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The effects of dietary supplementation of yeast culture on performance, blood parameters and immune system in broiler turkeys*

Bülent ÖZSOY[1], Sakine YALÇIN[2]

[1] Mustafa Kemal University, Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Disease, Hatay, Turkey. [2] Ankara University, Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Disease, Ankara, Turkey.

Summary: This experiment was carried out to determine the effects of different levels of yeast culture (*Saccharomyces cerevisiae)* supplementation to the broiler turkey diets on the performance characteristics, some blood parameters and immune system. A total of 48 female poults aged five weeks were divided into one control group and three treatment groups each containing 12 female poults. The diets of the first, second and third treatment groups were supplemented with 1, 2 and 3 g/kg yeast culture (Diamond V "XP", *Saccharomyces cerevisiae)*, respectively. The experimental period lasted 10 weeks. At the end of the experiment body weight, body weight gain, feed consumption, feed efficiency, carcass yield, weights and rates of internal organs, abdominal fat and the values of pH and viscosity of small intestine of turkeys were not significantly affected by different levels of yeast culture. There were no significant differences among the groups in total protein, cholesterol, triglyceride, uric acid, alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase of blood serum and haemetological parameters. Immune system of turkeys was also not affected by dietary yeast culture. The results in this study demonstrated that yeast culture (*Saccharomyces cerevisiae*) supplementation at the levels of 1, 2 and 3 g/kg to the diets of female broiler turkeys did not have any significant effects on performance characteristics, some blood parameters and immune system.

Key words: Broiler turkey, blood parameters, immune system, performance, yeast culture

Broyler hindi rasyonlarına maya kültürü ilavesinin performans, kan parametreleri ve bağışıklık sistemi üzerine etkileri

Özet: Bu araştırma, broyler dişi hindi rasyonlarına farklı düzeylerde maya kültürü (*Saccharomyces cerevisiae)* ilavesinin hindilerde verim özellikleri, bazı kan parametreleri ve immun sistem üzerine etkilerini belirlemek amacıyla yapılmıştır. Toplam 48 adet 5 haftalık dişi palazı her biri 12 adet palazdan meydana gelen 1 kontrol ve 3 deneme olmak üzere toplam 4 gruba ayrılmıştır. Birinci, ikinci ve üçüncü deneme grupları rasyonlarına sırasıyla 1, 2 ve 3 g/kg düzeylerinde maya kültürü (Diamond V "XP", *Saccharomyces cerevisiae)* ilave edilmiştir. Deneme 10 hafta sürdürülmüştür. Araştırma sonunda rasyonlara farklı düzeylerde ilave edilen maya kültürünün hindilerde canlı ağırlık, canlı ağırlık artışı, yem tüketimi ve yemden yararlanma oranı üzerine önemli etkisi gözlenmemiştir. Rasyonlara maya kültürü ilavesi karkas randımanını, iç organ ağırlıklarını, abdominal yağ ağırlığı ile oranlarını, ince bağırsak pH'sı ve viskositesini etkilememiştir. Kan serumu toplam protein, kolesterol, trigliserit, ürik asit ALT, AST, ALP düzeyleri bakımından gruplar arasında istatistik önem taşıyan farklılık oluşmamıştır. Hindilerde maya kültürünün immun sistem üzerinde de herhangi bir önemli etkisi olmadığı görülmüştür. Sonuç olarak, broyler dişi hindi rasyonlarına 1, 2 ve 3 g/kg düzeylerinde maya kültürü (*Saccharomyces cerevisiae*) ilavesinin hindilerde verim özellikleri, bazı kan parametreleri, ince bağırsak pH'sı ve viskositesi ile immun sistem üzerinde önemli bir etkisi saptanmamıştır.

Anahtar kelimeler: Etlik hindi, immun sistem, kan parametreleri, maya kültürü, performans

Introduction

Yeasts are important natural growth promoters. *Saccharomyces cerevisiae*, also known as "bakers yeast", is one of the most widely commercialized yeast species. Yeasts were the best source of protein, amino acid and vitamins B. Yeast contains protein which is equivalent approximately to soy-bean meal protein. The deficiency of lysine in diets can be completed with yeast.

There are some reports about the usage of yeast culture in poultry. Guevara et al. (1978) observed a trend toward decreased growth rate and feed utilization in broiler chicks as the dietary concentration of live yeast

* This research has been summarized from Ph.D. thesis.

Table 1. Composition (%) and nutrient contents of diets
Tablo 1. Karma yemlerin bileşimi (%) ve besin maddesi içerikleri

	Weeks				
Ingredient (%)	6-7	8-9	10-11	12-13	14-15
Corn	41,15	46,50	51,00	55,70	57,50
Soybean meal	34,00	29,70	22,1	14,00	8,50
Full-fat soya	15,50	15,00	16,00	19,55	21,30
Meat and bone meal	4,50	3,50	4,00	3,50	3,70
Sunflower seed oil	1,40	2,20	3,80	4,25	6,20
Limestone	1,20	1,10	1,10	1,10	1,00
Dicalcium phosphate	1,25	1,15	1,15	1,15	1,10
Salt	0,25	0,25	0,25	0,25	0,25
Vitamin premix [1]	0,15	0,15	0,15	0,15	0,15
Mineral premix[2]	0,10	0,10	0,10	0,10	0,10
Methionine	0,25	0,20	0,20	0,10	0,10
Lysine	0,25	0,15	0,15	0,15	0,10
Chemical analyses					
Metabolisable energy (kcal/kg)[3]	2948	3053	3202	3329	3483
Dry matter (%)	91,80	91,10	91,30	91,15	91,85
Crude protein (%)	25,95	23,90	21,80	19,50	17,90
Ether extract (%)	6,85	8,00	10,40	10,75	13,90
Crude fibre (%)	2,58	2,68	2,60	2,88	2,44
Ca (%)	1,31	1,26	1,29	1,34	1,12
P (%)	0,88	0,65	0,67	0,67	0,66

[1] Provides per kg : 14 000 000 IU vitamin A, 4 000 000 IU vitamin D3, 80 g E vit, 30 g vitamin K, 33 g vitamin B1, 8 g vitamin B2, 40 g niacin, 12 g panthotenic acid,6 g vitamin B6 0,03 g vitamin B12, 2 g folic acit, 0,15 g biotin, 50 g vitamin C.
[2] Provides per kg : 150 g Mn, 120 g Fe, 150 g Zn, 14 g Cu, 0,4 g Co, 3g I, 0,3 g Se
[3] Metabolizable energy content of diets estimated using the equation of Carpenter and Clegg (Leeson and Summers, 2001).

culture increased in the diet. Onifade and Babatunde (1996) indicated that the supplementation of dried yeast containing *Saccharomyces cerevisiae* as a pure culture to high fiber diets containing palm kernel meal significantly ($P < 0.05$) improved body weight gain, feed efficiency, and apparent retention coefficients of dry matter, crude protein, ether extract, crude fiber, and neutral detergent fiber in broiler chicks from 7 to 35 d of age. Gao et al. (2008) concluded that yeast culture improves growth performance and immune system. The effects of feeding yeast culture on the production and the effective level of supplementation in broiler turkeys are still controversial. Therefore the present study was conducted to evaluate the effects of different levels of yeast culture (*Saccharomyces cerevisiae*) supplementation to the diets on the performance characteristics, some blood parameters and immune system in female broiler turkeys.

Materials and Methods

A total of 48 female poults (Canadian white feather colour Hybrid Converter), five weeks old, were used in this study. Poults were divided into 4 equal groups (each group contained 12 poults) with one control group and three treatment groups. Each group was divided into four replicates comprising three poults each. They were housed in cages (170x94x90 cm; widthxlengthxheight) in a windowed house with a light regimen of 18L:6D. Temperature in house was maintained at 30°C for the first week and then gradually reduced according to the normal management practices, to a temperature of 20°C. Feed (in mash form) and water were provided ad libitum during the entire 10 weeks.

The ingredients and chemical composition of the basal diets are presented in Table 1. The diets were formulated to meet or exceed the nutrient requirements of poults of the management guide of Canadian white feather colour Hybrid Converter (Cold Spring Farm, 2000). Each basal diet was supplemented with 1, 2, 3 g/kg commercial yeast culture product (Diamond V XP yeast culture supplied from Interchemie Chemistry Industry Import Export and Trading Corp., Ankara, Turkey). This was a fermented product composed of *Saccharomyces cerevisiae* grown on a medium of ground yellow corn, hominy feed, corn gluten feed, wheat middlings, rye middlings, diastatic malt, corn syrup and cane molasses and dried to preserve the fermenting activity of yeast. The analysis of yeast culture product was not less than 12.0% of crude protein, not less than 3.0% ether extract and not more than 6.5% crude fiber (DIAMOND, 2007).

Nutrient composition of basal diet was determined according to the AOAC (2000). The sample of diets was ashed in a muffle furnace prior to the analysis of calcium (Farese et al., 1967) and total phosphorus (ADAS, 1981). Metabolizable energy levels of diets were estimated using the equation of Carpenter and Clegg (Leeson and Summers, 2001):

ME, kcal/kg = 53 + 38 [(crude protein,%) + (2.25 x ether extract, %) + (1.1 x starch, %) + (sugar, %)].

Poults were weighed individually at the beginning of the experimental period and weekly to calculate body weight gain. Feed consumption was recorded weekly and feed efficiency was calculated as kg feed per kg body weight gain. Animals were followed up daily to determine mortality.

At the last of the trial all of the animals were individually weighed and 5 animals per group were randomly selected, weighed and slaughtered by severing the jugular vein, inert organs, head and foot were removed manually after defeathering. Hot carcass weights were determined and carcass yield was calculated. Absolute and proportional weights of abdominal fat, liver, heart, gizzard, spleen and kidney were also determined. The contents of small intestine were homogeneized in the tubes and the pH was measured with pH meter (Orion 420A). The homogenized intestinal contents were placed in microcentrifuge tubes, and then centrifuged at 12 000 g for 10 minutes. The supernatant was withdrawn and the viscosity determined with viscometer (model LVDV-I, Brookfield Digital Viscometer) as cps (centipoise) (Graham et al., 1993).

At d 69, five animals from each group were randomly selected and bled from the brachial vein. Blood samples were taken in two tubes, one contained EDTA for estimating the haemetological parameters and the other had no anticoagulant for estimating blood serum parameters. Hemoglobine was determined with siyanid method by spectrophotometrically (Shimadzu digital spectrophotometer, HV-150 Kyoto, JAPAN) (Plaksi, 1972; Wells and Horn, 1965) and blood heamatocrit level was calculated using microheamatocrit method (Konuk, 1981). To determine serum parameters blood samples were centrifugated at 3 000 g for 10 minutes. Then sera were harvested and stored at -20 ^{o}C until analysis. Serum total protein, cholesterol, triglyceride, uric acid, alanin aminotransferase (ALT), aspartate amino transferase (AST) and alkaline phosphatase (ALP) were analyzed by Hitachi autoanalyser (Hitachi Ltd, Tokyo Seri No: 1238-23) using the commercial kits.

Immunization was determined by antibody against to New Castle Viruse. At the beginning of trial, blood samples were collected before vaccination. New Castle Vaccination was used at the eight week of trial. After twenty one day of vaccination blood samples were collected to measure antibody level by Hemaglutination-Inhibiton test (Arda, 1976).

Statistical anayses were done using SPSS programme (SPSS Inc., Chicago, IL, USA). The normality of data distribution was checked using the Kolmogorov-Smirnov test. One-way ANOVA was performed to examine differences among groups. The significance of mean differences between groups were tested by Duncan. Values were given as mean±standard error. Level of significance was taken as $P<0.05$ (Dawson and Trapp, 2001).

Results

Dietary supplementation of yeast culture had no significant effect on body weight (Table 2), body weight gain, feed intake and feed efficiency (Table 3). There were no treatment effects on carcass yield and the percentages of heart, liver, gizzard, spleen, kidney and abdominal fat weights (Table 4). Dietary treatments did not significantly affect blood parameters (Table 5), pH and viscosity of small intestinal content and anti-NDV titers (Table 6). No mortality was seen during the experiment.

Table 2. The body weights of groups (mean±standart error)
Tablo 2. Grupların ağırlıkları (g) (ortalama ± standart hata)

Weeks	Control group	Experimental groups		
		1	2	3
Start of trial (5. wk)	1232 ± 25	1242 ± 24	1263 ± 26	1250 ± 23
6	1851 ± 40	1868 ± 32	1892 ± 51	1924 ± 36
7	2519 ± 57	2540 ± 51	2574 ± 68	2615 ± 53
8	3270 ± 61	3298 ± 72	3330 ± 82	3399 ± 84
9	4067 ± 78	4087 ± 94	4151 ± 92	4276 ± 96
10	4844 ± 93	4903 ± 105	4955 ± 126	5089 ± 121
11	5586 ± 103	5682 ± 129	5784 ± 135	5876 ± 138
12	6350 ± 133	6359 ± 162	6561 ± 147	6638 ± 160
13	7135 ± 150	7075 ± 178	7361 ± 148	7435 ± 159
14	7835 ± 153	7842 ± 189	8126 ± 161	8254 ± 161
15	8392 ± 159	8501 ± 194	8742 ± 177	8948 ± 172

n=12 per group
No significant differences ($P>0.05$) among groups.

Discussion and Conclusion

The values for body weight (Table 2), body weight gain, feed intake and feed efficiency (Table 3) of broiler turkeys were not significantly affected from dietary yeast culture supplementation. Yeast culture at the level of 1, 2 and 3 g/kg increased total body weight gain 1,40 %, 4,47 % and 7,52 %, respectively compared to the control group. However this improvement in body weight gain was not statistically significant ($P>0.05$). Similar to the results of the present study yeast culture supplementation had no effect on body weight gain, feed intake and feed efficiency of poults (Bradley and Savage, 1995), broilers (Kahraman et al., 1999; Karaoğlu and Durdağ, 2005) and broiler breeders (Brake, 1991). Yalçın et al. (2008) reported that yeast culture (*Saccharomyces cerevisiae*, Diamond V XP) supplementation at the level of 2 g/kg increased body weight gain and did not significantly affect feed intake and feed efficiency in laying hens. Onifade and Babatunde (1996) reported that supplementation of dried yeast (*Saccharomyces cerevisiae*) to the high fibre diets improved body weight gain of broiler chicks, feed efficiency was also improved in broilers fed 0.15 and 0.45% of dried yeast ($P<0.05$). Gao et al. (2008) observed that dietary supplemental yeast culture at 0.25 % improved average daily gain and feed efficiency during

Table 3. The effects of dietary yeast culture supplementation on body weight gain, feed intake and feed efficiency of turkeys (mean ± standard error)
Tablo 3. Rasyonlara maya kültürü ilavesinin hindilerde ağırlık artışı, yem tüketimi ve yemden yararlanma oranı üzerine etkileri (ortalama ± standart hata)

Weeks	Control	Experimental groups			P
		1	2	3	
Body weight gain, g					
1-2	1286 ± 16	1298 ± 33	1311 ± 19	1364 ± 52	0,40
3-4	1548 ± 13	1547 ± 45	1577 ± 33	1662 ± 56	0,20
5-6	1520 ± 48	1595 ± 33	1634 ± 93	1600 ± 78	0,68
7-8	1549 ± 70a	1393 ± 44b	1577 ± 50a	1558 ± 66a	0,06
9-10	1257 ± 42b	1426 ± 38a	1381 ± 28ab	1513 ± 56a	0,01
Total	7159 ± 100	7259 ± 91	7479 ± 191	7697 ± 225	0,10
Feed intake, g					
1-2	2162 ± 23	2148 ± 49	2201 ± 24	2252 ± 49	0,22
3-4	3206 ± 23	3158 ± 76	3278 ± 43	3297 ± 83	0,39
5-6	3975 ± 138	3968 ± 124	4037 ± 234	4004 ± 176	0,99
7-8	4550 ± 31	4088 ± 148	4537 ± 125	4370 ± 160	0,08
9-10	4850 ± 215	5201 ± 101	5036 ± 96	5375 ± 196	0,18
Total	18744 ± 243	18566 ± 303	19090 ± 390	19300 ± 357	0,42
Feed efficiency (kg feed / kg body weight gain)					
1-2	1,68 ± 0,03	1,66 ± 0,02	1,68 ± 0,01	1,65 ± 0,03	0,80
3-4	2,07 ± 0,01	2,04 ± 0,03	2,08 ± 0,05	1,98 ± 0,03	0,22
5-6	2,62 ± 0,11	2,48 ± 0,03	2,47 ± 0,06	2,50 ± 0,01	0,42
7-8	2,94 ± 0,01	2,94 ± 0,1	2,88 ± 0,07	2,81 ± 0,11	0,70
9-10	3,85 ± 0,04a	3,65 ± 0,04b	3,65 ± 0,08b	3,55 ± 0,02b	0,01
Total	2,62 ± 0,02	2,56 ± 0,01	2,55 ± 0,05	2,51 ± 0,04	0,18

n=4 per group
a,b: means within a row followed by the same superscript are not significantly different (P>0.05).

Table 4. The effects of dietary yeast culture supplementation on carcass weight. carcass yield, internal organ weights and percentages in turkeys (mean ± standard error)
Tablo 4. Rasyonlara maya kültürü ilavesinin hindilerde karkas ağırlığı, karkas randımanı. iç organ ağırlıkları ve oranları üzerine etkileri (ortalama ± standart hata)

	Control group	Experimental groups		
		1	2	3
Slaughter weight, kg	8319 ± 173	8208 ± 156	8326 ± 78	8670 ± 166
Carcass weight, kg	6700 ± 157	6623 ± 124	6658 ± 117	7094 ± 136
Carcass yield, %	80,53 ± 0,58	80,70 ± 0,25	79,95 ± 0,92	81,82 ± 0,83
Abdominal fat, g	191,9 ± 28,8	187,8 ± 10,9	204,9 ± 13	202,6 ± 4,1
Abdominal fat yield, g/100 g BW	2,09 ± 0,49	2,29 ± 0,15	2,74 ± 0,31	2,34 ± 0,05
Liver weight, g	82,26 ± 3,09	82,28 ± 2,62	81,13 ± 4,09	86,61 ± 0,89
Liver yield, g/100 g BW	0,98 ± 0,029	1,01 ± 0,041	0,97 ± 0,052	1,00 ± 0,016
Gizzard weight, g	91,93 ± 7,27	84,58 ± 2,05	87,26 ± 1,49	95,04 ± 3,27
Gizzard yield, g/100 g BW	1,10 ± 0,081	1,03 ± 0,028	1,05 ± 0,014	1,09 ± 0,031
Heart weight, g	29,01 ± 1,15	28,41 ± 0,93	31,83 ± 0,81	30,24 ± 1,39
Heart yield, g/100 g BW	0,35 ± 0,011	0,35 ± 0,15	0,38 ± 0,011	0,35 ± 0,017
Spleen weight, g	6,87 ± 0,53	5,87 ± 0,45	6,78 ± 0,27	7,04 ± 0,25
Spleen yield, g/100 g BW	0,082 ± 0,006	0,072 ± 0,006	0,081 ± 0,003	0,081 ± 0,003

n=5 per group
No significant differences (P>0.05) among groups.

Table 5. Some biochemical blood parameters in the groups (mean±standart error)
Tablo 5. Grupların bazı biyokimyasal kan parametreleri (ortalama ± standart hata)

	Control group	Experimental groups		
		1	2	3
Total protein, g/dl	3,22 ± 0,06	3,40 ± 0,089	3,24 ± 0,093	3,30 ± 0,084
Cholesterol, mg/dl	117,0 ± 5,4	121,2 ± 5,3	104,8 ± 6,4	111,2 ± 3,6
Triglyceride, mg/dl	122,8 ± 14,0	135,20 ± 17,54	98,20 ± 10,11	106,60 ± 17,66
Uric acid mg/dl	3,32 ± 0,13	3,14 ± 0,23	3,24 ± 0,20	2,96 ± 0,40
ALT, U/I	4,20 ± 0,74	4,20 ± 0,66	4,00 ± 0,55	4,20 ± 0,49
AST, U/I	390,8 ± 15,1	363,0 ± 20,8	362,6 ± 29,9	343,6 ± 6,0
ALP, U/I	1068 ± 90	1056 ± 42	1045 ± 80	1003 ± 35
Haematocrit, %	35,80 ± 1,11	35,60 ± 1,78	34,00 ± 089	34,00 ± 0,45
Haemoglobin, g/dl	10,98 ± 0,94	12,01± 1,22	12,29 ± 1,08	10,85 ± 0,47

n=5 per group No significant differences (P>0.05) among groups.

Table 6. The intestinal pH and viscosity values and the antibody titer (log_2) against to Newcastle vaccination of groups
Tablo 6. Grupların ince bağırsak pH ve viskosite değerleri ile Newcastle hastalığı virusuna karşı oluşan ortalama log_2 antikor titre değerleri (ortalama ± standart hata)

	n	Control group	Experimental groups		
			1	2	3
pH	5	5,94 ± 0,06	5,94 ± 0,05	5,95 ± 0,06	6,09 ± 0,63
Viscosity	4	1,90 ± 0,08	2,21± 0,23	2,33 ± 0,20	1,77 ± 0,46
Antibody titer	5	8,80 ± 0,86	10,80 ± 0,49	11,80 ± 0,37	9,40 ± 1,69

No significant differences (P>0.05) among groups.

grower and overall periods in broilers (P≤0.05). Some researchers reported that yeast culture have beneficial effects on broiler performance when broilers were challenged with Eimeria spp. (Stanley et al., 2004a) or consumed aflatoxin diet (Stanley et al., 2004b). The results of nonsignificant effect in performance in the present study may be explained that broiler turkeys were maintained in good experimental conditions and little environmental stress. Mortality was not seen in this study. Similarly, some researchers observed that no difference in mortality among groups fed diets supplemented with yeast culture in broilers (Gao et al., 2008) and laying hens (Yalçın et al., 2008). However, in the study of Tangendjaja and Yoon (2002) mortality was reduced (P<0.05) by the yeast culture supplementation in laying hens.

Carcass weight, carcass yield and the percentages of liver, gizzard, heart, spleen and abdominal fat were not affected by dietary yeast culture (Table 4). Similarly, yeast culture supplementation had no effect on the carcass yield of turkeys (Savage et al, 1985) and broilers (Kahraman et al. 1999; Karaoğlu and Durdağ, 2005). However, Onifade et al. (1999b) reported that yeast culture supplementation increased carcass weight and carcass yield compared to control group (P<0,01). Savage et al. (1985) concluded that live yeast culture supplementation reduced the fat content of female turkeys. In agreement with our findings, Karaoğlu and Durdağ (2005) observed that probiotic (*Saccharomyces cerevisiae*, 115-Biogallinox) supplementation had no effect on the percentages of liver, heart and gizzard in broilers.

Dietary yeast supplementation did not significantly affect blood parameters (Table 5). Similar results were also obtained by Yalçın et al. (2008) in serum levels of total protein, triglyceride, cholesterol, ALT, AST and ALP. Saoud and Daghir (1980) also observed that single cell protein had no effect on serum uric acid in broilers. However, Yalçın et al. (2008) observed that serum uric acid was increased (P<0.05) by dietary yeast culture supplementation. Onifade et al. (1999a) reported that serum protein level was decreased and the serum levels of cholesterol, ALT, AST and ALP were increased with dietary yeast culture in rabbits. Onifade et al. (1999a) also concluded that rabbits fed 0.3% yeast culture had improved (P<0.05) haematological indices, namely haematocrit and haemoglobin compared to control group.

It was observed in the present study that there were no significant differences in pH and viscosity of small intestinal content (Table 6). Similarly intestinal pH in broilers (Kahraman et al., 1999), viscosity of small intestinal content in broilers (Owens and McCrachen (2003) and in rabbits (Kermauner and Struklec, 1999) were not affected by dietary yeast supplementation.

Dietary treatments did not significantly affect anti-NDV titers (Table 6). However, Gao et al. (2008) reported that antibody titers to NDV increased linearly (P<0.05) when the level of dietary yeast culture increased which suggests that yeast culture may also influence systemic or humoral immunity of broilers.

Yeast culture contains yeast cells and metabolites such as peptides, organic acids, oligosaccharides,

aminoacids, flavor and aroma substances to improve performance in animals. However no improvement in performance was obtained by yeast culture supplementation in broiler turkeys. Differences in animal responses in literatures may be related to differences in the dose and type of yeast culture, quality of diets, age of animal and experimental conditions.

In conclusion yeast culture *(Saccharomyces cerevisiae*) supplementation at the levels of 1, 2 and 3 g/kg to the diets of female broiler turkeys did not have any significant effects on performance characteristics, some blood parameters, small intestine pH and viscosity values and immune system.

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Corresponding author:
Dr. Bülent Özsoy
Mustafa Kemal University
Faculty of Veterinary Medicine
Department of Animal Nutrition and Nutritional Disease
31040 Antakya/HATAY
e-mail: bulent58@gmail.com