

Effects of omitting vitamin- mineral premixes from finisher diets on performance, carcass parameters and blood characteristics of broilers fed maize- or wheat- based diets

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Abstract

An experiment was conducted to investigate the effect of cereal sources (maize or wheat) and omitting premix from finisher diets (from 29 to 42 days of age) on broiler performance, carcass measurements, and blood biochemical properties. Before starting an experiment, chicks were fed on two dietaries (240 chicks/maize-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 The experiment consisted of 4 treatments as follows: Treatment 1, no withdrawn of premix from maize-soybean meal diets, treatment 2, withdrawal premix from maize-soybean meal diets, treatment 3, no withdrawn of premix from wheat-soybean meal based diets and treatment 4, withdrawal premix from wheat-soybean meal diets.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). 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 maize-based diets, but the reduction in body weight gain, relative weight of heart, bursa of Fabricius and abdominal fat was noticed in birds fed wheat-based diets deficient in vitamins-minerals premixes. Blood biochemical properties were not affected by cereal type and vitamins-minerals premix withdrawal.

Keywords: blood parameters, broilers, carcass traits, maize, performance, premix omitting, wheat
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تأثير سحب خليط الفيتامينات والمعادن من علائق النهائي في الأداء الإنتاجي ومواصفات

الذبيحة وصفات الدم لفروج اللحم المغذى على علائق الذرة الصفراء أو الحنطة

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الخلاصة

اجريت التجربة بهدف التحري عن تأثير مصدر الحبوب (الذرة الصفراء والحنطة) وسحب البريمكس من علائق النهائي (29-42 يوم) في الأداء الانتاجي لفروج اللحم، قياسات الذبيحة وصفات الدم الكيموحيوية. غذيت الافراخ قبل البدء بالتجربة على عليقتين بواقع (240 فرخاً/ عليقة الذرة الصفراء- كسبة فول الصويا و240 فرخاً على عليقة الحنطة- كسبة فول الصويا) من اليوم الاول من عمرها لحد 28 يوم. تم استخدام 480 فرخاً من ذكور فروج اللحم سلالة (Ross308) لمدة 14 يوم من عمر التجربة (من 3/11/2016 إلى 16/11/2016). تألفت التجربة من اربع معاملات كما يأتي: المعاملة الاولى، تغذى الطيور على عليقة الذرة الصفراء مع البريمكس، المعاملة الثانية، تغذى الطيور على عليقة الذرة الصفراء من دون البريمكس، المعاملة الثالثة، تغذى الطيور على عليقة الحنطة مع البريمكس والمعاملة الرابعة، تغذى الطيور على عليقة الحنطة من دون البريمكس. تألفت كل

معاملة من ثمان مكررات (15 طير/ مكرر). اشارت النتائج بعدم تأثر كل من وزن الجسم، الزيادة الوزنية، استهلاك العلف، معامل التحويل الغذائي، قياسات الذبيحة والصفات الكيموحيوية للدم عند سحب خليط الفيتامينات والمعادن من علائق الذرة الصفراء، لكن لوحظ انخفاض في كل من الزيادة الوزنية، الاوزان النسبية للقلب، غدة فابريشيا ودهن البطن في الطيور المغذاة على علائق الحنطة. لم تتأثر الصفات الكيموحيوية للدم بنوع مصدر الحبوب ولا مستوى الديرمكس.

الكلمات المفتاحية: معايير الدم، فروج اللحم، مواصفات الذبيحة، الذرة الصفراء، الأداء، خليط الفيتامينات والمعادن، الحنطة.

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 occurred in this period (1). NRC (1994)(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 (4-8), but in heat stressed broilers conflict may found, some researchers (6, 9, 10) found the reduction in performance, whereas others (11) they not found any adverse effects on performance. Broilers are routinely fed diets contain maize or wheat as the main source of cereal grains and soybean meal as a major protein source. Maize 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. Maize and wheat are different in macro and micro mineral, intrinsic phytase, and vitamins content. For example, wheat contains total calcium, phosphorus, magnesium and doubles concentration of copper and zinc than maize, whereas, maize contains about for times more manganese than wheat (12). Meanwhile, wheat has higher phytase and acid phosphatase activities than maize (13). Vitamins and carotenoids in maize and wheat are also different. For example, vitamin E (14) that consider the most beneficial antioxidant are more concentrated in maize than wheat. On the other hand, with respect to B vitamins, maize has much less thiamine, riboflavin (15), Pyridoxine, niacin (16, 17) and higher biotin bioavailability (18) compared with wheat. These differences in vitamins and minerals in wheat and maize may don't give the minimum requirements that recommended by NRC (2) therefore, the successfully of omission VIT and MRT premixes from finisher broilers ration may depend on the ingredient feedstuffs that formulate diets. 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 maize-based diets are common in the USA (19) and wheat-barley diets are common in Europe (20). 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 maize- 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 flock. Only hygienic birds were used in this experiment.
- **Feeding and dietary treatment:** Chicks were fed on maize- 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. At 29 d of age, bird that fed on maize-based diets still to eat experimental maize-based diets, while those fed on wheat- based diets are also eaten experimental wheat-based diets. Four experimental dietary treatments were offered as follows: T1, birds fed on maize-based diets with premixes; T2, birds fed on maize-based diets without premixes; T3, birds fed on wheat-based diets with premixes; T4, birds fed on wheat-based diets without premixes., (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 (MAXCARE, Trouw nutrition Hifeed, B. V. Holland) was used in the present experiment.
- **Measurements:** Chicks were weighted 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 weighted 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 by Cotter (21). The non-heparinized tubes were centrifuged at 3000 rpm for 15 min to separate serum. Serum lipids examined included glucose, triacylglycerol, total cholesterol and total protein, calcium, phosphorus, AST and ALT.
- **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 (22).

Table (1) Ingredients and compositions of starter and grower diets of broilers

Ingredient and composition (%)	Starter (1-14 d of age)		Grower (15-28 d of age)	
	Maize-based	Wheat-based	Maize-based	Wheat-based
Maize	56.70	--	60.00	---
Wheat	--	59.26	--	64.24
Soybean meal (48%)	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	0.10	0.17	0.00	1.5
DL-Methionine	0.10	0.17	0.10	1.1
Calculated analysis				
Crude Protein%	23.03	23.13	21.72	21.09
ME (Kcal/kg)	3011	3011	3107	3107
Crude Fiber%	2.72	3.08	2.64	3.02
Lysine%	1.46	1.44	1.30	12.4
Methionine%	0.66	0.69	0.64	0.69
Methionine +Cysteine%	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 (2) Ingredients and compositions of finisher diets of broilers

Ingredients and composition	Maize- based diets		Wheat-based diets	
	With	Without	With	Without
Maize	64.00	63.02	-	-
Wheat	-	-	68.36	67.25
Soybean meal(48%)	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	0.50	1.60
DL-Methionine	-	0.22	0.18	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
ME (Kcal/kg feed)	3177	3167	3158	3144
Crude Fiber %	2.57	2.56	2.96	2.96
Lysine%	1.18	1.17	1.15	1.12
Methionine%	0.52	0.53	0.55	0.56
Methionine + Cysteine%	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

Results

- **Performance:** The omission of VIT- MRT premix from finisher wheat-based diets caused a reduction in BWG during a period from 29 to 35 d and 29 to 42 d of age compared with counterparts fed maize-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 group of birds fed on wheat-based diets absent from VIT- MRT premix (Table 3).
- **Carcass parameters:** For processing parameters, carcass weight (g) and yield (%), gizzard, liver, breast, thigh and drumsticks was not affected by dietary treatments. While, relative weight of heart, abdominal fat pad and bursa of fabricia was decreased significantly in group of birds fed on wheat-based diets absent from VIT- MRT premixes during finishing period (Table 4).
- **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.

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

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

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

¹: T1, birds fed on maize-based diets with premixes; T2, birds fed on maize-based diets without premixes; T3, birds fed on wheat-based diets with premixes; T4, birds fed on wheat-based diets without premixes.

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

Traits	Treatments ¹					Pooled SEM	P- value
	T1	T2	T3	T4			
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	1.11 ^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	

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

¹: T1, birds fed on maize-based diets with premixes; T2, birds fed on maize-based diets without premixes; T3, birds fed on wheat-based diets with premixes; T4, birds fed on wheat-based diets without premixes.

Table (5) Blood parameters of broilers fed a maize or wheat-based diets presences or absent from vitamin- trace mineral premixes

Traits	Treatments ¹				Pooled SEM	P- value
	T1	T2	T3	T4		
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

¹: T1, birds fed on maize-based diets with premixes; T2, birds fed on maize-based diets without premixes; T3, birds fed on wheat-based diets with premixes; T4, birds fed on wheat-based diets without premixes.

Discussion

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 maize-based diets. This is might be wheat have much less antioxidant (Vitamin E and carotenoids), low biotin bioavailability (18) and low levels of manganese (12) than maize. Schiedt, (23) 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). In the current experiment, the vitamin A (less carotenoid in wheat which act 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 (24) but when sunflower oil (fortified with vitamin E) was added to finisher diets, the compensation of

vitamin E may occur accordingly. 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 (25) who found the major differences between wheat- and maize-based diets is the concentration of carotenoids (lutein and zeaxanthin) which was 11.8 and 5.6 mg/ kg in maize- 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) was another element can cause decreases in BWG and FCR(27). 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 in these vitamins. The reduction in BWG and feed efficiency due to removing of vitamins and minerals premix from finisher ration was reported (6, 9, 28). 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 (V) and trace mineral (TM) premixes from broiler diets from 28 to 49 d of age. Razuki et al. (30) 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. (31) 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 absolute and relative weight of carcass and carcass yield (%), percentages of breast, thighs, drumsticks (Table 5). These findings confirm the results obtained by Maiorka et al. (4), Khajali, et al. (7), Razuki et al. (10) and Abudabos et al. (30). 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 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 (31). The current finding was not confirmed the previous study (32) that found the relative weight of bursa of Fabricius was not affected by VIT withdrawal. Our results suggested that the VIT and TRM contents of wheat and soy-bean meal diet were not sufficiently to maintaining 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. (33) 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. (30) 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 TRM premixes withdrawal from finisher rations. Whereas, the omission of VIT and TRM might be applied to birds fed a maize-based diet.

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