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Effect of Adding Dietary Humate on Productive Performance of Broiler Chicks

S.M. Hassan
Department of Animal and Fish Production, College of Agriculture and Food Sciences, King Faisal University, P.O. Box 402, Al-Ahsa, 31982, Kingdom of Saudi Arabia

ABSTRACT

Using natural product as growth promoter in poultry nutrition has lately been increased. This study was conducted to evaluate the effect of adding dietary humate on productive performance of broiler chicks from 1-28 days of age. The 271 days old broiler chicks were randomly distributed among 3 treatment groups with six replicates of 15 chicks each. Chicks were fed a starter broiler diet containing 0.0, 5.0, or 10.0 g humate kg^{-1} diet. Body weight at 14th day of age and body weight gain from 8-14 days of age for chicks fed 5.0 g humate were lighter than those fed 0.0 and 10.0 g humate. At 21st day of age, body weight for chicks fed 5.0 g humate were lower than those fed 0.0 g humate. From 22-28 days of age, the body weight gain of chicks fed 5.0 g humate was better than those fed 0.0 and 10.0 g humate. Final body weight at 28th day of age and body weight gain from 15-21 and 1- 28 days of age for chicks fed 10.0 g humate were lower than those fed 0.0 and 5.0 g humate. From 8-14 days of age, feed consumption of broiler chicks fed diet containing 5.0 g humate kg^{-1} was significantly lower than those fed diet containing 0.0 and 10.0 g humate kg^{-1}. Feed consumption of chicks fed 5.0 g humate was higher than those fed 0.0 and 10.0 g humate from 22-28 days of age. However, feed consumption from 1-28 days of age for chicks fed 0.0 g humate was the lowest. Feed conversion ratio from 8-14 days of age for chicks fed 5.0 g humate was worse than those fed 10.0 g humate. From 15-21, 22-28 and 1-28 days of age, feed conversion ratio of chicks fed 10.0 g humate was the worst. Performance index from 15-21 and 22-28 days of age for chicks fed 10.0 g humate was significantly less than those fed 0.0 and 5.0 g humate. Results suggest that adding 5.0 or 10.0 g humate kg^{-1} into diet negatively affect the productive performance of broiler chicks in respect to feed conversion ratio and performance index.

Key words: Broiler chicks, growth rate, humate, productive performance

INTRODUCTION

Using antibiotic as a growth promoter in poultry nutrition has lately been banned due to their bacterial resistance and residual risk in their products on human health (Engberg *et al*., 2000; Attia *et al*., 2011). Therefore, poultry nutritionists have been searched intensively for natural antibiotic alternatives to use as growth promoter harmless to human health. During the past several years, adding humate in poultry diet was suggestible as an organic growth promoter alternative of antibiotic in animal (Griban *et al*., 1991; Kocabagli *et al*., 2002; Ceylan *et al*., 2003; Karaoglu *et al*., 2004; Yoruk *et al*., 2004).

Humate is a natural bio active growth-promoting agent primarily decomposed from organic matter by living bacteria in the soil (Senn and Kingman, 1973; Shermer *et al*., 1998; Mac Carthy, 2001). Humate is mainly composed of humic, fulvic and ulmic acids (Stevenson, 1994). Humic acids

are not approved as feed additive but as veterinary drug at Europe Union although several reports remarked those as feed additives claiming growth promoting effect. Humate is naturally odorless dark brown or black powder occurring highly oxidized form humic acid. Humate is the salt of humic acid in which the exchange site is Ca^{+},Na^{+}, K^{+}, Al^{+} and Fe^{+2} rather than hydrogen.

Several studies reported that humate is not toxic and contains no carcinogenic substances (Yasar *et al*., 2002). In recent years, it has been observed different effects for adding humate to poultry diet. Although, some reports found that adding dietary humate to broiler have no effects on productive performance, other studies observed several beneficial and harmful effects. Therefore, the objective of the present study was to determine the effects of adding dietary humate at the level of 5.0 and 10.0 g kg^{-1} diet on the productive performance of broiler chicks from 1-28 days of age.

MATERIALS AND METHODS

This study was conducted from May till June 2012 at the Experimental Station belonged to Collage of Agriculture and Food Sciences, King Faisal University, Kingdom of Saudi Arabia.

Experimental design: The 271 days old unsexed Ross 308 broiler chicks were purchased from a local commercial hatchery weighed and randomly distributed in battery cages among three treatment groups with six replicates of 15 chicks per replicate. Chicks were assigned to feed one of

Table 1: Composition and calculated analysis (%) of the broiler diet used from 1-28 days of age

Parameter	Percentage (%)
Ingredients	
Yellow corn	64.70
Dehulled soybean meal (48.5%)	31.00
DL-methionine	0.25
L-lysine HCl	0.30
Limestone	1.00
Dicalcium phosphate	2.00
Salt	0.25
Minerals premix[1]	0.25
Vitamins premix[2]	0.25
Calculated chemical composition	
Metabolizable energy (kcal kg^{-1})	3025
Crude protein	22.88
Crude fiber	2.88
Ether extract	4.59
Calcium	0.92
Available phosphorus	0.49
Methionine	0.57
Methionine+Cystine	0.66
Lysine	1.30
Threonine	0.77
Tryptophan	0.28

[1]Minerals premix added at this rate yields: 149.60 mg Mn, 16.50 mg Fe, 1.70 mg Cu, 125.40 mg Zn, 0.25 mg Se, 1.05 mg I kg^{-1} diet. [2]Vitamins premix added at this rate yields: 11,023 IU vitamin A, 46 IU vitamin E, 3,858 IU vitamin D_3, 1.47 mg minadione, 2.94 mg thiamine, 5.85 mg riboflavin, 20.21 mg pantothenic acid, 0.55 mg biotin, 1.75 mg folic acid, 478 mg choline, 16.50 µg vitamin B_{12}, 45.93 mg niacin and 7.17 mg pyridoxine per kg diet

the following three dietary treatment groups: 1) Chicks fed control broiler diet containing 0.0 g humate, 2) Chicks fed control broiler diet containing 5.0 g humate and 3) Chicks fed control broiler diet containing 10.0 g humate kg^{-1}. The experimental broiler diet used in the present study was calculated to contain 3025 kcal/ME/kg and 22.88% CP which met the broiler nutritional requirement according to NRC (1994) from 1-28 days of age as shown in Table 1. Feed and water were provided *ad libitum* and lighting regime was continuous throughout the entire course of the study. The temperature was maintained at 32°C for the first week and then reduced until a temperature of 22°C was achieved by the fourth week, gradually. Weekly body weight, body weight gain, feed consumption, feed conversion ratio, mortality rate and performance index were recorded from 1-28 days of age. Feed conversion ratio was calculated by dividing the mean feed consumption to mean body weight gain. On the other hand, Performance Index (PI) was calculated according to the equation reported by North (1981):

$$PI = \frac{\text{Body weight (kg)}}{\text{Feed conversion ratio}} \times 100$$

Statistical analysis: Data obtained were subjected to one-way ANOVA using the GLM procedure of a statistical software package (SPSS, 2010). Experimental units were based on cage averages. Treatment means were separated as Mean±SEM at $p \leq 0.05$ using the Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Body weight: No significant differences in the initial body weight and body weight at 7th day of age were observed among all dietary treatment groups. Chicks fed diet containing 5.0 g humate were significantly lighter than those fed diet containing 0.0 and 10.0 g humate at 14th day of age, whereas no significant differences in body weight were recorded between chicks fed diet containing 0.0 g humate. By 21st day of age, body weight of chicks fed 5.0 g humate was lighter than those fed 0.0 g humate but there were significant differences between chicks fed 10.0 g humate and the other remaining treatments. The final body weight at 28th day of age for chicks fed diet containing 10.0 g humate weighed (711.94 g) significantly less than chicks fed diet containing 0.0 g humate (840.90 g) and 5.0 g humate (794.90 g) but there were no significant differences between chicks fed diet containing 0.0 and 5.0 g humate Table 2.

Body weight gain: The body weight gain was not different among all the dietary treatment groups from 1-7 days of age. From 8-14 days of age, body weight gain of broiler chicks fed diet containing 5.0 g humate kg^{-1} was significantly lower than those fed diet containing 0.0 and 10.0 g humate kg^{-1} but were no significant differences between chicks fed diet containing 0.0 and 10.0 g humate. From 15-21 days of age, chicks fed diet containing 10.0 g humate kg^{-1} feed were significantly less in body weight gain than those fed diet containing 0.0 and 5.0 g humate kg^{-1}, whereas there were no significant differences between chicks fed diet containing 0.0 and 5.0 g humate kg^{-1}.

From 22-28 days of age, chicks fed diet containing 5.0 g humate kg^{-1} feed were significantly the highest body weight gain compared with the other remaining treatments. The total body weight gain from 1-28 days of age for chicks fed diet containing 10.0 g humate kg^{-1} feed was significantly less than those fed diet containing 0.0 and 5.0 g humate kg^{-1} but were no differences between chicks fed diet containing 0.0 and 5.0 g humate kg^{-1} (Table 2).

Table 2: Productive performance of broiler chicks fed 0, 5 and 10 g humates kg^{-1} diet from 1-28 days of age

	Humate level (g kg^{-1} diet)		
Age (Days)	0	5	10
Body weight (g)			
0	45.78±0.47	47.12±0.62	47.16±0.86
7	123.12±2.58	122.62±2.14	122.19±1.30
14	305.97±14.03^{a}	253.71±9.27^{b}	316.51±5.17^{a}
21	582.69±28.34^{a}	509.93±12.21^{b}	548.71±10.55^{ab}
28	840.90±28.29^{a}	794.90±18.14^{a}	711.94±10.72^{b}
Body weight gain (g)			
1-7	77.34±1.22	75.50±1.51	75.03±0.44
8-14	182.85±6.61^{a}	131.09±7.13^{b}	194.32±3.87^{a}
15-21	276.72±8.26^{a}	256.22±2.94^{a}	232.20±5.38^{b}
22-28	258.21±0.03^{b}	284.97±5.92^{a}	163.23±5.92^{c}
1-28	795.12±16.06^{a}	747.78±17.51^{a}	664.78±9.86^{b}
Mortality rate (%)			
1-7	0.00±0.00	1.25±0.72	1.25±0.72
8-14	0.00±0.00	1.25±0.72	1.25±0.72
15-21	2.50±0.95	3.75±1.06	5.00±1.54
22-28	3.75±1.06	3.75±1.06	5.00±1.54
Feed consumption (g)			
1-7	84.10±1.03	83.93±2.48	83.22±0.97
8-14	229.29±3.96^{a}	180.35±18.39^{b}	221.35±2.78^{a}
15-21	494.44±17.23	502.14±5.82	497.25±14.39
22-28	283.60±5.73^{c}	499.51±12.26^{a}	454.62±15.15^{b}
1-28	1091.43±27.95^{b}	1265.93±38.94^{a}	1256.44±33.29^{a}
Feed conversion ratio (Feed consumption (g): Body weight gain (g))			
1-7	1.09±0.00	1.11±0.01	1.11±0.01
8-14	1.26±0.02^{ab}	1.37±0.07^{a}	1.14±0.01^{b}
15-21	1.79±0.01^{c}	1.96±0.00^{b}	2.14±0.01^{a}
22-28	1.10±0.02^{c}	1.75±0.01^{b}	2.79±0.09^{a}
1-28	1.37±0.01^{c}	1.69±0.01^{b}	1.89±0.02^{a}
Performance index			
1-7	11.34±0.27	11.05±0.23	11.02±0.30
8-14	9.76±0.34	9.34±0.78	10.71±0.16
15-21	33.14±1.48^{a}	26.13±1.27^{a}	25.60±0.79^{b}
22-28	77.56±5.05^{a}	45.68±3.89^{b}	25.87±2.17^{c}

Means±SEM within a row that do not share a common superscript are significantly different at $p \leq 0.05$

Therefore, the results obtained from the present study indicated that adding humate at the level higher than 5 g humate kg^{-1} feed affect negatively body weight and body weight gain of broiler chicks from 1-28 days of age. These results were in agreement with the findings of Bailey *et al.* (1996) who found that adding 5.0 g humate kg^{-1} broiler diet did not affect body weight of male broiler at 35th days of age and Rath *et al.* (2006) who noted that adding humate at the levels ranged from more than 5.0 up to 25.0 g kg^{-1} broiler diet for 4-5 weeks of age decreased body weight and body weight gain.

However, several other studies reported that adding humate to broiler diet did not affect body weight and body weight gain (Karaoglu *et al.*, 2004; Kaya and Tuncer, 2009). Also, Kocabagli *et al.* (2002) noted that adding humate into broiler diet at the level of ranged from 1-2.5 g kg^{-1} feed from 1-42 days of age did not significant affects on body weight up to 21st day of

age but they reported the most beneficial effect in respect to growth by increasing body weight by 4.28% during the growing period determined from 22-42 days of age compared with those fed control diet. Yoruk *et al.* (2004) showed no significant effect on body weight of laying hens after adding humate at the levels ranged from 1.0 to 2.0 g humate kg^{-1} diet. Karaoglu *et al.* (2004) noted that the differences in body weight gain were not significant among broiler fed diet containing 0.0, 1.0, 2.0, 3.0 g humate kg^{-1} feed at the 3rd, 5th, 6th and 7th week of age but were significantly higher for chicks fed diet containing humate at the level of 2.0 g kg^{-1} feed than those fed diet containing 0.0, 1.0 or 3.0 g humate kg^{-1} feed at the 4th week of age. A similar finding was reported by Esenbuga *et al.* (2008) who found that body weight gain was not affected by adding dietary humate up to 3.0 g kg^{-1} broiler diet but broiler chicks fed diet containing humate at the level of 2.0 g kg^{-1} feed exhibited a greater body weight gain than those broiler chicks fed diet containing humate at the levels of 0.0, 1.0, or 3.0 g kg^{-1} broiler diet.

On the contrary, some studies noted better body weight after adding humate to poultry diet (Shermer *et al.*, 1998; Ceylan *et al.*, 2003). Stepchenko *et at.* (1991) and Zhorina and Stepchenko (1991) found that adding humate to broiler diet increased body weight by 5.0-7.0% compared to those fed control diet. In another study, Bailey *et al.* (1996) found that adding 5.0 g humate kg^{-1} broiler diet increased significantly body weight of female broiler at 42nd day of age. Parks (1998) reported that adding humate to turkey's diet improved body weight gain from 8-12 week of age but this response did not persist through to 20th week of age. Eren *et al.* (2000) noted that adding humate at the level of 2.5 g kg^{-1} feed increased significantly body weight and body weight gain at 42nd day of age, without significant effect at 21st day of age. Ceylan *et al.* (2003) reported that adding humate at the level of 5.0 g kg^{-1} broiler diet enhanced body weight gain. Also, Teravita (2004) indicated that the adding dietary humate during late period for broiler increased body weight by 30.0%.

Mortality rate: No significant differences in mortality rate among all the dietary treatment groups during the entire course of the study were recorded Table 2. However, the mortality rate recorded was within the normal range values throughout the experimental period. These results were in agreement with the observations reported by Moreover, Kocabagli *et al.* (2002) who noted that adding humate into broiler diet at level of 2.5 g kg^{-1} feed did not significant affects mortality rate from 1-42 days of age. Also, Rath *et al.* (2006) noted that adding humate at the levels ranged from 5.0 to 25.0 g kg^{-1} broiler diet for 4-5 weeks of age did not affect mortality rate.

On the other hand, Stepchenko *et at.* (1991) reported that adding humate to poultry diet reduced mortality rate by 3.0-5.0% compared to those fed control diet. Karaoglu *et al.* (2004) noted that adding humate at the levels ranged from 1.0-3.0 g kg^{-1} broiler diet decreased mortality rate. Also Teravita (2004) found that adding dietary humate during late period for broiler diet decreased mortality rate by 50.0%. In similar study, Yoruk *et al.* (2004) reported that adding humate at the levels ranged from 1.0-2.0 g kg^{-1} laying diet reduced mortality rate linearly with increasing level of adding humate. However, Bailey *et al.* (1996) reported that adding humate at level of 5.0 g kg^{-1} broiler diet increased mortality rate at 42nd day of age.

Feed consumption: There were no significant differences in the feed consumption among all the dietary treatments from 1-7 and 15-21 days of age. From 8-14 days of age, feed consumption of broiler chicks fed diet containing 5.0 g humate kg^{-1} was significantly lower than those fed diet

containing 0.0 and 10.0 g humate kg^{-1} but there were no significant differences between chicks fed diet containing either 0.0 and 10.0 g humate kg^{-1} feed. Chicks fed diet containing 5.0 g humate consumed the highest feed compared with the other remaining treatments during the last week of the study (22-28 days of age). However, the total cumulative feed consumption recorded from 1-28 days of age were significantly higher in chicks fed diet containing either 5.0 and 10.0 g humate kg^{-1} than those fed diet containing 0.0 g humate kg^{-1} but there were no significant differences between chicks fed diet containing either 0.0 and 5.0 g humate kg^{-1} feed Table 2.

Therefore, the results obtained from the present study indicated that adding humate at 5 and 10 g humate kg^{-1} feed increased significantly feed consumption of broiler chicks from 1-28 days of age. These results were in disagreement with the findings of Rath *et al.* (2006) who noted that adding humate at the levels ranged from 5.0 to 25.0 g kg^{-1} broiler diet for 4-5 weeks of age decreased feed consumption. Conversely, Karaoglu *et al.* (2004) found that the highest feed consumption for chicks fed diet containing 2.0 g humate kg^{-1} feed while the lowest one were reported for chicks fed diet containing 1.0 g humate kg^{-1} feed.

On the other hand, several other studies reported that adding humate into broiler diet at the level of 2.5 g kg^{-1} feed did not significant affects feed consumption compared to those fed control diet (Kocabagli *et al.*, 2002). A similar study by Ceylan *et al.* (2003) noted that adding humate at the level of 5.0 g kg^{-1} broiler diet did not affect feed consumption. Also, Yoruk *et al.* (2004) noted that adding 1.0 and 2.0 g humate kg^{-1} laying diet had no effect on feed consumption. Few years ago, Esenbuga *et al.* (2008) found that feed consumption was not affected by adding dietary humate up to 3.0 g kg^{-1} to broiler diet. Also in recent study, Hakan *et al.* (2012) found no significant effect on feed consumption of laying hens after adding humate at the level of 1.0 g kg^{-1} laying diet.

Feed conversion ratio: There were no significant differences in the feed conversion ratio among all the dietary treatments from 1-7 days of age. From 8-14 days of age, feed conversion ratio was significantly worse in chicks fed diet containing 5.0 g humate kg^{-1} feed than chicks fed diet containing 10.0 g humate kg^{-1} feed but there were no significant differences between chicks fed 0.0 g humate and the other remaining treatments. Feed conversion ratio was significantly better in chicks fed diet containing 0.0 g humate kg^{-1} feed than chicks fed diet containing either 5.0 or 10.0 g humate kg^{-1} feed from 15-21, 22-28 and 1-28 days of age Table 2.

Therefore, the results obtained from the present study indicated that adding humate at 5 and 10 g humate kg^{-1} feed resulted in worse feed conversion ratio compared with those fed 0.0 g humate from 1-28 days of age. These results were in disagreement with the observations of Bailey *et al.* (1996) who reported that adding 5.0 g humate kg^{-1} broiler diet improved cumulative feed conversion ratio at 35th day of age. A similar findings reported by other studies noted better feed conversion ratio (Parks *et al.*, 1986) in turkey, (Eren *et al.*, 2000) in broiler, (Yoruk *et al.*, 2004; Kucukersan *et al.*, 2005) in laying hens. In another study, Yoruk *et al.* (2004) showed a better feed conversion ratio in laying hens fed diet containing humate at the levels ranged from 1.0-2.0 g kg^{-1}. Esenbuga *et al.* (2008) reported that the feed conversion ratio for broiler chicks fed diet containing humate at the level of 1.0 g kg^{-1} feed was slightly better by 2.0% than for those fed control diet but feed conversion ratio was not affected by humate supplementation up to 3.0% g kg^{-1} broiler diet. On the other hand, Kocabagli *et al.* (2002) noted that adding humate into broiler diet at the level of 2.5 g kg^{-1} feed from 1-42 days of age did not significant affects feed conversion ratio up to 21 days of age but reported an improvement in feed conversion ratio from 22-42 days of age.

Also, Ceylan *et al.* (2003) reported that adding humate at the level of 5.0 g kg^{-1} broiler diet did not affect feed conversion ratio. Karaoglu *et al.* (2004) noted that feed conversion ratio in broiler was not affected by adding humate at level of 1.0 g kg^{-1} broiler diet. Also Kaya and Tuncer (2009) noted no significant affect on feed conversion ratio of broiler fed diet containing humate at the level of 2.5 g kg^{-1} broiler diet from 1-42 days of age. Conversely, Hakan *et al.* (2012) found that adding 1.0 g humate kg^{-1} to laying diet increased feed conversion ratio (worse) of laying hens.

Performance index: There were no significant differences in the performance index before 14 days of age. From 15-21 days of age, the performance index was significantly lower for chicks fed diet containing 10.0 g humate kg^{-1} feed than those diet containing 0.0 and 5.0 g humate kg^{-1} feed but there were no significant differences between chicks fed diet containing 0.0 and 5.0 g humate kg^{-1} feed. From 22-28 days of age, the performance index was significantly the lowest for chicks fed diet containing 10.0 g humate kg^{-1} feed compared with the other remaining treatments Table 2.

Therefore, the results obtained from the present study indicated that adding humate at 5 and 10 g humate kg^{-1} feed reduced the performance index of broiler chicks Table 2. Orban *et al.* (1993) who reported that the increasing levels of humate from 2.0 to 3.0 g humate kg^{-1} broiler diet didn't improve their productive performance traits. Also, in recent study, Abdel-Mageed (2012) showed that the performance index of Japanese quail fed diet containing humic substances at a level of 10.0 or 20.0 mL kg^{-1} diet from 1-6 week of age was higher than those fed control diet.

It is appeared that the differences in productive performance of broiler chicks fed 5.0 or 10.0 g humate kg^{-1} diet obtained in the present study and the other studies might be attributed to the differences in the chemical composition among different commercial humate products resulted from the differences in the humate sources and its treating procedure, chick's age, administration method and the level and period of the humate supplementation.

Results obtained from the present study conclude that adding 5.0 or 10.0 g humate kg^{-1} into diet negatively affect the productive performance of broiler chicks in respect to feed conversion ratio and performance index. Little information is known about the mechanism by which adding dietary humate affects the productive performance of broiler chicks. Therefore, further studies using different levels of adding dietary humate are required.

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