The Effects of Dietary Humate Supplementation on Broiler Growth and Carcass Yield

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ABSTRACT The growth-promoting effect of Farmagülatör DRY™ Humate (FH) on live performance, carcass weight, and the abdominal fat pad of broilers was studied during different feeding periods. Four hundred, 1-d-old straight-run birds were randomly distributed to 20 floor pens of an environmentally controlled house. Four dietary regimens were replicated in five pens, each containing 20 chicks, as follows: 1) birds received no added FH in the starter or grower (NAFH), 2) birds received FH from 0 to 21 d ($FH_{0\text{-}21}$), 3) birds received FH from 22 to 42 d ($FH_{22\text{-}42}$), 4) birds received FH from 0 to 42 d ($FH_{0\text{-}42}$) in the starter and grower diets, respectively. The FH was added to the diets at 2.5 kg/per ton of feed. Starter and grower diets were formulated to meet the minimum NRC requirements for broilers and were provided as a mash feed. Body weights at 21 d were not affected by the dietary regimens. At 42 d, body weights and feed conversions of broilers were significantly affected by the dietary humate treatments. Birds fed $FH_{22\text{-}42}$ weighed more than the NAFH, whereas the $FH_{0\text{-}21}$ and $FH_{0\text{-}42}$ were intermediate and not different from the other treatments. Feed:gain was lower for the $FH_{22\text{-}42}$ and $FH_{0\text{-}42}$ treatments compared to the NAFH. There was no difference in carcass yield or abdominal fat pad percentages due to feeding FH. Feeding FH during the grower period had the most beneficial effect in terms of growth and feed conversion on broiler performance.

(*Key words*: broilers, humate, live performance, carcass yield, abdominal fat pad)

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INTRODUCTION

Humate is considered a growth-promoting agent in Europe. Humates are formed from decayed plant matter with the aid of living bacteria in the soil. The composition of humates includes humus, humic acid, fulvic acid, ulmic acid, and trace minerals, which are necessary for plant development (Stevenson, 1994). Humus was defined as decomposed organic matter of soil (Senn and Kingman, 1973). Humic acids have cation and anion exchange sites. Humates are the salts of humic acid in which the exchange site is Ca^{+}, Na^{+}, Al^{+}, and Fe^{+2} rather than hydrogen. Humic acid, used for growing plants, chelates with trace minerals to enable uptake of nutrients by the plant cells. Using humates in animal nutrition has a very short history. Griban et al. (1991) and Lenk and Benda (1989) first used humic acid to improve the immune system of calves. Kühnert et al. (1989, 1991) used humic acid to treat digestive disorders and diarrhea of cats and dogs, respectively. In recent years, it has been observed that humates included in the feed and water of poultry promote growth (Bailey et al., 1996; Parks, 1998; Shermer et al., 1998; Eren et al., 2000). The objective of this study was to investigate the effects of dietary humates on live performance, carcass weights, and abdominal fat pads of broilers.

MATERIALS AND METHODS

Four handred straight-run broiler birds (Isa × Isa) were obtained from a local hatchery[2] in İstanbul. Day-old chicks were weighed and randomly distributed in 20 floor pens (1.25 × 1.60 m), and each pen contained 20 chicks. Four dietary regimens were replicated five times. Dietary regimens were as follows: 1) birds did not receive any humate (NAFH) in starter or grower diets, 2) birds received Farmagülatör DRY™ Humate[3] (FH) from 0 to 21 d ($FH_{0\text{-}21}$) of the experiment, 3) birds received FH from 22 to 42 d ($FH_{22\text{-}42}$), and 4) birds received FH from 0 to 42 d ($FH_{0\text{-}42}$) in starter and grower diets. The FH was added to the diet at 2.5 kg/ton and its composition was

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Abbreviation Key: FH = Farmagülatör DRY™ Humate; MH = menefee humate; NAFH = no added Farmagülatör DRY™ Humate.

TABLE 1. Composition of the experimental broiler diets (% as-is basis)

	Starter		Grower	
Ingredient	Control	Humate	Control	Humate
Ground corn	53.07	52.92	45.75	45.56
Wheat	3.50	3.50	15.00	15.00
Soybean meal (48 % CP)	30.50	30.50	27.20	27.20
Fish meal (60% CP)	4.90	4.90	1.25	1.25
Meat-Bone meal	2.30	2.30	3.62	3.62
Sunflower oil (8,950 kcal/kg)	3.00	3.00	5.00	5.00
Limestone	1.10	1.10	1.09	1.03
Dicalcium phosphate[1]	0.60	0.50	0.15	0.15
Vitamin-mineral premix[2]	0.25	0.25	0.25	0.25
Vitamin E[3]	0.10	0.10	0.10	0.10
Biotin (2.0%)	0.10	0.10	. . .	. . .
Salt	0.25	0.25	0.25	0.25
DL-Methionine	0.13	0.13	0.14	0.14
Coccidiostat	0.10	0.10	0.10	0.10
Antioxidant[4]	0.10	0.10	0.10	0.10
Farmagülatör DRY™ Humate[5]	. . .	0.25	. . .	0.25
Total	100.00	100.00	100.00	100.00
Calculated and analyzed values				
Metabolizable energy, kcal/kg	3,111	3,106	3,256	3,256
CP, % (Analyzed)	23.51	23.50	21.04	21.03
Lysine, %	1.41	1.40	1.17	1.17
Methionine, %	0.56	0.55	0.49	0.49
Methionine + cystine, %	1.10	1.08	1.00	0.98
Ca, % (Analyzed)	1.10	1.08	1.00	0.98
P, % (Analyzed)	0.50	0.49	0.40	0.40

[1]Contains 24% Ca and 17.5% available P.

[2]Supplied the following per kilogram of diet: Vitamin A, 15,000 IU; cholecalciferol, 1,500 ICU; vitamin E, 30.0 IU (dl-α-tocopheryl acetate); menadione, 5.0 mg; thiamine, 3.0 mg; riboflavin, 6.0 mg; niacin, 20.0 mg; panthotenic acid, 8.0 mg; pyridoxine, 5.0 mg; folic acid, 1.0 mg; vitamin B_{12}, 15 mcg; manganese, 80.0 mg; zinc, 60.0 mg; iron, 30.0 mg; copper, 5.0 mg; iodine, 2.0 mg; and selenium, 0.15 mg.

[3]dl-α-tocopheryl acetate.

[4]Ethoxyquin.

[5]Supplied the following per kilogram of premix: polymeric polyhydroxy acids (humic, fulvic, ulmic, and humatomelanic acids), 80 g; silisium oxide as carrier, 920 g; trace minerals of Al, Na, K, Fe, Ca, Mg, Mn, P, Cu, and Zn. Farmavet International, Kocaeli, 41400 Turkey.

provided in Table 1. Mash diets were formulated to meet the minimum NRC (1994) requirements for broilers. Experimental diets were analyzed for DM, CP, and ether extract (Association of Official Analytical Chemists, 1994). Metabolizable energy was calculated based on the prediction formula generated by Alp (1989). Water and feed were provided ad libitum, and lighting was continuous. Birds were vaccinated for Marek's disease at hatch, and wood shavings were used as litter. Mortality was recorded as it occurred.

Broilers were weighed individually at hatch and at 21 and 42 d of age; feed consumption was determined on a pen basis. At 42 d, two birds from each pen were randomly selected and weighed before processing. Birds were slaughtered according to the local kosher customs in Turkey. Hot carcasses (without neck, giblets, and feet) were weighed, and abdominal fat pads were removed from the abdominal cavity and weighed.

Data were analyzed by one-factor ANOVA using the general linear models procedure of SAS software (SAS Institute, 1994) for the main effect of dietary regimen. The percentage of mortality data was transformed by arc sin before analysis (Snedecor and Cochran, 1967). The Student-Newman-Keul's multiple-comparison procedure (Steel and Torrie, 1980) was utilized when the F-test was significant ($P < 0.05$).

RESULTS AND DISCUSSION

Experimental diets were formulated to contain equal amounts of energy and CP to meet the minimum require-

TABLE 2. Effects of dietary Farmagülatör DRY™ Humate on live performance of male broilers (0-21 d)

Dietary regimen	Hatch weight (g)	Body weight (g) (21 d)	Feed: gain (g:g) (0-21 d)
NAFH[1]	45.6	758	1.68
$FH_{(0-21)}$[2]	45.5	735	1.74
$FH_{(22-42)}$[3]	44.9	749	1.67
$FH_{(0-42)}$[4]	44.6	737	1.71
SEM	0.31	7.9	0.039
Diet effect (P-value)[5]	0.1440	0.1403	0.5453

[1]NAFH = no added Farmagülatör DRY™ Humate.

[2]Farmagülatör DRY™ Humate provided from 0 to 21 d (2.5 kg/ton of feed).

[3]Farmagülatör DRY™ Humate provided from 22 to 42 d (2.5 kg/ton of feed).

[4]Farmagülatör DRY™ Humate provided from 0 to 42 d (2.5 kg/ton of feed).

[5]NS, $P > 0.05$.

TABLE 3. Effects of dietary Farmagülatör DRY™ Humate on live performance of male broilers (22-42 d)

Dietary regimen	Body weight (g) (42 d)	Feed:gain (g:g) (22-42 d)	Feed:gain (g:g) (0-42 d)	Overall mortality (%)
NAFH[1]	2,346^{b}	2.14^{a}	1.99	8.0
$FH_{(0-21)}$[2]	2,394^{ab}	2.03^{ab}	1.95	1.0
$FH_{(22-42)}$[3]	2,451^{a}	1.99^{b}	1.89	5.0
$FH_{(0-42)}$[4]	2,428^{ab}	1.99^{b}	1.92	7.0
SEM	25.9	0.037	0.032	2.03
Diet effect (*P*-value)	0.0292	0.0416	0.2522	0.1138

[a-b]Means within columns with different superscripts are significantly different ($P < 0.05$).

[1]No added Farmagülatör DRY™ Humate.

[2]Farmagülatör DRY™ Humate provided from 0 to 21 d (2.5 kg/ton of feed).

[3]Farmagülatör DRY™ Humate provided from 22 to 42 d (2.5 kg/ton of feed).

[4]Farmagülatör DRY™ Humate provided from 0 to 42 d (2.5 kg/ton of feed).

ments for broilers, as recommended by NRC (1994). The composition of the experimental diets is shown in Table 1. Body weights of birds at placement were not significantly different among the dietary regimens (Table 2). Dietary regimens of feeding FH did not have significant effects on body weights, feed consumption (data not shown), or feed conversions up to 21 d of age. Body weights of birds fed FH_{22-42} were greater than those fed NAFH, whereas weights of birds fed FH_{0-21} and FH_{0-42} were intermediate (Table 3). Grower diet (22 to 42 d) consumption of birds was not affected by the different dietary regimens (data not shown). Birds receiving the FH from 22 to 42 d or from 0 to 42 d had significantly better feed conversions than the NAFH-fed birds, whereas feed conversion of birds fed FH_{0-21} was intermediate. Overall feed consumption (data not shown) and feed conversions (0 to 42 d) were not statistically significant among the dietary regimens. The overall mortality was not significant for any of the dietary regimens due to the variation in mortality among pens (Table 3).

The FH dietary regimens had no effect ($P > 0.05$) on the preslaughter live weights, hot carcass weights, percentage carcass yield (relative to their respective live weights at 42 d), or percentage abdominal fat pad at 42 d compared with the NAFH diet (Table 4). In the present study, feeding FH from 22 to 42 d significantly improved body weights, which were 4.28% greater than those of the NAFH-fed birds. Feeding FH to the broilers from 0 to 21 and from 0 to 42 d resulted in 2.00 and 3.38% increases, respectively, in body weights compared with the NAFH treatment; however, these increases were not statistically different from the NAFH treatment.

Eren et al. (2000) compared the effects of dietary humate (Farmagülatör DRY™) supplementation at 1.5 and 2.5 g/kg on broiler performance from 0 to 42 d. Although there was no performance difference at 21 d, they found that dietary supplementation of humate at 2.5 g/kg significantly improved the live weights of broilers at 42 d. They also found that serum Na^+ concentration and tibia bone ash of male broilers were significantly elevated when humate was fed at 2.5 g/kg but not at 1.5 g/kg. In the present experiment, humate supplementation indeed increased the body weights of broilers. The most beneficial effect was realized with feeding humate, a growth-promoting agent, during the 22-to-42-d feeding period.

Bailey et al. (1996) found that feeding Menefee® humate (MH) to male broilers did not affect body weights at 35 d, whereas broilers receiving the 0.5% MH diet converted feed into body mass significantly better than the control birds fed the basal diet. They also reported that dietary MH supplementation increased mortality significantly, improved cumulative feed conversion by Day 35, and increased body weights by Day 42 in female broilers. Parks (1998) reported that feeding MH to turkeys improved body weight gain and feed conversions from 8 to 12 wk of age ($P < 0.05$), but this response did not persist through to 20 wk of age.

TABLE 4. Effects of Farmagülatör DRY™ Humate on carcass performance of male broilers at 42 d

Dietary regimen	Processing plant weight (g)	Hot carcass weight (g)	% Carcass	Abdominal fat pad (%)
NAFH[1]	2,519	1,862	73.89	1.97
$FH_{(0-21)}$[2]	2,600	1,910	73.47	2.04
$FH_{(22-42)}$[3]	2,641	1,968	74.56	2.18
$FH_{(0-42)}$[4]	2,670	1,981	74.18	2.19
SEM	47.49	37.58	0.404	0.299
Diet effect (*P*-value)	0.1457	0.1127	0.2860	0.9426

[1]No added Farmagülatör DRY™ Humate.

[2]Farmagülatör DRY™ Humate provided from 0 to 21 d (2.5 kg/ton of feed).

[3]Farmagülatör DRY™ Humate provided from 22 to 42 d (2.5 kg/ton of feed).

[4]Farmagülatör DRY™ Humate provided from 0 to 42 d (2.5 kg/ton of feed).

Dietary supplementation with 1.0% MH significantly decreased fat pad weights when compared to turkeys fed 0.5 or 0.0% MH, although the percentage abdominal fat pad of broilers was not influenced by the inclusion of dietary FH in the present study. Parks (1998) also demonstrated that MH improved cell-mediated immunity of turkeys fed low crude protein diets. Shermer et al. (1998) examined the short-chain fatty acids (SCFA), amino acid concentrations, and microbial populations in the digestive track of birds fed diets containing 0, 5, or 10 g of MH/kg. Shermer et al. (1998) hypothesized that humates might influence the performance of birds by altering the microflora in the gastrointestinal system, e.g., in the cecum; however, they found that feeding MH at various levels did not influence the cecal concentrations of the SCFA and amino acids. Only *Escherichia coli* populations were increased by the increased levels of dietary MH.

Performance differences due to humate supplementation observed in the literature might result from the compositional differences among the commercially available humate products. Although there is not enough evidence to hypothesize how humates promote the growth in broilers, it is assumed that humates might increase the uptake of nitrogen, phosphorus, and other nutrients due to their chelating properties. This assumption needs to be further validated in poultry.

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