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RESEARCH ARTICLE

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Effects of Usage of Sepiolite in Layer Diet on Pellet Quality and Pellet Production Parameters

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ABSTRACT

The purpose of this experiment was to determine the effects of sepiolite usage on pellet quality and pellet production parameters for layer diet under industrial conditions. In this study; 14 t pellet diets for control and treatment groups with 7 batch were produced in a commercial feed factory. Each batch was 2 t. Control group diet manufactured in this study, contained 14.12% crude protein, 4.47% crude fibre and 3.20% ether extract. For the treatment group diet 1% sepiolite was used as top dressed in the mixer. Pelleting disc having 6 mm hole diameter was used in the factory. Sepiolite usage reduced energy consumption at the level of 16.14% and increased pellet durability index significantly ($p<0.001$). Pellet durability index was found to be 49.08% in the control group and 87.39% in the treatment group. Therefore, it is concluded that sepiolite usage in layer diets would be beneficial for improvement in pellet quality.

Keywords: Layer diets, Pellet durability, Pellet quality, Sepiolite.

Yumurta Tavuğu Yemlerinde Sepiyolit Kullanımının Pelet Kalitesi ve Pelet Üretim Parametrelerine Etkisi

ÖZ

Bu araştırmanın amacı, endüstri koşulları altında yumurta tavuğu yemlerinde sepiyolit kullanımının pelet kalitesine ve pelet üretim parametrelerine olan etkisini belirlemektir. Araştırmada, kontrol ve deneme grubu için yedişer parti olmak üzere her grup için toplam 14 tonluk pelet yem ticari bir yem fabrikasında üretilmiştir. Her parti 2 tondur. Üretilen kontrol grubu yemi %14,12 ham protein, %4,47 ham selüloz ve %3,20 ham yağ içermektedir. Deneme grubu yemine karıştırıcıda %1 sepiyolit ilave edilmiştir (top-dressed). Fabrikada 6 mm delik çaplı peletleme diski kullanılmıştır. Sepiyolit kullanımı enerji tüketimini %16,14 düzeyinde azaltmış, pelet dayanıklılık indeksini önemli ölçüde artırmıştır ($p<0,001$). Pelet dayanıklılık indeksi, kontrol grubu yeminde %49,08 ve deneme grubu yeminde %87,39 bulunmuştur. Bu nedenle, yumurta tavuğu yemlerinde sepiyolit kullanımının pelet kalitesi üzerine faydalı etkileri olabileceği sonucuna varılmıştır.

Anahtar Kelimeler: Yumurta tavuğu yemi, Pelet dayanıklılığı, Pelet kalitesi, Sepiyolit.

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INTRODUCTION

One of the most common heat treatment methods in poultry feed production is pelleting of feeds. The main aim of pelleting is to aggregate the smaller feed particles by the use of heat, mechanical pressure and moisture. Especially, offering feed to the swine and poultry industries in pellet form enhances the economics of production by increasing the feed intake, and thus growth performance and feed efficiency (Patterson 1989, Abdollahi et al. 2013). Löwe (2005) indicated that pellet quality has an economic value because the feed is too expensive to waste. Pellet quality depends proportionally on the factors of 40% feed formulation, 20% feed particle size, 20% steam-conditioning, 15% pellet die specification and 5% cooling and drying. To manufacture high physical quality pellet feed, a number of these factors can be applied alone or in combination (Moritz and Lilly 2010, Abdollahi 2011).

Some researchers (Kertz et al. 1981, Brewer et al. 1989, Zatari et al. 1990, Mina-Boac et al. 2006) stated that good quality pellets have better performance and feed efficiency than those fed with mash, reground pellet feeds and pellet feeds having more fine particles. It was highlighted in recent years the absorptive and rheological properties of clay minerals may be contributed to improving the pellet quality (Galan 1996, Zhang et al. 2017). For this purpose, sepiolite is a good technological additive due to its properties such as reducing energy cost in pellet production, the amount of dusting during the production and transport of feeds (Angulo et al. 1995). EFSA (2013) also reported that sepiolite is a feed additive (E-562) that can be used as a binder and anticaking agent up to 2% in all feeds for all animal species. Since sepiolite binds the other ingredients in the feed, it forms pellets with high durability and hardness.

Latshaw and Moritz (2009) reported that the energy from each unit of feed and heat increment was influenced by the forms of feed. Poultry fed pellet diets spend less time for eating and obtain more nutrients per every unit of expended energy than poultry fed mash diets (Jones et al. 1995, Vilarino et al. 1996). In addition, pellet durability is an important factor affecting production parameters of pelleted feeds.

Sepiolite supplementation at 1% to the broiler diets (Durna et al. 2016), micronized clinoptilolite supplementation at 0.4, 0.6 and 0.8% (Küçükersan et al. 2016) reduced pellet production time and improved the pellet durability index. Yalçın et al. (2017) reported that 1% sepiolite addition to dairy cattle and fattening cattle concentrates decreased energy consumption during pellet production and enhanced pellet durability index. Angulo et al. (1995) indicated that addition of sepiolite supplementation may improve the performance of pelleted diets, especially those containing high levels of fat. There are limited studies about supplementation of sepiolite in poultry diets for energy consumption during pelleting processes and pellet quality. Therefore the aim of this experiment was to evaluate the effects of sepiolite usage to the diets of laying hens on some pellet production parameters and pellet quality characteristics.

MATERIALS and METHODS

Commercial concentrate feed for laying hen was used in this experiment. Manufacturing pellet feeds were produced in a commercial feed factory. Commercial pellet feed contained mainly corn (582 kg/t), sunflower seed meal (184 kg/t) and soyabean meal (65 kg/t). One control and one treatment group concentrate feeds were manufactured. Sepiolite (Exal T, Manufacturing Lot number: L-12113, Tolsa Turkey) was added to the treatment concentrate feed at 1% as top dressed to the mixer. Generally 1% sepiolite usage is accepted in the commercial feed factories. Sepiolite Exal T used in this experiment was produced in Türkiye-Polatlı (Tolsa Turkey Company). Moisture and ash content of sepiolite were determined according to the AOAC (2000). Mineralogical composition was analysed by D8 Advance Diffractometer AXS (Bruker, Germany). Pellet concentrate feeds were produced with 7 batch (each batch was 2 t) and pellet diameter was 6 mm. Water was not used in the pellet manufacturing processes. The parameters for manufacturing processes are shown in Table 1.

Table 1. Parameters for pellet manufacturing processes

Parameter	Control	Sepiolite
Production, t	14	14
Mixer capacity, t	2	2
Water added in mixer	No	No
Disc hole diameter, mm	6	6
Disc hole length, mm	60	60

In the commercial factory, the data of steam temperature (°C), electric current (ampere) and pellet production time (min/10 t) were measured. Energy consumption of pelleting machine (electric power in kilowatts, kW) was calculated as multiplying electric current (in ampere) with voltage supply (volts) and then dividing by 1000. The voltage supply of feed pellet machine was 380 volts.

Seven samples for each group were collected from the mixer, after the conditioner and pelleted feed after cooling. Moisture content was analysed in all of the samples collected (AOAC, 2000). Crude protein, crude fibre, ether extract, ash and starch analysis of control pelleted feeds were determined (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 Box Equipment (Figure 1) using the sieve having the hole diameter of 4.75 mm (Başer and Yalçın 2017). Quadruplicate measurements were done with each sample.

Figure 1. Phost box equipment

Statistical Analysis

Data were given as mean ± standard error of mean. The experimental unit was 7. The normality of data distribution was checked using the Kolmogorov-Smirnov test. Comparison between groups was examined with independent samples t test. Level of significance was taken as $p<0.05$ (Dawson and Trapp 2001).

RESULTS

Moisture content was found to be 8.20% and ash was 89.80% in sepiolite used in this study. Sepiolite (Exal T) contains 74% sepiolite, 18% dolomite and 8% calcite. The nutrient composition of layer diet for control group was shown in Table 2. The layer diet used in this study had 36.41% starch and was low in fat (3.20%). Production parameters during pelleting of layer diets were given in Table 3. Addition of 1% sepiolite to the mixer as top dressed significantly ($p<0.001$) increased steam temperature and reduced energy consumption. Pellet production time was found to be similar for control and treatment group diets. No differences were observed in moisture content of feed samples from the mixer, after conditioner and pellet after cooling between groups (Table 4). Sepiolite addition to layer diet significantly ($p<0.001$) increased pellet durability index values (Table 5).

Table 2. Nutrient composition of layer diet

Content	%
Dry matter, %	88.31
Crude protein, %	14.12
Crude fibre, %	4.47
Ether extract,%	3.20
Starch, %	36.41
Ash, %	14.34
ME, kcal/kg	2599

Table 3. Production parameters of pelleting of layer feed

Group	Steam temperature, ^{o}C	Electric current, Ampere	Energy consumption*, kW	Production time, min/10 t
Control	29.94±0.38	202.81±1.05	77.07±0.40	96
Sepiolite	40.94±0.28	170.08±0.67	64.63±0.26	97
p	<0.001	<0.001	<0.001	

*: Energy consumption was calculated using 380 of voltage in pelleting machine.

Table 4. Moisture (%) content of layer diets during pellet manufacturing

Group	Moisture (%)		
	Mixer	After conditioner	Pellet after cooling
Control	12.18±0.14	14.72±0.10	12.27±0.10
Sepiolite	12.34±0.12	13.84±0.08	12.15±0.08
p	0.155	0.180	0.521

Table 5. Effects of sepiolite addition on PDI (%) value of layer diets

Group	PDI (%)
Control	49.08±0.98
Sepiolite	87.39±0.37
p	<0.001

DISCUSSION

In the factory feeding rate, amount of production, disc hole diameter and disc hole length were same in the manufacturing of pellet concentrate feeds. Production output, energy consumption and pellet quality are important process variables that related to each other. Many factors affect pellet durability and specific energy consumption (Yalçın et al. 2017).

Sepiolite supplementation at the rate of 1% to the mixer as top dressed significantly ($p<0.01$) reduced energy consumption at the level of 16.14% with increasing steam temperature at the level of 36.74%. The steam temperature in control group was seen to be low, this steam temperature is not enough to obtain high-quality pellet. Similarly, Yalçın et al. (2017) reported that energy consumption is 9.63% lower in dairy cattle feed and 5.27% lower in fattening cattle feed during pelleting process than control group ($p<0.01$). Addition of dietary sepiolite supplementation also reduces the pellet production time by 8.47% for fattening cattle feed production except for that dairy cattle feed (Yalçın et al. 2017). Durna et al. (2016) observed that 1% sepiolite supplementation reduced pelleting production time at the level of 10.60% in broiler starter diets. Contrarily, in our study, use of sepiolite in layer diets did not affect pellet production time. This case may be due to the ingredients and chemical composition of layer diet. In a conventional pelleting process, increasing conditioning temperature can be performed by increasing steam flow rate. More steam means more heat and moisture; the two primary prerequisites needed to improve binding features and thus improved pellet quality (Abdollahi 2011). Skoch et al. (1981) reported that steam conditioning increased pellet production rate by 250 and 275% on account of enhancing pellet durability index and decreased the amount of fines generated and energy consumption. Abdollahi (2011) also indicated that pellet durability and hardness were increased ($p<0.001$) with steam-conditioning and increasing conditioning temperatures.

Pellet durability index is an important factor that affects the pellet production parameters. Sepiolite acts as a filter and therefore decreases porosity in pelleted feed. In this study, 1% sepiolite addition increased pellet durability index ($p<0.001$). Pellet durability index in the diet having 1% sepiolite was 78.06% higher than that of control diet. Sepiolite usage was very effective in layer diet manufactured in this study in the conditions of commercial factory.

Zhang et al. (2017) indicated that addition of 1% palygorskite in broiler pellet diets could enhance the hardness and durability index of pellet, and improve the growth performance of broilers. Durna et al. (2016) reported that the addition of 1% sepiolite to the broiler starter diet increased the pellet durability index. In the study of Angulo et al. (1996), sepiolite improved the durability of pellets of starter chicken diets ($p<0.05$) but not in the finisher diets. The improvement in pellet quality could be due to the absorptive and rheological properties of sepiolite as a clay (Galan 1996, Lin 2007, Yalçın et al. 2017, Zhang et al. 2017)

CONCLUSION

Consequently, 1% sepiolite supplementation to the diets of laying hens decreased energy consumption during pelleting and enhanced pellet durability index. The results of this study indicate that the use of sepiolite brings benefits to impact on reducing energy costs by improving the efficiency of the pelleting process and improving feed durability by minimizing the formation of fine particles. Further studies are needed to investigate the different levels of sepiolite with different diet formulation on laying hens performance and pellet quality.

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