major bowls of cereal sources provide energy to poultry feed and at the same time, it provides protein, vitamins, and minerals. Corn and wheat are different in their contents from macro and micro minerals, intrinsic phytase, and vitamins. For example, wheat contains total calcium, phosphorus, magnesium and doubles concentration of copper and zinc than corn, whereas, corn contains about four times more manganese than wheat [12]. Meanwhile, wheat has higher phytase and acid phosphatase activities than corn [13]. Vitamins and carotenoids in corn and wheat are also different. For example, vitamin E and carotenoids that consider the most beneficial antioxidant are more concentrated in corn than wheat. On the other hand, with respect to B vitamins, corn has much less thiamine, riboflavin, pyridoxine, niacin and higher biotin bioavailability compared with wheat [14-20]. These differences in vitamins and minerals in wheat and corn may don't give the minimum requirements that recommended by NRC therefore, the successfully of omission

VIT and MRT premixes from finisher broilers ration may depend on the ingredient feedstuffs that formulate diets [2]. There is a paucity of information in the literature regarding the effects of removing VIT and TRM premixes from diets differ in cereal sources since diet formulations differ across the world, so corn-based diets are common in the USA and wheat-barley diets are common in Europe [21,22]. Therefore it is reasonable to suggest that these diets will have the different impact on broiler parameters when fed diets absence from vitamins and trace minerals. The present work was carried out to evaluate the effects of VIT and TRM premixes withdrawal from the finisher diet on growth performance, carcass parameters, and blood characteristics of male broiler chickens fed on corn- or wheat-based diets.

Materials and Methods

Chickens and housing

A total of 480 days old male commercial chick of Ross 308 was used. Newly hatched chicks were reared by thirty-two replicated floor pens were bedded with a wood-shavings litter and equipped with one feeder and one watered. Feed and water were provided ad libitum. Lighting maintained continuously throughout the experimental period. The chicks were obtained from commercial parents stocks that found in Iraq in that time. Any chicks that appear morbid or sick were culled from the flock so, only hygienic birds were used in this experiment.

Feeding and dietary treatment

Chicks were fed on corn- or wheat – based diets ad libitum from day to 11 days of age on the starter and from 11-28 days of age on grower diet fortified with vitamins and trace minerals that supplied from premix (Table 1). At 28 d of age, the bird that fed on corn-based diets still to eat experimental corn-based diets, while those fed on wheat-based diets are also eaten experimental wheat-based diets. Four experimental dietary treatments were offered as follows: treatment 1, no withdrawal premix from corn-soybean meal diets, treatment 2, withdrawal premix from corn-soybean meal diets, treatment 3, no withdrawn of premix from wheat-soybean meal based diets and treatment 4, withdrawal premix from wheat-soybean meal diets (Table 2). Each dietary treatment consisted of 8 replicates (15 birds/ replicate). Finisher ration with no antioxidant added was prepared at the day of initiation of the experiment. Commercial VIT-MRT premix was used in the present experiment.

Ingredient and composition (%)	Starter (1-14 d of age) ¹		Grower (15-28 d of age) ²	
	Corn-based	Wheat-based	Corn-based	Wheat-based
Corn	56.70	--	60.00	---
Wheat	--	59.26	--	64.24
SBM (48% CP)	37.40	33.40	34.10	28.00
Vitamin-mineral premix	2.50	2.50	2.50	2.50
Sunflower oil	1.90	3.40	2.50	4.20
Limestone powder	0.70	0.70	0.00	2.0
Dicalcium phosphate	0.50	0.40	0.80	6.0
L-Lysine HCL	0.10	0.17	0.00	1.5
DL-Methionine	0.10	0.17	0.10	1.1
Calculated analysis				
Protein	23.03	23.13	21.72	21.09
ME (Kcal/kg)	3011	3011	3107	3107
Lysine	1.46	1.44	1.30	12.4
Methionine	0.66	0.69	0.64	0.69
Methionine +Cystine	1.05	1.07	1.00	0.99
Tryptophan	0.32	0.32	0.29	0.29
Threonine	0.82	0.78	0.77	0.70
Calcium	1.06	0.98	0.91	0.94
Phosphorus (Avail.)	0.47	0.48	0.46	0.45

Table 1: Ingredients and compositions of starter and grower rations of broilers

¹Vitamins and mineral mix supplied the following per kg of diet: vitamin A (retinol acetate), 4.64 mg; vitamin D3 (cholecalciferol), 0.12 mg; vitamin E (d-alpha-tocopherol), 45 mg; vitamin B1 (thiamine mononitrate), 3 mg; vitamin B2 (riboflavin), 9 mg; vitamin B6 (pyridoxine chlorhydrate), 4.5 mg; vitamin B12 (cyanocobalamin), 0.017 mg; vitamin K3 (menadione), 3 mg; Ca panthothenate, 16.5 mg; nicotinic acid, 51 mg; folic acid, 1.8 mg; biotin, 0.03 mg; Fe, 54 mg; I, 1.2 mg; Co, 0.6 mg; Cu, 12 mg; Mn, 90 mg; Zn, 66 mg; Se, 0.18 mg; Mb, 1.2 mg

²Vitamins and mineral mix supplied the following per kg of diet: vitamin A (retinol acetate), 4.64 mg; vitamin D3 (cholecalciferol), 0.12 mg; vitamin E (d-alpha-tocopherol), 45 mg; vitamin B1 (thiamine mononitrate), 3 mg; vitamin B2 (riboflavin), 9 mg; vitamin B6 (pyridoxine chlorhydrate), 4.5 mg; vitamin B12 (cyanocobalamin), 0.017 mg; vitamin K3 (menadione), 3 mg; Ca panthothenate, 16.5 mg; nicotinic acid, 51 mg; folic acid, 1.8 mg; biotin, 0.03 mg; Fe, 54 mg; I, 1.2 mg; Co, 0.6 mg; Cu, 12 mg; Mn, 90 mg; Zn, 66 mg; Se, 0.18 mg; Mb, 1.2 mg

Ingredients and composition	Corn- based diets		Wheat-based diets	
	With (T1)	Without (T2)	With (T3)	Without(T4)
Corn	64.00	63.02	-	-
Wheat	-	-	68.36	67.25
Soybean meal	29.80	30.00	23.50	24.30
Vitamin-mineral premix	2.50	0.00	2.50	0.00
Sunflower oil	3.00	3.60	4.60	5.00
Limestone	-	1.00	0.15	1.05
Dicalcium Phosphate ³	0.70	1.70	0.20	1.60
DL-Methionine	-	0.22	0.08	0.30
L-Lysine	-	0.16	0.11	0.20
Salt	-	0.30	-	0.30
Calculated Analysis				
Crude Protein	19.55	19.31	19.52	19.50
MK (Kcal/kg feed)	3177	3167	3158	3144
Lysine	1.18	1.17	1.15	1.12
Methionine	0.52	0.53	0.55	0.56
Methionine + Cystine	0.86	0.86	0.88	0.88
Crude fiber	2.57	2.56	2.97	2.96
Crude fat	5.73	6.29	6.54	6.92
Calcium	0.88	0.88	0.88	0.88
Avail. Phosphorus	0.43	0.42	0.43	0.42

Table 2: Ingredients and compositions of finisher rations of broilers

²Vitamins and mineral mix supplied the following per kg of diet: vitamin A (retinol acetate), 4.64 mg; vitamin D3 (cholecalciferol), 0.12 mg; vitamin E (d-alpha-tocopherol), 45 mg; vitamin B1 (thiamine mononitrate), 3 mg; vitamin B2 (riboflavin), 9 mg; vitamin B6 (pyridoxine chlorhydrate), 4.5 mg; vitamin B12 (cyanocobalamin), 0.017 mg; vitamin K3 (menadione), 3 mg; Ca panthothenate, 16.5 mg; nicotinic acid, 51 mg; folic acid, 1.8 mg; biotin, 0.03 mg; Fe, 54 mg; I, 1.2 mg; Co, 0.6 mg; Cu, 12 mg; Mn, 90 mg; Zn, 66 mg; Se, 0.18 mg; Mb, 1.2 mg

Measurements

Chicks were weighed at 28, 35 and 42 days of age. BW Gain (BWG) was calculated from 28-35, 35-42 and 28-42 days of age. Feed consumption (FC) and feed conversion ratio (FCR) were determined by pen (replicate) weekly and then summarized in periods from 28-35, 35-42 and 28-42 days of age. FC was adjusted for mortality. At 42 days of age, 16 birds per treatment group were selected randomly and fasted overnight (16 hr.). They were weighed and slaughtered, scalded, picked and eviscerated. Weights of carcass yield (minus giblets and abdominal fat), gizzard, liver, heart, abdominal fat pad, spleen and bursa of Fabricius, breast, thigh, drumsticks, wings, back, neck and abdominal fat pad were calculated based on live body weight. Blood samples were collected from birds at 42 d of age via jugular vein after slaughtering by the Halal method. A blood sample was divided into two parts, one placed in heparinized tubes and other placed in non- heparinized tubes. Blood in heparinized tubes was used to determine the white blood cells, heterophil, and lymphocyte. Monolayer films made by pushing approximately 3 µL of blood across a standard microscope slide were dried immediately by a hot air stream. Slides were then immersed in 95% ethanol and postfixed for 10 to 15 min. Films were stained by Wright-Gimsa method following the times and procedures recommended by the manufacturer [23]. The non-heparinized tubes were centrifuged at 3000 rpm for 15 min to separate serum. Serum lipids examined included triacylglycerol, total cholesterol and total protein using enzymatic kits (Linear Chemicals, Barcelona, Spain). Serum glucose was measured using a commercialized glucose oxidation method according to the manufacturer's instructions (Sigma Diagnostics Inc., Michigan; USA). Alanine (ALT) and aspartate aminotransferase (AST) activity in serum were measured colorimetric kits according to the manufacturer's instructions (Randox, London, the UK). Serum calcium and phosphorus were determined photometrically using commercial kits (Linear Chemicals, Barcelona, Spain).

Statistical analysis

Data were subjected to one-way analysis of variance. Duncan's multiple range tests were used to compare the differences among treatment means. All statistical analysis by General Linear Models (GLM) procedure was carried out with SAS/STAT software [24].

Results

Performance

The omission of VIT - MRT premix from finisher wheat-based diets caused a reduction in BWG during a period from 28 to 35 d

and 28 to 42 d of age compared with counterparts fed corn-based diets. But when comparisons made between the same cereals sources with respect to the omission of VIT - MRT premix, the BW, and BWG did not differ significantly. Feed consumption (FC) and feed conversion ratio (FCR) was not affected by the removal of VIT - MRT premix from finisher ration, but numerical decreases in FC was noticed in the group of birds fed on wheat-based diets absent from VIT - MRT premix (Table 3).

Traits	Treatments ¹					
	T1	T2	T3	T4	Pooled SEM	P- value
Body weight (g)						
28 d	1131 ^b	1147 ^b	1275 ^a	1225 ^{ab}	19.99	0.0263
35 d	1895	1957	2024	1924	23.43	0.2481
42 d	2851	2839	2881	2806	23.79	0.7547
Weight gain (g/bird)						
28 to 35 d	764 ^{ab}	810 ^a	748 ^{ab}	699 ^b	12.96	0.0176
35 to 42d	956	882	857	882	15.46	0.1180
28 to 42 d	1720 ^a	1691 ^{ab}	1605 ^{bc}	1581 ^c	18.63	0.0144
Feed consumption (g/bird)						
28 to 35 d	1247	1264	1190	1149	19.58	0.1338
35 to 42d	1450	1500	1440	1394	27.33	0.3326
28 to 42 d	2698	2765	2630	2544	43.77	0.7547
Feed Conversion Ratio (g feed: g gain)						
28 to 35 d	1.64	1.57	1.59	1.64	0.02	0.7170
35 to 42d	1.54	1.70	1.67	1.59	0.03	0.4652
28 to 42 d	1.57	1.63	1.63	1.61	0.02	0.828

Table 3: Body weight, weight gain, feed consumption and feed conversion ratio of broilers fed a corn or wheat-based diets presences or absent from vitamin- trace mineral premixes

^{a-c} means within the same row have the different superscripts differ significantly (P<0.05)

¹: T1, birds fed on corn-based diets with premixes; T2, birds fed on corn-based diets without premixes; T3, birds fed on wheat-based diets with premixes; T2, birds fed on wheat-based diets without premixes

Carcass parameters

For processing parameters, carcass weight (g) and yield (%), gizzard, liver, breast, thigh, and drumsticks were not affected by dietary treatments. While, the relative weight of heart, abdominal fat pad and bursa of fabricia was decreased significantly in the group of birds fed on wheat-based diets absent from VIT - MRT premixes during finishing period (Table 4).

Traits	Treatments ¹					
	T1	T2	T3	T4	Pooled SEM	P- value
Carcass weight (g)	1871	1849	1730	1790	53.14	0.4034
Carcass yield (%)	73	75	73	74	0.48	0.3923
Heart %	0.57 ^{ab}	0.61 ^a	0.50 ^{bc}	0.49 ^c	0.01	0.0067
Gizzard %	1.70	1.61	1.39	1.40	0.05	0.1310
Liver %	2.64	2.58	2.39	2.51	0.07	0.7439
Abdominal fat %	1.28 ^{ab}	1.51 ^a	1.1 ^b	1.05 ^b	0.07	0.1211
Spleen %	0.12	0.12	0.11	0.09	0.006	0.5908
Bursa of Fabricius %	0.16 ^a	0.13 ^{ab}	0.13 ^{ab}	0.08 ^b	0.01	0.0722
Breast (g)	670	663	657	667	25.95	0.4067
Thigh (g)	268	269	267	260	12.82	0.9954
Drumsticks (g)	236	234	227	250	6.47	0.6700
Breast %	26.98	27.18	27.86	26.00	1.08	0.9202
Thigh %	10.92	10.99	11.38	9.91	0.59	0.8553
Drumsticks %	9.51	9.56	9.60	9.41	0.25	0.9951

Table 4: Carcass characteristics of broilers fed a corn or wheat-based diets presences or absent from vitamin- trace mineral premixes

^{a-c} means within the same row have the different superscripts differ significantly (P<0.05)

¹: T1, birds fed on corn-based diets with premixes; T2, birds fed on corn-based diets without premixes; T3, birds fed on wheat-based diets with premixes; T2, birds fed on wheat-based diets without premixes

Blood Parameters

Table 5 shows the effect of dietary treatments on blood parameters. White blood cell, heterophils/ lymphocytes ratio and blood – biochemical was not affected by VIT and TRM premixes withdrawal from finisher rations of broilers.

Traits	Treatments ¹					
	T1	T2	T3	T4	Pooled SEM	P- value
White blood cells (10 ³ / mm ³)	21.65	21.32	21.65	21.67	0.25	0.8672
Heterophils (H)%	28.12	31.25	28.87	26.25	1.19	0.5399
Lymphocytes (L) %	63.87	60.50	63.12	64.62	1.26	0.6996
H/ L ratio	0.44	0.52	0.46	0.41	0.03	0.7059
Serum protein (g/dl)	3.50	3.62	3.58	3.35	0.05	0.3441
Serum albumin (mg/dl)	2.66	2.75	2.67	2.52	0.05	0.5476
Serum cholesterol (mg/dl)	158.87	154.12	152.00	151.12	2.26	0.6465
Serum triglyceride (mg/dl)	153.75	162.12	160.37	159.62	3.16	0.8197
Serum calcium (mg/dl)	9.10	8.95	9.13	8.66	0.12	0.5296
Serum phosphorus (mg/dl)	7.31	6.91	6.82	6.17	0.15	0.0675
Serum ALT (U/L)	11.00	11.25	11.25	10.62	0.34	0.3201
Serum AST (U/L)	12.87	13.00	14.12	12.50	0.31	0.9176

Table 5: Blood parameters of broilers fed a corn or wheat-based diets presences or absent from vitamin- trace mineral premixes ^{a-c} means within the same row have the different superscripts differ significantly (P<0.05)

¹: T1, birds fed on corn-based diets with premixes; T2, birds fed on corn-based diets without premixes; T3, birds fed on wheat-based diets with premixes; T2, birds fed on wheat-based diets without premixes

Discussion

At the beginning of experiment at 28 d of age, BW of birds fed wheat-based diets was significantly greater than those fed corn-based diets because chicks fed wheat-based diets from day old to 28 d achieved better performance than those fed corn-based diets. On the other hands, the hypothesis of this experiment was to investigate the impact of the differences in cereals type at starter period on broiler's performance at finisher period when fed diets absent from VIT and TRM. Although the results showed that the BW of birds fed wheat-based diets was higher than corn-based diets, the BWG was tending to greater in birds fed corn-based diets. Feed conversion ratio during period from 28-35 d of age was better than other periods may be as results of lower feed intake with greater BW gain in this period.

In the same cereals grains, the omission of VIT and TRM premixes could not casus and deleterious effects on performance. But when the comparison was made among all treatment, chicks fed wheat-based diets absent from VIT and TRM premixes achieved lower BWG than those fed deficient corn-based diets. This is might be wheat have much less antioxidant (Vitamin E and carotenoids), low biotin bioavailability and low levels of manganese than corn. Schiedt, noticed that the carotenoids involved in growth metabolism. Vitamin E (α -tocopherol) also effect on growth when would not meet the requirement of broilers [2,12,20,25]. In the current experiment, the vitamin A (less carotenoid in wheat which acts as a precursor of vitamin A) and vitamin E in group of birds fed on wheat-based diets absent from VIT-TRM premix was less than requirements recommended by nutrition supplements guide of this strain but when sunflower oil (fortified with vitamin E) was added to finisher diets, the compensation of vitamin E may occur accordingly [26]. So the reduction in growth in wheat-based diets may be due to a reduction in precursor of vitamin A as reported by Surai and Sparks [27] who found the major differences between wheat- and corn-based diets is the concentration of carotenoids (lutein and zeaxanthin) which was 11.8 and 5.6 mg/ kg in corn- and wheat-diet respectively. Koutsos *et al.* [28] found greater body weight losses in birds fed diets containing 0 mg lutein/ kg diet compared with those fed 40 mg lutein/ kg diet. Manganese deficient diets (14.82 mg/ kg) were another element can cause decreases in BWG and FCR [29]. Maiorka *et al.* [4] reported that the omission of fat-soluble vitamins is not an issue due to these vitamins can liberate from fat to overcome any shortening of these vitamins. This hypothesis may true in corn-based diets, but with wheat-based diets may be not, because of a type of fat in the body was more firm than in corn and consequently, fat-soluble vitamins are hard to be liberated again when body they needed it after vitamins shortening in the broiler diets [16]. The reduction in BWG and feed efficiency due to removing of vitamins and minerals premix from finisher ration was reported [6,9,30]. Maiorka *et al.* [4] found poor feed conversion due to the withdrawal of vitamin mix from finisher rations. Whereas, Skinner *et al.* [5] found no adverse effect on growth performance due to removing vitamin and trace mineral premixes from broiler diets from 28 to 49 d of age. Razuki *et al.* [31] found that reduction of protein concentrate packages (PC) to 50% of recommended levels (10%) didn't have any adverse effect on broiler performance at various periods of reductions. Abudabos *et al.* [32] concluded possibility of reduction vitamin-minerals premix up to 50% for 21 days intervals without any jeopardizing on performance. Conflict results may due to the increase of broiler requirements due to continuously selection to increase market BW at constant age. Furthermore, the environmental tool (hot vs temperate climate),

management practice (cage or floor litter) or ingredient type (diet composition) may be another reason make differences to be found in the literature.

Removing premix from finisher ration between 28 to 42 days of age had no significant impact on the absolute and relative weight of carcass and carcass yield (%), percentages of breast, thighs, and drumsticks (Table 5). These findings confirm the results obtained by others [4,7,10,32]. The relative weight of heart, bursa of Fabricius and abdominal fat pad was decreased in birds fed wheat-based diets absent from VIT and TRM premix. The low weight of bursa may due to the reduction in carotenoid (precursor of vitamin A) and vitamin E in these diets. Vitamin E, a major chain-breaking antioxidant of membranes, can scavenge the hydroxyl, alkoxy, peroxy, and superoxide anion radicals and increase membrane stability [33]. The current finding was not confirmed the previous study that found the relative weight of bursa of Fabricius was not affected by VIT withdrawal [34]. Our results suggested that the VIT and TRM contents of wheat and soybean meal diet were not sufficient to maintain the immunity response when the grower wheat-based diet was not fortified with VIT and TRM premix. The reduction in relative weight of abdominal fat pad due to omission VIT and TRM premix from wheat-based diets was a result of low feed intake, even showed non-significant with other treatments. Chen *et al.* [35] found the significant depression in the abdominal fat percentage in birds fed on diets containing 70% of their energy requirements. In the present study, the serum blood constituents were not affected by omission of VIT and TRM premix. These results are agreement with Khajali *et al.* [7] who found no effect on H/L ratio when diets deplete from VIT and TRM premix and with Abudabos *et al.* [32] who found no significant effect of vitamin- trace minerals withdrawal on blood parameters.

Conclusion

The current results suggested that the broiler dietary grain sources influenced the gain with respect to VIT and MRT premixes withdrawal from finisher rations. Whereas, the omission of VIT and MRT might be applied to birds fed a corn-based diet.

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