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Effect of Supplemental Humate at Different Levels on the Growth Performance, Slaughter and Carcass Traits of Broilers

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Abstract: The current trial was carried out to determine the influence of supplemental humates including humic, fulvic and ulmic acids and some microminerals on the performance and carcass traits of broilers. A study was conducted with total 240 male broiler chicks (Ross-308), received from a commercial hatchery at 1 day of age. Chicks were allocated to four dietary treatments (H_0, H_1, H_2 and H_3 groups) as completely randomized experimental design . Feed and water were offered for *ad libitum* consumption and lightening was continuous throughout experimental period. A basal diet (H_0), basal diet plus 0.10 (H_1), 0.20 (H_2) and 0.30 % (H_3) humate (Farmagulator DRY™, Humate, Farmavet International Inc., Kocaeli 41400, Turkey) were offered during experimental period. All birds were housed in batteries from 1 to 21 days, and in grower broiler pens to 49 days in the Application and Research Farm of the Agricultural Faculty, Atatürk University. At the end of the trial all birds were slaughtered. Feed intake and body weight gains were recorded weekly per pen. Final body weights were 2525, 2494, 2646 and 2546 g for H_0, H_1, H_2 and H_3 groups respectively, and the difference was not significant. Average daily weight gains were 51.8, 49.8, 52.9 and 49.9 g, respectively, and the supplementation had statistically no significant effect on this parameter. Daily feed consumptions were 103.2, 95.6, 104.4 and 98.6 g and the difference between control and treatment groups was significant ($P<0.05$). FCR values were 1.87, 1.84, 1.86 and 1.85. At the end of the trial, hot carcass weights and yields were 1874, 1913, 1912 and 1884 g and 75.78, 75.51, 75.55 and 75.55 %, and difference was not significant. There was no different in offal weights. Abdominal fat pad weights were found to be 35.5, 40.33, 40.0 and 32.16 g, respectively. Difference among the groups in terms of abdominal fat weights was not statistically significant. The mortality was 1.8, 0.0, 0.0 and 0.0 % for H_0, H_1, H_2 and H_3 and there was no significant different among the groups. In conclusion, although humate supplementation to diets of broilers had no effect on performance, slaughter and carcass characteristics, a slightly improvement was observed in FCR for H_1 group fed with diet containing 0.1 % humate. In addition, it was not observed dead chick in humate groups while 1.8 % of mortality in control group.

Key words: Humate, broiler, performance, slaughter, carcass

Introduction

Feed is the major item of cost in the production of poultry meat and eggs. In addition to feedstuffs, some microbiological cultures and various chemical agents such as probiotics, prebiotics, antibiotics, humates and enzymes, etc. have been adding to animal diets as feed additive to enhance nutrient utilization, improve feed conversion efficiency and maintain health status. But during the past several years, inclusion of probiotics and humates in rations is preferable to antibiotics, primarily because they cause no harmful effects on consumers (Yörük *et al*., 2004).

Humates, a part of fertilizers, are derived from plant matter decomposed by bacteria (Seen and Kingman, 1973) and contain humus, humic acid, fulvic acid, ulmic acid and some microelements (Stevenson, 1994). Previous studies related to humates have focused mainly on the growth of germinal tissue in seed. The idea of using humates as feed additives in animal nutrition is new. At first humates were used as a part of replacement therapy for digestive system disturbances such as malnutrition and diarrhea and increased for feed conversion efficiency in calves, dogs and cats. Remarkable changes in electrolyte balance and enhancements in immune potency of poultry (Yörük *et al*., 2004; Parks *et al*., 1986) in response to humate supplementation have been reported. In addition, consistent agreements in the limited numbers of published articles show that humates promote growth by altering partitioning of nutrient metabolism (Parks, 1998), reducing mortality (Eren *et al*., 2000) and improving feed conversion efficiency (Yörük *et al*., 2004; Eren *et al*., 2000).

The objective of the present study was to investigate the effect of supplementation of humate on performance, slaughter and carcass characteristics of broilers.

Materials and Methods

Chicks and diets: The Research Animal Ethic Committee of Atatürk University approved this experimental protocol. A study was conducted with total 240 male broiler chicks (*Ross-308*), received from a

commercial hatchery (KÖY-TUR) at 1 day of age. Chicks, initially about 40 g, were randomly allocated to four dietary treatments and were housed in batteries from 1 to 21 days, and in grower broiler pens from 21 to 49 days in the Application and Research Farm of the Agricultural Faculty, Atatürk University. The ambient temperature was thermostatically controlled. This temperature was set at 33 °C the 1 st day of the experiment and decreased 1 °C every 3rd day thereafter for the duration of the experimental period. The chicks were weighed and distributed randomly into four treatment groups. Each treatment group was replicated six times as subgroups, comprising of 10 birds each. Feed and water were offered for *ad libitum* consumption, and lightning was continuous throughout experimental period. All birds were fed a starter diet from day 1 to 21, and a finisher diet to 49 days. Diets were formulated according to NRC recommendations (1994). Feed composition was analyzed by the AOAC (1990) and shown in Table 1.

Table 1: Composition of starter and grower diets

	Starter diet	Grower diet
Ingredients and composition (kg ton^{-1})		
Ground corn	462.9	462.3
Soybean meal (480 g CP kg^{-1} feed)	221.4	210.0
Full fat soy	125.0	100.0
Ground wheat	100.0	100.0
Fish meal	40.0	25.0
DCP	16.7	17.3
Ground limestone	5.9	13.0
Salt (NaCl)	2.5	2.6
Soya oil	15.8	33.1
Poultry fat	-	15.0
Lysine	-	0.8
DL-methionine	2.4	2.5
Choline cloride	0.4	0.4
Trace mineral premix[1]	3.0	3.0
Vitamin premix[1]	5.0	5.0
Coccidiostat	1.0	1.0
Lasolocyde	-	1.0
Analysis (g kg^{-1}, dry matter basis)[2]		
Dry matter	940.0	930.0
Crude protein	220.0	200.0
Ash	67.4	59.6
Ether extract	44.0	49.9
Crude fiber	74.6	60.5
N-free extracts	570.0	560.0
ME (kcal kg $^{-1}$)	3000	3100

[1]Premixes were formulated to meet recommended levels for minerals and vitamins (NRC, 1994).
[2]Calculated by AOAC (1990).

Humate was added to starter and finisher diets of chicks at different levels (0.0, 0.1, 0.2 and 0.3%). Each kg of humate contained 160 mg polymeric polyhydroxy acid (humic, fulvic, ulmic and humatomelanic acids), 663.3 SiO_2 and other minerals (Mn, 50 mg; Zn, 60 mg; Fe, 60 mg; Cu, 5 mg; Co, 0.2 mg; I, I mg; Se, 0.5 mg; and Al, Na, K, Mg and P in trace amounts). The experimental groups consisting four dietary treatments were: 1) H_0 was fed with only basal diet, 2) H_1 was fed with basal diet plus 0.1 % humate, 3) H_2 was fed with basal diet plus 0.2 % humate, and 4) H_3 was fed with basal diet plus 0.3% humate during experimental period. The weights of chickens and feed consumptions were weekly recorded, per pen. Mortality was recorded as it occurred and percentage mortality was determined at the end of the study.

At the end of the trial, the birds were held for 10-12h without food and water prior to the determining of final body weights. Each bird was weighed live, slaughtered and allowed to bleed for 180 s, previously determined to be sufficient time for bleeding. The bird was then reweighed to calculate blood weight by difference, sub-scalded at 50-52 °C for approximately 30 s, and placed in a rotary drum plucker for 30 s to remove feathers.

The bird was reweighed to calculate feather weight by difference. The bird then processed by removing the head, neck, shanks and feets, and was eviscerated by cutting around the vent removing the viscera without disturbing the fat pad along the abdominal wall. The heart, liver and gizzard were dissected from the viscera, and the gizzard was cut open and rinsed of its content. All of the above components were weighed individually. The weight of the remaining gastrointestinal tract, including fat and mesentery, was determined by difference between the whole picked bird weight minus the various components and dressed carcass weight. The lungs were left in the eviscerated carcass. The carcass was immersed in water 4 °C and washed. Upon removal from water, the carcass was drained for 10 min, weighed for hot carcass weight and yield, bagged and stored at 3 ± 0.5 °C for 24h. (Yalçin *et al.*, 1999). Upon removal from the bag, the fat pad lining abdominal wall was removed from carcass, and both of fat pad and carcass were weighed to determine a cold carcass weight and yield. All of the evisceration steps and cutting procedures mentioned above performed by two experienced people according to Brake *et al.* (1993).

Statistical Analysis: The data were subjected to analysis using a General Linear Model procedure of SAS (SAS Institute, 1996) for the completely randomized experimental design. Differences between means were determined by Duncan's multiple range test at significance level of $P<0.05$.

Results and Discussion

Growth Performance and Feed Efficiency: The average daily weight gain, daily feed consumption and feed conversion values of treatment groups are shown in

Table 2: Daily weight gain, feed consumption and feed conversion ratios of broilers during experimental period

		Age (weeks) Daily Weight Gain (g)							
Groups	n	1	2	3	4	5	6	7	Average
H_0	6	12.9	29.6	45.2	55.3^{b}	80.1	84.0	55.7	51.8
H_1	6	12.4	28.3	42.6	58.7^{b}	81.8	53.3	70.6	49.8
H_2	6	12.6	31.0	44.8	66.1^{a}	84.7	71.0	60.0	52.9
H_3	6	12.8	28.9	42.2	57.3^{b}	80.3	69.4	58.1	49.9
SEM		±0.69	±2.17	±2.22	±2.11	±2.30	±10.74	±8.77	±1.14
Significance		Ns	Ns	Ns	*	Ns	Ns	Ns	Ns
Daily Feed Consumption (g)									
H_0	6	17.2	46.5	79.4	116.1	155.5^{b}	174.4^{a}	133.2	103.2^{a}
H_1	6	17.1	38.4	68.1	111.1	165.8^{ab}	129.9^{b}	139.3	95.6^{b}
H_2	6	17.4	43.1	77.4	117.4	168.4^{a}	150.5^{ab}	156.4	104.4^{a}
H_3	6	17.6	38.6	70.2	115.5	158.3^{ab}	147.1^{ab}	142.9	98.6^{ab}
SEM		±0.57	±1.50	±1.35	±2.99	±3.82	±3.00	±8.34	±2.06
Significance		Ns	Ns	Ns	Ns	*	**	Ns	*
Feed Conversion Ratio									
H_0	6	1.33	1.57	1.74	2.10	1.94	2.08	2.30	1.87
H_1	6	1.31	1.36	1.60	1.91	2.03	2.44	1.97	1.81
H_2	6	1.39	1.39	1.73	1.77	1.99	2.12	2.60	1.86
H_3	6	1.38	1.33	1.66	2.01	1.97	2.13	2.45	1.85
SEM		±0.06	±0.10	±0.10	±0.08	±0.06	±0.14	±0.42	±0.16
Significance		Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

**: (P<0.01); *: (P<0.05); NS: Non significant.
[a,b]: Means within a column with no common superscripts differ significantly (P<0.05).

Table 2.
It is apparent that the difference between control (H_0) and treatment groups in terms of daily weight gain (H_1, H_2 and H_3) was not significant at the 3, 5, 6 and 7 wks of the trial. The daily weight gain of H_2 group was found statistically higher than that of H_0, H_1 and H_3 groups at 4th week of experimental period. In generally, it was observed that there was no significant difference among the treatment groups in this characteristic (Table 2). However, H_2 group produced an important increase in daily weight gain, as compared with the other groups. Table 2 presents the daily feed consumption and feed conversion ratio (FCR) according to ages (wks) of broilers. It was determined that there was significant difference between control and other groups (P<0.05) in daily feed consumption. It was observed that the highest feed consumption was in H_2 group while the lowest one in H_1 group. Karaoglu and Durdag (2003) found that the daily feed consumptions for control and probiotic-treated groups were 94.5, 95.0 and 96.3 g, and these findings were similar to the results of the current study.

The feed efficiency was not affected by humate supplementation during experimental period. Table 2 shows that the FCR values were more or less similar up to 6th wk for all groups. At the end of the trial, although humate didn't have an appreciable effect on FCR (P>0.05). The feed efficiency of H_1 group was slightly better than those of the other groups. Approximately 2 %-improvement was observed in H_1 for FCR as compared with the H_0 group. Orban *et al.* (1993) reported that feed conversion ratios ranged from 1.72 to 1.90. FCR, determined herein, was closely or better than the findings of Summers *et al.* (1992). The use of increasing levels of humate (H_2 and H_3 groups) didn't improve performance traits of broilers.

In addition, survival rates of broilers were determined in present study. Mortality for control group fed the basal diet was higher than that for groups fed diets containing humate at different levels. The mortality was 1.8, 0.0, 0.0 and 0.0 % for H_0, H_1, H_2 and H_3, respectively and there was no significant different among the groups. These values were lower than findings ranged from 2.7 to 6.52 reported by Richter *at al.* (1999) and Pradhan *et al.* (1998) for broilers fed diets containing probiotic at different levels. Little is known about the mechanism by which humate supplementation enhances the life span and improves production efficiency. But, data obtained from present study suggest that humate supplementation may benefit poultry production. In a study, it was reported that supplemental humate alleviates toxicity of Cd in chickens (Herzig *et al.*, 1994) by reducing deposition of toxic metals in organs.

Slaughter and Carcass Traits: Producing lean poultry meat to meet the demands of the consuming public is a major objective of the broiler industry. One of the major

Table 3: Effect of humate on the slaughter and carcass characteristics of broilers

Parameters	H_0	H_1	H_2	H_3	SEM±	Significance
	Slaughter Characteristics					
Body weight before slaughter (g)	2473	2533	2528	2477	61.65	Ns
Body weight after slaughter (g)	2385	2449	2454	2403	62.25	Ns
Body weight after plucking (g)	2193	2240	2249	2203	58.14	Ns
Blood	88	84	74	74	6.4	Ns
Feathers	117	125	130	120	5.6	Ns
Head	76	84	75	80	3.4	Ns
Feet and shanks	109	104	99	104	3.4	Ns
Offals	105	117	112	117	6.2	Ns
Heart	10	10	10	11	0.6	Ns
Liver	42	42	43	43	2.2	Ns
Gizzard	43	41	40	43	2.2	Ns
Abdominal fat pad weight (g)	36	40	40	32	4.5	Ns
Hot carcass weight (g)	1874	1913	1912	1884	51.3	Ns
Hot carcass yield (%)	76	76	76	76	0.5	Ns
Cold carcass weight (g)	1847	1889	1882	1856	49.1	Ns
Cold carcass yield (%)	75	75	74	75	0.5	Ns
Carcass Characteristics						
Wing weight (g)	209	206	212	203	6.9	Ns
Leg weight (g)	748	774	745	709	26.7	Ns
Breast weight (g)	763	787	802	790	23.9	Ns
Neck weight (g)	96	97	97	89	5.7	Ns
Tail weight (g)	28	23	26	27	2.61	Ns

Ns: Non-significant; ±, Standard error of samples.

items is to obtain the higher percentage yield of saleable products and consequently to increase the edible 3 portions. The results on the slaughter weight and blood, feather, head, feet and shanks and gastrointestinal tracts as inedible portions, and gizzard, heart and liver as edible organs, and carcass weights and yields are shown in Table 3. As shown, the differences among the groups in terms of all slaughter and carcass characteristics were not significant in present study.

Dickens and Lyon (1993) noted that blood loss were 2.64 and 2.86 % of live weight, in our study it was around 3.2% and H_0 had the highest blood volume as compared with control and the other treatment groups. Brake *et al.* (1993) reported that the slaughter weight, blood, feathers, head, feet and gastrointestinal tract were 2547.4, 98.1, 108.1, 61.0, 114.3 and 170.8 g, and heart, liver, gizzard, abdominal fat pad, hot and cold carcass weights were 13.3, 42.3, 40.4, 43.3, 1789.3 and 1771.6 g. In generally, findings obtained from the present study were higher than these results reported by Brake *et al.* (1993). The findings on carcass yields values were in agreement with results reported by Eren *et al.* (2000) and Kocabagli *et al.* (2002).

In conclusion, although humate supplementation to diets of broilers had no effect on performance, slaughter and carcass characteristics, a slightly improvement was observed in FCR for H_1 group fed with diet containing 0.1 % humate. In addition, it was not observed dead chick in humate groups while 1.8 % of mortality in control group.

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