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Effect of glauconite, sepiolite and oil supplementation on pellet quality parameters in poultry compound feed

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ABSTRACT: The aim of this study was conducted to determine the effect of glauconite, sepiolite and oil on pellet quality parameters in poultry compound feed. There are limited studies with supplementation of different levels of sepiolite and glauconite clay minerals in diets about pellet quality during the pelleting processes. Thus, the effect of sepiolite and glauconite on pellet quality parameters was investigated in our study. The study was carried out in two different. Firstly, 1% and 2% levels sepiolite and glauconite were added to each concentrate in pellet production without adding oil. Secondly, 1% and 2% levels of sepiolite, glauconite and 1% oil were added to the concentrates during pelleting. In both experiments, the trial consisted of 1 control and 4 trial groups. Pellet concentrate feeds were produced with 7 batches (each batch was 100 kg). The disc that has hole diameter 3.5 mm and wall thickness of 70 mm was used in production. At the end of the study, dry matter level of the pellets was statistically influenced by the addition of sepiolite, glauconite and oil in poultry compound pellet feed The lowest pellet dry matter value belongs to C and CO groups ($p<0.05$). Pellet durability index of poultry compound pellet feed were not statistically affected by the addition of sepiolite, glauconite and oil. Pellet water activity of poultry compound pellet feed were not statistically affected by the addition of sepiolite, glauconite and oil. However, the pellet water activity of laying hens pellet concentrates (without oil addition) were statistically affected by the addition of sepiolite and glauconite ($p<0.05$). Pellet water activity has the lowest value especially in the groups in which glauconite is added. In conclusion, these findings showed that glauconite, sepiolite and oil can be used for pellet quality in poultry compound feed (especially laying hen feed) and improve pellet storage conditions and due to the positive effect of glauconite and sepiolite on pellet water activity.

Keywords: pellet durability index, pellet water activity, sepiolite, glauconite, poultry compound feed

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INTRODUCTION

Pelleting is an important method in feed technology. Pellet is defined as combining the feeds used in animal feed and preparing a mixture representing whole feed in a pellet grain. In other words, it is defined as the animal's consumption of this particle, which represents all the food with each pellet (Ergun et al., 2019). In pellet quality (palatability, keeping together), there are features such as not being easily dispersed, not being chewed too hard, and not being burned excessively.

The materials to be pelleted are forcibly pushed through the perforated channel (which determines the diameter) and in the meantime, they are cut at a certain time interval (which determines the length). This is the application of heat rise and pressure and eliminates some antinutritional factors. In this way, the settling of some microorganisms is reduced, external moisture intake decreases, digestibility may increase (gelatinization) (Ergun et al., 2019). Pellet feed has a significant role in spreading the use of better yield from animals consuming this feed with its physical positive effects (Dozier, 2001). High-quality pellet feeds are important for broiler feeds in terms of feed selection and waste prevention (Durna et al., 2016).

Clay minerals can be used as adsorbents in feeds. Clay minerals are mainly hydrated aluminum silicate (brucite), kaolinite, hallocyte, montmorillonite, illite, chlorite, attapulgite (sepiolite), bentonite, zeolite, and hydratsodium calcium aluminosilicate (HSKAS). It is stated that these aluminosilicates have pellet binding properties in compound feeds, prevent or delay the formation of molds and fungi in feeds with their water adsorbing capacity, reduce the toxic effect of heavy metals, bind to mycotoxins in the digestive tract and prevent their toxicological and pathological effects (Ramos, 1997).Clays supplemented to the ratio can bind, immobilize toxic substances in the gastrointestinal tract of animals and reduce their toxicity (Subramaniam and Kim, 2015).Clays are inherently non toxic to the environment (Zhou et al., 2004).

Sepiolite is a hydrated magnesium silicate clay. Sepiolite can be used as a binder and anti-caking feed additive (E-562) in all animal feeds (Angulo et al. 1995; EFSA, 2013; Wolter et al., 1990).The most important properties of sepiolite are its large specific area, high absorption capacity, low cation exchange capacity and rheological properties. The addition of sepiolite to concentrated feeds increases pellet strength and hardness and increases the physical strength of compound feed and reduces dust loss (Burçak and Yalçın, 2016). Since sepiolite binds the other ingredients in the feed, it forms pellets with high durability and hardness.(EFSA, 2013). Use of 1% sepiolite in broiler diets increase body weight gain and reduce serum cholesterol and triglyceride levels (Eser et al., 2012). In addition, 1% sepiolite supplement in layer diets reduced egg yolk cholesterol and improved egg shell quality (Yalçın et al., 2016).

Glauconite is the natural mineral with the chemical formula (K, H_{20})) (Fe^{3+}, Al, Fe^{2+}, Mg)$_2$ [Si_3AlO_{10}] (OH)$_2$ x nH_2O) and it is a three-layer silicate mineral (Venig et al., 2014). Glauconite is slightly acidic and capable of absorbing moisture 10 times more than ordinary sand. It consists of marine potash, silica, iron, magnesium, and lime, plus up to 30 other trace minerals. (İbrahim et al., 2019). Glauconite is one of the clay minerals. Glauconite can absorb various substances on the surface. Also, it can intercalate many inorganic and organic ions, replacing K^+, Ca^2+, etc in interlayers sites (ion-exchange capacity) (Avisar et al., 2009; Wang et al., 2010). Glauconite mineral is known to be used as dermatological and gastrointestinal agents (Venig et al., 2017). In the literature search, no studies on the use of glauconit in poultry feeding have been found. However, the non-toxic and historically therapeutic use of the glauconite clay mineral suggested that it could be used as a feed additive in poultry. Only in the one study, the addition of 1% and 2% doses glauconite in broiler rations did not affect the performance parameters, biomechanical properties of bones and histomorphology of the ileum (Durna Aydin et al., 2020).

Based on this information, there are limited studies with supplementation of different levels of sepiolite and other clay minerals in diets about pellet quality during the pelleting processes. However, no study was found to investigate the effect of glauconite mineral on pellet quality parameters in poultry compound feed in the literature study. Therefore, the purpose of this study was to the effect of glauconite, sepiolite and oil on pellet quality parameters in poultry compound feed.

MATERIALS AND METHODS

Concentrated feeds were made by the rations research team, whose raw materials were taken from a commercial feed factory (Özhen Feed Inc., Ankara, Turkey) in this experiment. The ration of broiler and laying hens feeds in the study was prepared according to NRC (1994). Pellet feeds are prepared in two ways with or without oil addition after then sepiolite and glauconite additions. Firstly, 1% and 2% levels of sepiolite and glauconite were added to each concentrate in pellet production without oil addition. Groups, respectively control (C), 1% sepiolite (S1), 2% sepiolite (S2), gluconite 1% (G1) and 2% glauconite (G2). Secondly, 1% and 2% levels sepiolite, glauconite and 1% level vegetable oil were added to the concentrates during pelleting. Groups respectively control (CO), sepiolite 1% + vegetable oil (SO1), sepiolite 2% + vegetable oil (SO2), gluconit 1% + vegetable oil (GO1) and glauconite 2% + vegetable oil (GO2). In both experiments, the trial consisted of 1 control and 4 trial groups. While oil addition was done by a spraying method, sepiolite and glauconite additions were added to the mixer (top-dressed). Glauconite was obtained from the Saratov University of Russia. Sepitolite was supplied from Tolsa SA (Madrid, Spain). The oil used in the study is vegetable oil.

Pellet concentrate feeds were performed in the pellet making machine of Ankara University Veterinary Faculty Farm. Pellet concentrate feeds were produced with 7 batches (each batch was 100 kg). The disc that has a hole diameter 3.5 mm and a wall thickness of 70 mm was used in production. Pellet machine has a capacity of 100 kg / h. No water was used in pellet production processes. Production conditions for poultry compound pellet feed are shown in Table 3. After poultry compound feeds were pelleted, seven sample feeds were taken from each group from the mixer. All nutrient (dry matter, crude protein, crude fiber, ether extract, ash, and starch analysis) analyses of the collected pellet feed samples, which taken from the mixer, were performed according to AOAC (2000). The metabolizable energy level was calculated according to the formula proposed by Carpenter and Clegg (1956). Pellet durability index (PDI) was measured with a Pfost Equipment using the sieve having the hole diameter of 3 mm (Baser and Yalcın, 2017). Water activity values of feeds were measured by using water activity equipment (LabSwift-aw, Novasina, Switzerland). Quadruplicate measurements were done with each sample.

The one-way analysis of variance (ANOVA) method was used for the statistical calculations of the groups and a suitable post hoc test (Duncan's test) was used for determining the importance of the differences between the groups. The statistical analysis was done with the SPSS software package (IBM Inc, Chicago, USA, 2011).

Table 3. Production conditions for poultry compound pellet feed

Parameters	**C**	**S1**	**S2**	**G1**	**G2**
Production, kg	700	700	700	700	700
Mixer capacity, kg/h	100	100	100	100	100
Water added in mixer	No	No	No	No	No
Oil added in mixer	No	No	No	No	No
Sepiolite added in mixer	No	1%	2%	No	No
Glauconite added in mixer	No	No	No	1%	2%
Disc hole diameter, mm	3,5	3,5	3,5	3,5	3,5
Disc hole length, mm	70	70	70	70	70
Parameters	**CO**	**SO1**	**SO2**	**GO1**	**GO2**
Production, kg	700	700	700	700	700
Mixer capacity, kg/h	100	100	100	100	100
Water added in mixer	No	No	No	No	No
Oil added in mixer	1%	1%	2%	1%	2%
Sepiolite added in mixer	No	1%	2%	No	No
Glauconite added in mixer	No	No	No	1%	2%
Disc hole diameter, mm	3,5	3,5	3,5	3,5	3,5
Disc hole length, mm	70	70	70	70	70

The first trial (without vegetable oil); groups; control (C, basal ration), 1% sepiolite (S1), 2% sepiolite (S2), glauconite 1% (G1) and 2% glauconite (G2). **The sekond trial (with vegetable oil addition);** groups; control (CO, basal ration with added vegetable oil), sepiolite 1% + vegetable oil (SO1), sepiolite 2% + vegetable oil (SO2), glauconit 1% + vegetable oil (GO1) and glauconite 2% + vegetable oil (GO2).

RESULTS

The ration of broiler and laying hens feeds is given in Table 1. The chemical composition of the sepiolite and glauconite mineral is given in Table 2.

The effect of glauconite, sepiolite and oil on pellet dry matter in poultry compound pellet feed is given in Table 4. At the end of the study, pellet dry matter level was statistically influenced by the addition of glauconite, sepiolite and oil in poultry compound pellet feed. The lowest pellet dry matter value belongs to C and CO groups ($p<0.05$).

The effect of glauconite, sepiolite and oil on pellet durability index in poultry compound pellet feed is given in Table 5. The end of the study, pellet durability index of in poultry compound pellet feed were not statistically affected by the addition of glauconite, sepiolite and oil ($p> 0.05$).

The effect of glauconite, sepiolite and oil usage on pellet water activity is in poultry compound pellet feed given in Table 6. The end of the study, pellet water activity of broiler and laying hens pellet concentrates (with oil addition) were not statistically affected by the addition of sepiolite and glauconite ($p>0.05$). However, the pellet water activity of laying hens pellet feed (without oil addition) were statistically positively affected by the addition of sepiolite and glauconite. Pellet water activity has the lowest value especially in the groups in which glauconite is added ($p<0.05$).

Table 1. The composition of the rations used in the study (%)

Ingredient	Broiler*	Laying hen**
Corn	50.05	50
DDGS	5	5
Wheat	9.7	11.4
Razmol	5	5
Soybean meal, 48%	22.8	13.6
Sunflower meal, 35%	-	5
MCP	0.54	0.26
Marble powder	1.88	9.2
Salt	0.25	0.24
DL-methionine	0.03	0.05
Vegetable oil	4.5	-
Vitamin premix	0.10	0.10
Mineral premix	0.10	0.10
Phytase	0.05	0.05
Total	100.00	100.00
Analysis Values of Pellet Feeds		
ME, kcal/kg	3108	2650
Crude protein, %	19	16
Crude ash, %	5.54	12.2
Crude fat, %	7.2	2.71
Crude fiber, %	3.13	3.86
Starch, %	41	41.2
Ca %	1.00	3.82
Total P %	0.64	0.57

*Provided per kilogram of complete diet: vitamin A, 12,000 IU; vitamin D3, 2,500 IU; vitamin E, 40 IU; vitamin K3, 5 mg; thiamin, 2.5 mg; riboflavin, 6 mg; pyridoxine, 5 mg; pantothenic acid, 15 mg; niacin, 25 mg; folic acid, 1 mg; biotin, 50 μg; vitamin B12, 20 μg. Cu, 5 mg; I, 1 mg, Co, 200μg; Se, 150 μg; Fe, 60 mg; Zn, 60 mg; Mn, 80 mg. Folic Acid 1.000 mg/kg, Biotin 50 mg/kg, Copper 5.000 IU/kg, Iodine 1.000 IU/kg, Cobalt 200 mg/kg, Selenium 150 mg/kg, Iron 60.000 mg/kg, Zinc 60.000 mg/kg, Mangan 80.000 mg/kg.

**Composition (per 2.5 kg): 3.6 g retinol, 0.12 g cholecalciferol, 30 g DL-α tocopherol acetate, 2.5 g menadione, 2.5 g thiamin, 6 g riboflavin, 4 g pyridoxol, 20 mg cobalamin, 25 g niacin, 8 g calcium-D-panthotenate, 1 g folic acid, 50 g ascorbic acid, 50 mg Dbiotin, 150 g choline chloride, 1.5 g canthaxanthin, 0.5 g apo carotenoic acid esther, 80 g Mn, 60 g Zn, 60 g Fe, 5 g Cu, 1 g I,0.5 g Co, 0.15 g Se.

Table 2. The chemical composition of glauconite and sepiolite used in this study (%).

Sepiolite		Glauconite	
Moisture	8.23	Moisture	10.30
SiO_2	41.8	SiO_2	61.82
Al_2O_3	1.10	Al_2O_3	21.08
MgO	21.22	Fe_2O_3	3.25
CaO	13.50	CaO	2.44
Fe_2O_3	0.50	MgO	2.67
Na_2O	0.30	CaO+ MgO	5.11
K_2O	0.34	K_2O	0.95
Mn_2O_3	0.1	Na_2O	2.44

Table 4. The effect of glauconite, sepiolite and oil on pellet dry matter in poultry compound pellet feed

Groups	C	S1	S2	G1	G2	P
Without vegetable oil	x̄± S x̄	x̄± S x̄	x̄± S x̄	x̄± S x̄	x̄± S x̄	
Broiler	90.00±0.01[a]	90.83±0.01[b]	90.97±0.02[c]	90.95±0.02[c]	91.45±0.03[d]	**0.000***
Laying hen	91.80±0.02[a]	91.68±0.03[a]	92.55±0.04[d]	92.04±0.06[b]	92.18±0.03[c]	**0.000***

Groups	CO	SO1	SO2	GO1	GO2	P
With vegetable oil addition	x̄± S x̄	x̄± S x̄	x̄± S x̄	x̄± S x̄	x̄± S x̄	
Broiler	91.07±0.02[b]	90.69±0.01[a]	91.30±0.02[c]	91.05±0.05[b]	91.14±0.02[b]	**0.000***
Laying hen	91.96±0.03[a]	92.18±0.02[b]	92.47±0.00[d]	92.12±0.02[b]	92.38±0.02[c]	**0.000***

The first trial (without vegetable oil); groups; control (C, basal ration), 1% sepiolite (S1), 2% sepiolite (S2), glauconite 1% (G1) and 2% glauconite (G2). **The sekond trial (with vegetable oil addition);** groups; control (CO, basal ration with added vegetable oil), sepiolite 1% + vegetable oil (SO1), sepiolite 2% + vegetable oil (SO2), glauconit 1% + vegetable oil (GO1) and glauconite 2% + vegetable oil (GO2). Statistically not significant (p >0.05). *All values are given as mean ± standard error of mean (SEM), (n=7).* a,b,c,d; The differences between the mean values with a different letter in the same row were statistically significant (p<0.05)* (P<0.001)***

Table 5. The effect of glauconite, sepiolite and oil on pellet durability index in poultry compound pellet feed

Groups	C	S1	S2	G1	G2	P
Without vegetable oil	x̄± S x̄	x̄± S x̄	x̄± S x̄	x̄± S x̄	x̄± S x̄	
Broiler	99.88±0.00	99.17±0.30	99.67±0.05	99.78±0.02	99.78±0.10	**0.176**
Laying hen	99.54±0.13	99.61±0.10	99.69±0.03	99.59±0.07	99.65±0.03	**0.766**

Groups	CO	SO1	SO2	GO1	GO2	P
With vegetable oil addition	x̄± S x̄	x̄± S x̄	x̄± S x̄	x̄± S x̄	x̄± S x̄	
Broiler	99.83±0.05	99.72±0.11	99.56±0.05	99.63±0.04	99.79±0.01	**0.120**
Laying hen	99.70±0.04	99.63±0.00	99.66±0.04	99.53±0.15	99.67±0.00	**0.530**

The first trial (without vegetable oil); groups; control (C, basal ration), 1% sepiolite (S1), 2% sepiolite (S2), glauconite 1% (G1) and 2% glauconite (G2). **The sekond trial (with vegetable oil addition);** groups; control (CO, basal ration with added vegetable oil), sepiolite 1% + vegetable oil (SO1), sepiolite 2% + vegetable oil (SO2), glauconit 1% + vegetable oil (GO1) and glauconite 2% + vegetable oil (GO2). Statistically not significant (p >0.05). *All values are given as mean ± standard error of mean (SEM), (n=7).* a,b,c,d; The differences between the mean values with a different letter in the same row were statistically significant (p<0.05)* (P<0.001)***

Table 6. The effect of glauconite, sepiolite and oil on pellet water activity in poultry compound pellet feed

Groups	C	S1	S2	G1	G2	P
Without vegetable oil	**x̄± S x̄**	**x̄± S x̄**	**x̄± S x̄**	**x̄± S x̄**	**x̄± S x̄**	
Broiler	0.54±0.01	0.56±0.02	0.54±0.03	0.54±0.01	0.53±0.01	**0.815**
Laying hen	0.045±0.02[b]	0.44±0.01[b]	0.42±0.01[ab]	0.40±0.00[a]	0.40±0.01[a]	**0.047***

Groups	CO	SO1	SO2	GO1	GO2	P
With vegetable oil addition	**x̄± S x̄**	**x̄± S x̄**	**x̄± S x̄**	**x̄± S x̄**	**x̄± S x̄**	
Broiler	0.54±0.01	0.53±0.01	0.51±0.01	0.51±0.01	0.52±0.02	**0.261**
Laying hen	0.41±0.00	0.41±0.01	0.41±0.01	0.41±0.02	0.39±0.01	**0.346**

The first trial (without vegetable oil); groups; control (C, basal ration), 1% sepiolite (S1), 2% sepiolite (S2), glauconite 1% (G1) and 2% glauconite (G2). **The sekond trial (with vegetable oil addition);** groups; control (CO, basal ration with added vegetable oil), sepiolite 1% + vegetable oil (SO1), sepiolite 2% + vegetable oil (SO2), glauconit 1% + vegetable oil (GO1) and glauconite 2% + vegetable oil (GO2). Statistically not significant (*p* >0.05). *All values are given as mean ± standard error of mean (SEM), (n=7).* a,b,c,d; The differences between the mean values with a different letter in the same row were statistically significant (p<0.05)*

DISCUSSION

Pelleting is the most common method used to improve the use of starch, reduce feed waste, eliminate pathogens and antinutritional factors. For this reason, the use of poultry pellet feed is positively affected by improving the feed conversion ratio of broiler performance (Abdollahi et al., 2013; Svihus 2014). The pelleting process is affected by many factors. Good pellet quality is an indication that pellets can be reached to feeders without breaking or crumbling by mechanical processes such as packaging and transportation (Yalçın et al., 2019a).

Concentrated feed, especially fat, starch, cellulose and protein level is very important in terms of pellet quality. The increased protein content of feed affects the pellet quality positively and the cellulose content adversely affects (Basmacıoğlu, 2004). The broiler feed used in our study contains 19% crude protein, 3,13% crude cellulose, and laying hens feed 16% protein, 3.86% crude cellulose. High protein and low cellulose in boiler feed had no significant effect on pellet quality. On the other hand, low protein and high cellulose in laying hen feed decreased pellet water activity and improved pellet quality. Briggs et al., (1999) in the case of increasing the protein content of poultry concentrate found that pellet quality improvement. The oil naturally contained in the raw materials had no significant effect on pressing and friction in the matrix channel in the pelleting process. In this regard, the oil added to the concentrate from the outside adversely affected the pellet quality (Richardson and Day, 1976). The fact that oil, which is the natural content of raw materials, causes a lower crumbling in the pellet feed compared to the oil added externally is explained by the fact that the intracellular fat in the feed cannot be fully revealed by grinding (Ergül, 1994). In our study, the addition of oil increased the pellet dry matter level, did not affect the pellet durability index and the pellet water activity. Therefore, no adverse effect of oil addition on pellet quality was observed. This can be explained by the fact that the oil level used in our study is as low as 1% or the sepiolite and glauconite minerals are used as feed additives. The use of sepiolite in high-fat compound feeds allows high levels of oil to be added to the concentrate feed without disturbing the pellet quality (Burçak and Yalçın, 2016). Another a study, This study supports our findings. On the other hand, in a study where different types and levels of fat and pellet binders were added to broiler feed, pellet quality was positively affected (Hossein et al., 2019). Further studies using sepiolite and glauconite clays are needed to explain the difference among the results on the effect of nutrient contents of poultry compound feed on pellet quality.

Moisture content is an important factor of spoilage in feed and the maximum moisture level in feed raw materials should not exceed 13-14%. During cooling of the pellets, it should not absorb much moisture as it passes through the cooler and it is important to absorb the ambient moisture. It should not create an environment for the development of microorganisms in ships, containers, and trucks during the transportation of feeds. In this case, high absorption capacity of sepiolite is important for pelleting. In our study, pellet dry matter level was affected positively by addition of glauconite, sepiolite and oil. The use of sepiolite and glauconite in the production of pellets in broiler concentrate feeds increased the pellet dry matter level (EFSA, 2013). Since sepiolite use in broiler pellet feed links other feed ingredients in mixed feed, it improves pellet quality by reducing moisture content

(Burçak and Yalçın, 2016). In a different study, the addition of 1% sepiolite to the ration reduced the pellet moisture content (Yalçın et al., 2020). These studies are compatible with our study findings. On the other hand, Yalçın et al. (2019a) in their study did not affect the moisture content of sepiolite use in pellet feed production. The difference among the data obtained may be related to the dose and structure of sepiolite, and further studies need to reveal the effects of glauconite in this area.

A positive correlation between PDI and feed conversion ratio has been reported (Carre et al., 1956). High pellet strength reduces feed crumbling and reduces feed waste and prevents the selection of larger particles by poultry (Amerah et al., 2007). In this way, the performance of the animals is improved and the profits are increased in the poultry industry. In our study, PDI of poultry compound pellet feed were not statistically affected by the addition of glauconite, sepiolite and oil. Pappas et al. (2010) reported that palygorskite, a clay (Galan, 1996), did not significantly affect pellet durability index. In another study, it was reported that the addition of sepiolite to broiler starter concentrate feeds increased pellet durability index but did not affect broiler finishing concentrate feeds (Angulo et al. (1996). These studies are compatible with our study findings. On the other hand, Durna et al. (2016) reported that the use of 1% sepiolite in broiler starter concentrate feed increases the pellet durability index. Similarly, Yalçın et al. (2019a) reported that PDI value increased by adding 1.5 % sepiolite to dairy cattle concentrate feed. In a different study, it was reported that the addition of 15 mg / g sodium bentonite to the broiler feed increased the pellet durability index (Attar et al. 2019). Since there is no study on the effect of galuconite clay on pellet quality, it can not be included here. This difference between the obtained data can be explained by the difference in structure, chemical composition and dosage of sepiolite and glauconite clays.

Water activity is defined as the ratio of the vapor pressure of water in foods and feeds to the vapor pressure of pure water at the same temperature. The basic principle of various storage methods such as drying, freezing and concentrating to maintain the quality of food is to control the chemical activity of water. In other words, spoilage of feeds and foods is prevented by reducing water activities. Pathogenic effects of pathogenic microorganisms are prevented at a low water activity (Pala and Saygi, 1983).

The water activity level is an indicator of the volume of free water. The lower the free water present, the less the development of unwanted mould. A water activity level of 0.65 is often referred to as the limit for safe storage of foods, below which microbiological growth is unlikely to occur (Shi et al., 2001). Low water activity improves storage conditionsby preventing the reproduction of pathogenic microorganisms and the presence of toxins caused by fungi. However, when sepiolite and glauconite were added to the laying hen feed (without the addition of fat), the addition of glauconite and sepiolite at 1% and 2% levels decreased the pellet water activity. The use of glauconitic pellets has improved the usage time and storage conditions. In our study, when sepiolite and gluconite were added to the laying hen feed (without adding oil), pellet water activity was reduced. Especially the use of glauconite provided lower water activity. Therefore, sepiolite and especially glauconit have improved the usage time and storage conditions of the poultry compound pellet feed. Aluminosilicates (such as sepiolite, bentonite, zeolite) can bind pellets in concentrate feeds, water adsorption capacity prevented or delayed the formation of mold and fungus (Ramos and Hernandez, 1997). In an experiment, Yalçın et al. (2019b) reported no significant difference between the water activity values of pellet concentrates of dairy cattle from the group in which control or sepiolite was added. These studies are compatible with our study findings. However, to support our study, the effect of glauconite on pellet water activity could not be discussed due to the lack of a study. Therefore, more studies are needed in this area to understand the effects of using galuconite and sepiolite alone or in combination on pellet water activity in poultry compound feed.

CONCLUSION

The addition of glauconite, sepiolite and oil addition of in poultry compound pellet feed affected pellet dry matter and pellet water activity, but did not affect pellet durability. Because of to the positive effects of glauconite and sepiolite on pellet dry matter and pellet water activity, poultry compound feed (especially laying hen feed) can be used as feed additives in pelletting. In addition, glauconite and sepiolite can improve the pellet storage conditions and usage time. This result will be very useful for feed industry. Many studies are needed to elucidate the investigated parameters related to the use of glauconite in pellet production. Our study is a good source for further studies.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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