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RESEARCH ARTICLE

# Effects of Sepiolite Usage in Broiler Diets on Performance, Carcass Traits and Some Blood Parameters

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## Summary

This study was carried out to determine the effects of dietary sepiolite on performance, carcass traits and some blood parameters of broilers. A total of 204 daily Ross 308 female broiler chicks were allocated into one control group and two treatment groups each containing 68 chicks. Sepiolite was used at the level of 0%, 0.5% and 1% for the diets of control group and the first and second treatment groups, respectively. The experimental period lasted 6 weeks. Supplemental sepiolite improved body weight ($P<0.01$) and overall body weight gain ($P<0.05$). No differences were observed in feed intake, feed efficiency, carcass yield and the relative weights of gizzard, liver, heart, spleen and Bursa Fabricus among groups. The relative weight of abdominal fat and the levels of serum cholesterol and serum triglyceride were reduced with 1% sepiolite inclusion in the diet. Blood serum levels of total protein were not affected by sepiolite. It is concluded that 1% sepiolite in the diets of broiler increase body weight gain and reduce the relative weight of abdominal fat and the levels of serum cholesterol and triglyceride.

***Keywords:*** *Blood parameters, Broiler, Performance, Carcass traits, Sepiolite*

# Broyler Karma Yemlerinde Sepiyolit Kullanımının Performans, Karkas Özellikleri ve Bazı Kan Parametreleri Üzerine Etkileri

## Özet

Bu araştırma broyler karma yemlerinde sepiyolit kullanımının performans, karkas özellikleri ve bazı kan parametreleri üzerine etkilerini belirlemek amacıyla yapılmıştır. Toplam 204 adet günlük Ross 308 dişi broyler civciv her biri 68 adet içeren bir kontrol ve iki deneme grubuna ayrılmıştır. Sepiyolit, kontrol grubu, birinci ve ikinci deneme grupları karma yemlerinde sırasıyla %0, %0.5 ve %1 düzeylerinde kullanılmıştır. Deneme 6 hafta sürdürülmüştür. Sepiyolit ilavesi canlı ağırlık ($P<0.01$) ve toplam canlı ağırlık kazancını ($P<0.05$) artırmıştır. Yem tüketimi, yemden yararlanma, karkas randımanı ile taşlık, karaciğer, kalp, dalak ve Bursa Fabricus relatif ağırlıkları bakımından gruplar arasında farklılık gözlenmemiştir. Karma yemde %1 düzeyinde sepiyolit bulunması relatif abdominal yağ ağırlığı, serum kolesterol ve serum trigliserit düzeylerini azaltmıştır. Serum toplam protein düzeyi sepiyolitten etkilenmemiştir. Sonuç olarak, broyler karma yemlerinde %1 düzeyinde sepiyolit bulunması canlı ağırlık kazancını artırmış, relatif abdominal yağ ağırlığı ile serum kolesterol ve trigliserit düzeylerini azaltmıştır.

***Anahtar sözcükler:*** *Broyler, Kan parametreleri, Karkas özellikleri, Performans, Sepiyolit*

## INTRODUCTION

Sepiolite is a natural ingredient, clay family known as sepiolite-palygorskite. It is a hydrated magnesium silicate, $Si_{12}Mg_8O_{30}(OH_2)_4(OH)_4.8H_2O$. Sepiolite has high porosity and surface area, strong absorptive power, high structural stability, chemically inert and strong capacity to form stable suspensions at low concentrations. It reduces dust losses, improves the durability and hardness of pellets. Sepiolite is shown to be useful in following applications such as

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absorbents, environmental deodorants, catalyst carriers, polyesters, asphalt coatings, paints, pharmaceutical uses, decolorizing agents, filter aids, anticaking agents, phytosanitary carriers, cigarette filters, plastisols, rubber, animal nutrition, detergents, cosmetics, agriculture (soil conditioning, fluid carriers for pregerminated seeds, seed coating, fertilizer suspensions), grease thickeners, and drilling fluids. Sepiolite is used as an adsorbent for toxins, bacteria and viruses in the intestine, as lubricants of ground diets and as a pelleting agent during feed processing procedures [1-3].

Sepiolite may replace growth factors, antibiotics and anticoccidials in the diets of monogastric animals. Ayed et al.[4] reported that dietary sepiolite supplementation at the levels of 0.5%, 1% and 2% improved growth performances and feed efficiency. Chickens fed a diet containing 1.5% sepiolite showed a reduction in the intestinal transit time [5] which might correspond to a better nutrient utilisation. In Turkey, the use of sepiolite in animal nutrition is still limited. Therefore the objective of this trial was to assess the effects of sepiolite supplementation in broiler diets on growth performances, carcass traits and some blood parameters.

# MATERIAL and METHODS

### *Animals, Diets and Experimental Design*

The animals were treated according to the Animal Care and Use Regulation "European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purpose, 1996".

A total of 204 Ross 308 female broiler chicks aged one day were used. They were divided into one control group and two treatment groups each containing 68 chicks. Each group was divided into four replicates as subgroups, each comprising 17 chicks. Feed and water were provided for *ad libitum* consumption and the diets were presented in mash form. The experimental period lasted 6 weeks. Broilers were fed on starter diets during 1-21 days and fed on grower diets during 22-42 days. Sepiolite was used at the level of 0%, 0.5% and 1% for the diets of control group and the first and second treatment groups, respectively. Diets were formulated to be isonitrogenous and isocaloric. The ingredients and chemical composition of the diets are presented in *Table 1*.

***Table 1.*** *The ingredient and chemical composition of diets*
***Tablo 1.*** *Karma yemlerin yapısı ve kimyasal bileşimi*

| Ingredients (%) | Starter Diets (1-21 Days) | | | Grower Diets (22-42 Days) | | |
|---|---|---|---|---|---|---|
| | Control | S1 | S2 | Control | S1 | S2 |
| Corn | 53.95 | 52.85 | 51.80 | 51.90 | 50.90 | 49.90 |
| Soybean meal | 29.50 | 29.50 | 29.50 | 29.15 | 28.75 | 28.40 |
| Full fat soya | 9.00 | 9.30 | 9.55 | 9.50 | 10.2 | 10.85 |
| Fish meal | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Vegetable oil | 2.50 | 2.80 | 3.10 | 4.20 | 4.40 | 4.60 |
| Sepiolite | 0 | 0.50 | 1.00 | 0 | 0.50 | 1.00 |
| Limestone | 1.20 | 1.20 | 1.20 | 1.30 | 1.30 | 1.30 |
| Dicalcium phosphate | 1.10 | 1.10 | 1.10 | 1.20 | 1.20 | 1.20 |
| Salt | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| DL-Methionine | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Lysine | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Vitamin-mineral premix [1] | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| **Chemical Composition (Analyzed)** | | | | | | |
| ME [2] (kcal/kg) | 3122 | 3105 | 3105 | 3200 | 3210 | 3212 |
| Crude protein (%) | 22.05 | 22.00 | 22.06 | 21.89 | 21.94 | 21.85 |
| Calcium (%) | 0.95 | 1.00 | 0.95 | 0.98 | 1.02 | 1.03 |
| Total phosphorus (%) | 0.63 | 0.66 | 0.66 | 0.64 | 0.66 | 0.69 |

***S1:*** *Diet containing 0.5% sepiolite,* ***S2:*** *Diet containing 1% sepiolite*
*[1] Supplied the following per kilogram of diet: 12.000 IU vitamin A, 2.400 IU vitamin $D_3$, 30 mg vitamin E, 2.5 mg vitamin $K_3$, 2.5 mg vitamin $B_1$, 6 mg vitamin $B_2$, 4 mg vitamin $B_6$, 20 mg vitamin $B_{12}$, 25 mg niacin, 8 mg calcium-D-panthotenate, 1 mg folic acid, 50 mg vitamin C, 50 mg D-biotin, 80 mg Mn, 60 mg Zn, 60 mg Fe, 5 mg Cu, 1 mg I, 0.5 mg Co, 0.15 mg Se*
*[2] Metabolizable energy content of diets was calculated using the nutrient contents [9]*

### *Measurements, Sample Collection and Laboratory Analysis*

The nutrient composition of basal diets were determined according to the AOAC [6]. The samples were ashed in a muffle furnace prior to the analysis of calcium [7] and total phosphorus [8]. Metabolizable energy levels of samples were estimated using the following equation of Carpenter and Clegg indicated by Leeson and Summers [9]:

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

Chicks were weighed individually at the beginning of the experimental period and weekly to determine body weight and body weight gain. The birds were daily observed for evaluating mortality. Feed consumption was recorded weekly and expressed as g per bird per week and the feed conversion ratio was calculated as g feed per g body weight gain.

At day 42, 16 broilers from each group (4 from each replicate) were weighed and slaughtered by severing the jugular vein. Hot carcasses were weighed to determine the carcass yield. Weights of abdominal fat, gizzard, liver, heart, spleen and Bursa Fabricius were also determined to calculate relative weights.

At day 41, 16 broilers from each group (4 from each replicate) were randomly selected and bled from the brachial vein. Blood samples were taken in the tubes containing no anticoagulant and centrifuged at 3220 g for 8 min. Serum was collected and stored at -20°C for determination of total protein, cholesterol and triglyceride by Vitros 350 autoanalyser (New York, USA; Product code 680-2153) using their accompanying commercial kits (Vitros Chemistry Products, Ortho-Clinical Diagnostics, Johnson-Johnson Company, New York, USA).

### *Statistical Analysis*

Statistical analysis 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 Tukey. Values were given as mean and standard error of mean [10]. Level of significance was taken as $P<0.05$.

## RESULTS

The effects of dietary supplementation of sepiolite on body weight in broilers were given in *Table 2*. Dietary sepiolite supplementation increased body weight significantly ($P<0.01$). The group fed 1% sepiolite had the highest body weight at day 7. No differences were observed between the two doses of sepiolite for the mean of body weight after 7 days. Body weight gain during 1-21 days ($P<0.01$) and during 1-42 days ($P<0.05$) was improved by 1% sepiolite supplementation *(Table 3)*. Dietary treatments did not affect feed intake and feed conversion ratio of broilers *(Table 3)*. During experimental period one bird from control group and one bird from group fed diets supplemented 1% sepiolite dead. The effects of dietary supplementation of sepiolite on carcass yield and relative organ weights in broilers were shown in *Table 4*. Sepiolite had no significant effect on carcass yield and the relative weights of gizzard, liver, heart, spleen and Bursa Fabricus, but the relative weight of abdominal fat was decreased with 1% sepiolite supplementation ($P<0.05$).

The inclusion of sepiolite in the diet of broilers reduced the levels of serum cholesterol ($P<0.001$) and triglyceride ($P<0.05$). Serum total protein was not affected by the usage of sepiolite *(Table 5)*.

***Table 2.*** *Effects of dietary supplementation of sepiolite on body weight in broilers*
***Tablo 2.*** *Karma yemlere sepiyolit ilavesinin broylerlerde canlı ağırlık üzerine etkileri*

| Age (Day) | Groups | | | | | | SEM | P Value |
|---|---|---|---|---|---|---|---|---|
| | Control | | S1 | | S2 | | | |
| | n | Body Weight (g) | n | Body Weight (g) | n | Body Weight (g) | | |
| 1 | 68 | 38.7 | 68 | 38.4 | 68 | 38.6 | 0.1 | 0.671 |
| 7 | 67 | 125$^{c}$ | 68 | 138$^{b}$ | 67 | 147$^{a}$ | 1 | <0.001 |
| 14 | 67 | 350$^{b}$ | 68 | 375$^{a}$ | 67 | 386$^{a}$ | 3 | <0.001 |
| 21 | 67 | 654$^{b}$ | 68 | 694$^{a}$ | 67 | 717$^{a}$ | 5 | <0.001 |
| 28 | 67 | 1077$^{b}$ | 68 | 1119$^{a}$ | 67 | 1133$^{a}$ | 7 | <0.001 |
| 35 | 67 | 1562$^{b}$ | 68 | 1609$^{a}$ | 67 | 1625$^{a}$ | 8 | 0.004 |
| 42 | 67 | 2037$^{b}$ | 68 | 2079$^{a}$ | 67 | 2090$^{a}$ | 6 | <0.001 |

***S1:*** *Group fed starter and grower diets containing 0.5% sepiolite,* ***S2:*** *Group fed starter and grower diets containing 1% sepiolite*
*Different superscripts $^{a,b,c}$ in the same row indicate significant differences between groups (P<0.05 or more)*

***Table 3.*** *Effects of dietary supplementation of sepiolite on body weight gain, feed intake and feed conversion ratio in broilers*
***Tablo 3.*** *Karma yemlere sepiyolit ilavesinin broylerlerde canlı ağırlık artışı, yem tüketimi ve yemden yararlanma üzerine etkileri*

| Parameters | Groups | | | SEM | P Value |
|---|---|---|---|---|---|
| | Control | S1 | S2 | | |
| **Body weight gain (g/bird)** | | | | | |
| 1-21 days | 616[b] | 656[ab] | 678[a] | 9 | 0.006 |
| 22-42 days | 1383 | 1385 | 1374 | 6 | 0.757 |
| 1-42 days | 1999[b] | 2041[ab] | 2052[a] | 9 | 0.015 |
| **Feed intake (g/bird)** | | | | | |
| 1-21 days | 865 | 870 | 872 | 6 | 0.916 |
| 22-42 days | 2829 | 2833 | 2832 | 10 | 0.988 |
| 1-42 days | 3695 | 3704 | 3704 | 10 | 0.925 |
| **Feed conversion ratio (g feed intake/g body weight gain)** | | | | | |
| 1-21 days | 1.41 | 1.33 | 1.29 | 0.02 | 0.077 |
| 22-42 days | 2.05 | 2.05 | 2.06 | 0.01 | 0.656 |
| 1-42 days | 1.85 | 1.81 | 1.80 | 0.01 | 0.118 |

*n=4*
***S1:*** *Group fed starter and grower diets containing 0.5% sepiolite,* ***S2:*** *Group fed starter and grower diets containing 1% sepiolite*
*Different superscripts [a,b] in the same row indicate significant differences between groups (P<0.05 or more)*

***Table 4.*** *Effects of dietary supplementation of sepiolite on carcass yield and relative organ weights in broilers*
***Tablo 4.*** *Karma yemlere sepiyolit ilavesinin broylerlerde karkas randımanı ve relatif organ ağırlıkları üzerine etkileri*

| Parameters (%) | Groups | | | SEM | P Value |
|---|---|---|---|---|---|
| | Control | S1 | S2 | | |
| Carcass yield | 68.7 | 69.1 | 69.1 | 0.2 | 0.766 |
| Gizzard | 1.66 | 1.53 | 1.53 | 0.04 | 0.209 |
| Liver | 2.46 | 2.43 | 2.62 | 0.04 | 0.104 |
| Heart | 0.64 | 0.63 | 0.59 | 0.01 | 0.244 |
| Spleen | 0.14 | 0.15 | 0.14 | 0.01 | 0.908 |
| Bursa Fabricus | 0.11 | 0.12 | 0.12 | 0.01 | 0.792 |
| Abdominal fat | 1.73[a] | 1.39[ab] | 1.36[b] | 0.06 | 0.024 |

*n=16*
***S1:*** *Group fed starter and grower diets containing 0.5% sepiolite,* ***S2:*** *Group fed starter and grower diets containing 1% sepiolite*
*Different superscripts [a,b] in the same row indicate significant differences between groups (P<0.05 or more)*

***Table 5.*** *Effects of dietary supplementation of sepiolite on blood serum parameters in broilers*
***Tablo 5.*** *Karma yemlere sepiyolit ilavesinin broylerlerde kan parametreleri üzerine etkileri*

| Parameters | Groups | | | SEM | P Value |
|---|---|---|---|---|---|
| | Control | S1 | S2 | | |
| Cholesterol (mg/dl) | 116.6[a] | 109.8[a] | 94.6[b] | 1.9 | <0.001 |
| Triglyceride (mg/dl) | 57.2[a] | 50.6[ab] | 43.5[b] | 2.2 | 0.041 |
| Protein (g/dl) | 3.93 | 3.79 | 3.89 | 0.05 | 0.458 |

*n=16*
***S1:*** *Group fed starter and grower diets containing 0.5% sepiolite,* ***S2:*** *Group fed starter and grower diets containing 1% sepiolite*
*Different superscripts [a,b] in the same row indicate significant differences between groups (P<0.05 or more)*

## DISCUSSION

In the present study body weight was enhanced by incorporating sepiolite into broiler diets. At the end of the experiment (on day 42) the body weight of broilers receiving sepiolite was significantly higher (P<0.001) than that of control group. The effect of sepiolite on body weight gain was more important (P<0.01) between 1 and 21 days of age than in the grower period. Dietary sepiolite supplementation improved overall body weight gain (P<0.05) however had no effect on feed intake and feed efficiency. In agreement with the present study improving effects of sepiolite on growth performances in poultry were reported by Ayed et al.[4]. However Ouhida et al.[11] showed that sepiolite supplementation at 1% and 2% had no significant effect on body weight, feed intake and feed efficiency. Palygorskite (a clay with similar physical properties to sepiolite) supplementation at 1% in broiler diets had no significant effect on feed efficiency [12]. Alzueta et al.[13] reported that addition of sepiolite to the diets of broiler chickens had no influence on the nutrient utilization and intestinal digesta viscosity.

Improvement in growth performance with the usage of sepiolite might be explained that sepiolite may increase the digesta retention time and this increment may allow the endogenous enzyme activity to be more effective in the digestion of fat, protein and carbohydrates and improve their absorption [5,14]. Ouhida et al.[14] also reported that sepiolite decreased the viscosity of jejunum digesta and may cause a reduction in the antinutritive effects of high viscosity.

In the present study, one bird from control group and one bird from group fed diets supplemented 1% sepiolite dead during 42 days. Mortality was not related with sepiolite. Similarly some researchers observed that sepiolite [4] usage up to 2% and palygorskite [12] at 1% in the broiler diets had no effect on mortality rate.

As shown in *Table 4* dietary sepiolite supplementation had no significant effect on carcass yield and the relative weights of gizzard, liver, heart, spleen and Bursa Fabricus but the relative weight of abdominal fat decreased with 1% sepiolite addition to the diets. In agreement with the present study, some researchers showed that hot carcass yield[4] and the relative weights of gizzard, liver, spleen and heart[5] were not affected from sepiolite supplementation. Safaei Katouli et al.[15] reported that the relative weights of liver, spleen, heart and Bursa Fabricus were not affected by the usage of clay minerals (kaolin, bentonite and zeolite) in broilers. Miazzo et al.[16] also showed that the relative weights of liver, kidney, heart, gizzard and spleen were not changed by 0.3% sodium bentonite supplementation in broiler diets.

In this study dietary inclusion of sepiolite did not significantly affect serum total protein. Sepiolite supplementation at the level of 1% reduced serum levels of cholesterol and triglyceride. Similarly Pappas et al.[12] reported that serum total protein of broilers aged 42 days was not affected by the usage of palygorskite. Safaei Katouli et al.[17] observed that kaolin and zeolite at the level of 1.5% as clay minerals decreased serum triglyceride levels significantly however serum total protein in groups fed diets containing 1.5, 3.0% kaolin and 3% zeolite was significantly higher in compared to control group. The increase in serum protein could be due to the action of kaolin and zeolite on the enhanced digestibility of certain nutrients [17]. Clay based hydrated sodium calcium aluminosilicate did not result in any significant changes in serum chemistry in trials with chicks [18-22].

Sepiolite usage in barley-wheat based diets may be more useful to counteract negative effects of soluble non starch pollysaccharides in the diet by reducing the viscosity of jejunum digesta [14].

The results of this study indicate that 1% sepiolite in the diets improve body weight gain and reduce the relative weight of abdominal fat and the levels of serum cholesterol and triglyceride without any adverse effects on feed efficiency and carcass traits. The improvement in performance is the highest with the diet having 1% sepiolite in the starter period. Further studies are necessary to investigate the effects of dietary sepiolite under stressed conditions such as health, environmental or nutritional challenges.

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