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Effects of Dietary Different Levels of Rosemary Essential Oil on Performance and Eggshell Quality Parameters in Laying Hens

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ABSRACT

In this study was evaluated the effects of rosemary (*Rosmarinus officinalis*) essential oil on performance and eggshell quality parameters of laying hens. In experiment, a total of 192 twenty four-week-old NOVOgen White laying hens were assigned to the basal control diet supplemented with 50, 100, 150, 200 and 250 mg/kg of rosemary essential oil (6 treatment diets, 8 replicates, each replicate consists of 4 hens). Hens were fed with experimental diets from 24 to 36 weeks of age. Water and feed were supplied *ad libitum* throughout the experiment. The results of study indicated that there were no differences in egg production, feed intake, feed conversion ratio, egg weight, egg mass as performance parameters among the treatment groups. The eggshell weight had no significantly affected by the dietary treatments. However, eggshell thickness and eggshell breaking strength were significantly affected by the treatments ($P< 0.05$). The eggshell thickness was significantly increased fed with 250 mg/kg rosemary essential oil supplemented of group when compared to the control group. The breaking strength was increased by the addition of dietary rosemary essential oil. The results of this study demonstrated that performance parameters were not significantly influenced with rosemary oil addition in laying hens diet. But, rosemary oil addition in laying hens diet significantly increased to eggshell breaking strength. It may be said that the dietary addition of 50 mg/kg of rosemary essential oil would be beneficial to improve the egg shell quality in laying hens.

1. Introduction

Phytogenic plants and their bioactive components are presently attaining importance in animal diets for their antimicrobial (Lee et al., 2003), antibacterial (Srinivasan, 2004), antioxidant and digestive stimulant properties (Platel & Srinivasan, 2004). The ban on the growth promoter usage of antibiotics for poultry in European Union since 2006 has increased the interest in aromatic plants and their oils. Rosemary is one of the aromatic plants that containing the active ingredients. Rosemary (*Rosmarinus officinalis* L.), herb of the *Labiatae* family, has been recognized as the plant with the highest anti-oxidative activity (Estevez et al. 2007). Recent studies have focused on the effects of the active ingredients in the oils of these plants on the farm animals. Due to the wide variety of active ingredients, these additives can affect beneficial processes differently. Most of them promote appetite and nutrient uptake, others increase secretion of saliva, synthesis of bile acids, digestion and absorption of lipids (Christaki et al., 2011). They stimulate the release and activity of enzymes such as amylase, protease and lipase, resulting in increased digestibility (Hernandez et al., 2004).

Çimrin & Demirel (2016) reported that there was no difference between groups fed with 100, 200 and 300 mg/kg rosemary essential oil and control group in terms of body weight change, egg production, egg weight and egg quality characteristics in laying hens but feed intake and feed conversion ratio were affected significantly by dietary rosemary essential oil supplementation. Alagawany & Abd El-Hack (2015) demonstrated that productive performance and egg quality traits were improved by supplementation of 3000 mg/kg rosemary powder to laying hen diets.

The aim of this study was to evaluate the effect of dietary addition of rosemary essential oil at different levels on performance and egg quality in laying hens.

2. Materials and Methods

In this study, Hundred-ninety-two NOVOgen White laying hens at the twenty-four weeks old age were used. The birds were assigned into six dietary treatments replicated eight times with four hens per replicate. Dietary treatments included a corn-soybean-based

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typical layer diet (Table 1) that served as the control and five treatment diets based on the typical diet further enriched with 50, 100, 150, 200 and 250 mg/kg rosemary essential oil (*Rosmarinus officinalis*; Ecodab®-İnan Company), respectively. Diets were formulated to meet the requirements for nutrient and energy content for laying hens (NRC, 1994) and NO-VOgen White laying hens management guide (Table 1). The experiment lasted 12 weeks, diets and water were provided as *ad libitum*, whereas the lighting regimen was 16 h of continuous light per day. The birds were housed in an environmentally controlled room equipped with 48 metal battery cages (50×40×50 cm).

Egg production (EP) was recorded daily. Feed intake (FI) and egg weight (EW) were recorded biweekly. Egg mass (EM) was calculated from the biweekly EP and EW data using the formula: EM = (EP× EW)/Period (days). The feed conversion ratio (FCR) was calculated using the formula: FCR = FI/EM. The egg quality characteristics (shell weight, shell thickness and shell breaking strength) were evaluated using random samples of 8 eggs from each replicate every two weeks, thereby totalling 384 eggs from each treatment. Eggshell breaking strength was measured using a cantilever system by applying increasing pressure to the broad pole of the shell using an Egg Force Reader (Orka Food Technology Ltd., Ramat Hasharon, Israel). The eggshells were rinsed in running water and dried in an oven at 60°C for 12 h. Eggshells were weighed using a 0.01 g precision scale. Eggshell thickness (including the membranes) was determined at three points on the eggs (one point on the air cell and two randomized points on the equator) using a micrometer (Mitutoyo Inc., Kawasaki, Japan).

Data were analysed by one-way ANOVA using the Minitab (2000) statistical software package. A probability value of $P < 0.05$ was considered statistically significant.

Table 1.
Composition of experimental diets

Ingredients (%)	
Corn	57.00
Barley	5.00
Soybean meal	24.20
Vegetable oil	2.50
Limestone	9.00
Di-Calcium phosphate	1.60
Salt	0.30
Premix[1]	0.25
Methionine	0.15
TOTAL	100
Calculated nutrients	
Metabolizable Energy (Kcal/kg)	2784
Crude protein (%)	16.40
Calcium (%)	3.85
Available phosphorus (%)	0.40
Lysine (%)	0.88
Methionine (%)	0.42
Methionine +Cystine, %	0.68

[1] Premix provided the following per kg of diet: vitamin A, 8.800 IU; vitamin D_3, 2.200 IU; vitamin E, 11 mg; nicotinic acid, 44 mg; Cal-D-Pantothenate, 8.8 mg; riboflavin 4.4 mg; thiamine 2.5 mg; vitamin B_{12}, 6.6 mg; folic acid, 1 mg; D-Biotin, 0.11 mg; choline, 220 mg; manganese, 80 mg; copper, 5 mg; iron, 60 mg; zinc, 60 mg; cobalt, 0.20 mg; iodine, 1 mg; selenium, 0.15 mg.

3. Results and Discussion

The effects of dietary supplemental rosemary essential oil on the performance of laying hens are shown in Tables 2. In general, in egg production, feed intake, feed conversion ratio, egg weight and egg mass were not observed differences in laying hens fed with experimental diets. The effects of dietary supplemental rosemary on the eggshell quality traits are shown in Tables 3. No significant effects of dietary treatments were detected on eggshell weight, but eggshell thickness and eggshell breaking strength were significantly affected by the dietary treatments ($P< 0.05$). Eggshell thickness was significantly increased in group fed with 250 mg/kg rosemary essential oil of group compared to control group, but no significantly differences other groups ($P<0.05$). The eggshell breaking strength was decreased fed with control group compared to other groups ($P< 0.05$).

Table 2.
Effect of dietary rosemary essential oil on performance parameters

Dietary rosemary oil levels (mg/kg)	Egg production (%)	Feed intake (g/hen/d)	Feed conversion ratio (g feed/g egg mass)	Egg weight (g)	Egg mass (g/hen/d)
0	95.3±0.49	102.4±0.29	1.99±0.022	53.9±0.66	51.4±0.62
50	95.7±0.77	104.5±0.98	2.02±0.024	53.9±0.55	51.6±0.56
100	94.0±0.76	102.8±1.17	1.97±0.038	55.4±0.60	52.1±0.54
150	95.8±1.11	102.8±1.23	1.98±0.008	54.2±0.63	51.9±0.67
200	95.7±1.25	104.1±0.99	2.03±0.030	53.5±0.44	51.2±0.82
250	94.6±1.18	103.3±2.30	2.00±0.036	54.6±0.38	51.7±0.57

These results agree with those of other researchers (Florou-Paneri et al., 2006), which reported that feed intake, egg weight, egg mass, feed conversion ratio, and average body weight were not affected by supplementation of 5000 or 10000 mg/kg rosemary herb to laying hen diets. Şimşek et al. (2015) reported that there was no difference in egg production, egg weight, feed intake and feed conversion ratio in the group supplemented with 200 mg/kg of rosemary essential oil compared to the control group, but dietary supplementation of rosemary essential oil was increased eggshell thickness in laying quails.

Table 3.
Effect of dietary rosemary essential oil on egg quality

Dietary rosemary oil levels (mg/kg)	Eggshell weight (g/egg)	Eggshell thickness (mm)	Eggshell breaking strength (kg)
0	9.96±0.163	0.360±0.0043^{b}	4.16±0.092^{b}
50	9.99±0.113	0.373±0.0039^{ab}	4.47±0.082^{a}
100	9.91±0.116	0.373±0.0021^{ab}	4.47±0.108^{a}
150	9.75±0.117	0.369±0.0032^{ab}	4.42±0.080^{a}
200	9.92±0.135	0.374±0.0024^{ab}	4.55±0.095^{a}
250	9.96±0.140	0.377±0.0046^{a}	4.56±0.035^{a}

$^{a, b:}$ Values with different superscript letters within a column are significantly different at $p< 0.05$.

Yeşilbağ et al. (2013) reported that the dietary rosemary oil supplementation (at a level of 200 mg/kg) did not affect body weight, egg weight, egg mass, egg shell thickness or egg shell breaking strength of quails. There was no difference on feed intake of treatment groups and the inclusion of rosemary essential oil numerically improved the feed efficiency, but not statistically. Also, dietary rosemary essential oil supplementation significantly increased the egg production. Çimrin & Demirel (2016) reported that decreased feed intake and improved feed efficiency were observed in RMO supplemented (100 to 300 mg/kg) groups while other parameters such as live weight, egg production, egg weight, egg quality and feed conversion ratio were not affected by dietary rosemary essential oil supplementation in laying hens. Hajiazizi et al. (2016) reported that supplementation of rosemary essential oil to the diet had no significant effect on productive performance in laying hens. Similarly, dietary treatments did not affect eggshell weight, eggshell thickness. Bölükbaşı et al. (2008) reported that dietary supplementation of 200 mg/kg rosemary essential oil increased egg weight, reduced feed intake, and improved feed conversion ratio in laying hens. In other report (Alagawany & Abd El-Hack, 2015), a linear increase in egg weight and egg mass was observed as the level of rosemary powder increased from 3000 to 9000 mg/kg diet.

According to the results of this study, no significant differences was observed in performance parameters of control group and rosemary essential oil supplemented (50 to 250 mg/kg) diet consuming groups. However, an improvement in egg shell thickness was observed with the addition of rosemary essential oil to the diet which was superior in dietary 250 mg/kg rosemary essential oil supplemented group, also a linear improvement in egg shell breaking strength starting from dietary 50 mg/kg rosemary essential oil level. It may be said that the dietary rosemary essential oil supplementation would be beneficial to improve the egg shell quality in laying hens and 50 mg/kg rosemary essential oil level in diet is efficacious for this purpose.

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