Effect of myrtle (Myrtus communis L.) oil on performance, egg quality, some biochemical values and hatchability in laying quails

T. BULBUL1*, D. YESILBAĞ2, E. ULUTAS3, H. BIRICİK2, S. S. GEZEN2, A. BULBUL3

1Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Ayyun Kocatepe University, 03200, Ayyunkarahisar, TURKEY.
2Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, 16059, Uludag University, Bursa, TURKEY.
3Department of Physiology, Faculty of Veterinary Medicine, 03200, Ayyun Kocatepe University, Ayyunkarahisar, TURKEY.

*Corresponding author: tbulbul@aku.edu.tr

SUMMARY

The aim of this study was to evaluate the effect of myrtle (Myrtus communis L.) oil when added to the diet of laying quails on performance, egg quality, some biochemical values and hatchability. A total of 375 quails (250 females and 125 males; Coturnix coturnix japonica), aged eight weeks old, were randomly allocated to five dietary treatments (five replicates of ten females and five males). The birds were fed either a basal diet or the basal diet supplemented with myrtle oil at a dose of 500, 1000, 2000 or 5000 mg/kg feed. The experiment was conducted for eight weeks. At the end of the experiment, no significant differences were found among the groups in terms of initial live weight, feed consumption, egg weight, egg quality (fracture strength, haugh unit, shape index, yolk index, albumen index), serum biochemical values, hatchability, early embryonic death, late embryonic death and submembranous death. After 8 weeks, egg production was decreased (p<0.01), whereas feed conversion rate (FCR) was increased (p<0.05) in birds with a diet supplementation with myrtle oil doses of 5000 mg/kg. Eggshell thickness was decreased (p<0.05) of groups receiving myrtle oil doses of 2000 and 5000 mg/kg. Yolk color index was affected positively by addition of myrtle oil (p<0.001). Hatch performance was highest of the groups with diet supplemented with myrtle oil doses of 1000 mg/kg, whereas it was lowest of the groups received 5000 mg/kg myrtle oil (p<0.01). The addition of myrtle oil to the diets caused significantly decrease in serum total cholesterol (p<0.01), Ca (p<0.01) and Malondialdehyde (MDA; p<0.001) while determined significantly increase in blood urea (p<0.001) and serum β-carotene (p<0.001) concentrations. Serum creatine kinase-MB (CK-MB) was increased (p<0.001) a dose of 5000 mg/kg, whereas albumin concentration decreased (p<0.01). Egg yolk MDA concentration was decreased (p<0.01) in all groups that received myrtle oil supplementation in their diets on days 15th and 30th of storage (p<0.001). In conclusion, myrtle oil supplementation was changed laying performance and biochemical values in laying quails depending on supplemented quantity and duration. It is recommended to supplement diets with 1000 mg/kg myrtle oil as egg production, egg quality, yolk MDA concentrations and hatching parameters were taken into consideration.

Keywords: Myrtle, performance, hatchability, lipid peroxidation, quails.

Introduction

Adding aromatic plants or their extracts, separately or as a mixture, to animal diets has antibacterial [13, 44], antifungal [6, 47], anticoccidial [25], antioxidant [12] and antilipidemic [19] effects. There are also growth promoting effects that are due to the antimicrobial properties and positive influence on the microflora of the digestive tract [32]. Thus, aromatic plants and their extracts are accepted as natural and safe substances for birds.

RÉSUMÉ

Effets de l’huile essentielle de myrte (Myrtus communis L.) sur les performances, la qualité de l’œuf, certaines valeurs biochimiques et l’éclosion chez les cailles de ponte

Le but de cette étude était dévaluer l’effet de l’huile essentielle de myrte (Myrtus communis L.) sur les performances, la qualité de l’œuf, certaines valeurs biochimiques et l’éclosion lorsqu’elle est ajoutée à l’alimentation des cailles de ponte. Un total de 375 cailles (250 femelles et 125 mâles: Coturnix coturnix japonica), âgées de huit semaines, ont été réparties au hasard en cinq groupes homogènes (cinq réplicas de dix femelles et cinq mâles). Les animaux ont reçu une alimentation de base complétée par l’huile essentielle de myrte à des doses de 0, 500, 1000, 2000 et 5000 mg/kg d’aliments. L’expérience a été menée pendant huit semaines. A la fin de l’expérience, aucune différence significative n’a été perçue entre les groupes en termes de poids vif initial, de consommation d’aliments, du poids et la qualité de l’œuf, les valeurs biochimiques du sérum, l’éclosion, la mort précoce ou tardive de l’embryon et la mort sub-membranéuse. Après 8 semaines, la production d’œufs avait diminué (p<0.01) alors que l’indice de consommation avait augmenté (p<0.05) chez les cailles ayant reçu une alimentation complétée par la dose de 5000 mg/kg d’huile essentielle de myrte. L’épaississeur des coquilles avait diminué (p<0.05) chez les groupes recevant des doses d’huile essentielle de myrte de 2000 et 5000 mg/kg. L’indice de la couleur jaune a été affecté positivement par l’ajout de l’huile essentielle de myrte (p<0.001). La performance de l’éclosion était plus élevée chez les groupes ayant reçu une alimentation complétée avec des doses d’huile essentielle de myrte de 1000 mg/kg alors qu’elle était plus basse chez les groupes ayant reçu 5000 mg/kg (p<0.01). Lajout de l’huile essentielle de myrte à l’alimentation a significativement diminué le cholestérol (p<0.01), Calcium (p<0.01) et Malondialdéhyde (MDA; p<0.001) serti et augmenté significativement les concentrations d’azote uréique (p<0.001) et de β-carotène (p<0.001). La créatine kinase serti (CK-MB) a augmenté (p<0.001) à la dose de 5000 mg/kg alors que la concentration d’albumine a diminué (p<0.01). La concentration MDA du jaune d’œuf a diminué (p<0.01) dans tous les groupes qui ont reçu un complément d’huile essentielle de myrte à leur alimentation aux 15ème et 30ème jours de conservation (p< 0.001). En conclusion, la complémentation par de l’huile essentielle de myrte a changé la performance de ponte et les valeurs biochimiques chez les cailles de ponte selon la quantité et la période d’apport. La prise en compte des paramètres de production et qualité des œufs, de concentration en MDA dans le jaune d’œuf et du taux d’éclosion conduisent à recommander de compléter l’alimentation des cailles pondentes à la teneur de 1000 mg/kg d’huile essentielle de myrte.

Mots-clés : Myrte, performance, éclosion, peroxydation lipidique, cailles.
As an aromatic plant, Myrtus communis L. belongs to the Myrtaceae family. It is widely used in medicine and the pharmaceutical industry, because it contains volatile fatty acids (VFAs) and other compounds. Volatile fatty acids of M. communis L. include myrtenol, myrtenyl acetate, limonene, linalool, α-pinene, 1,8-cineole, β-caryophyllene, p-cymene, geraniol, nerol, phenylpropanoid and methyleugenol [38]. It has been reported that derivatives of some myrtus extracts, such as beta-triketones [30], tannens, myricetin, gallic acid and ellagic acid, have antibacterial effects and the plant has strong antioxidant activity due to its galloyl derivatives [43]. Also, it has antifungal [23], hypoglycaemic [46], anticonvulsant [18], anticarcinogenic [15], anti-inflammatory [20] and antimutagenic [28] effects.

Studies involving M. communis L. have focused mostly on its volatile components and the composition of phenolic compounds in leaves and fruit. However, no available scientific data were found about the utilisation of the plant’s versatile benefits in the diets of laying quails. The aim of this research was to investigate the effects on performance, egg quality, some biochemical values and hatchability of laying quails that received varying concentrations of myrtle oil added to their diets.

Material and Methods

ANIMALS, DIETS AND EXPERIMENTAL DESIGN

This experimental study was carried out in The Avian Research Farm at the Animal Research Center of Afyon Kocatepe University, Turkey, following the ethical committee approval. A total of 375 quails (250 females and 125 males; Coturnix coturnix Japonica), aged eight weeks old, were randomly allocated to receive one of five dietary treatments. The birds were fed either a basal diet or the basal diet with supplemented with myrtle oil doses of 500, 1000, 2000 or 5000 mg/kg feed. Each treatment consisted of five replicates of ten females and five males. The birds were housed in cages kept inside a windowed poultry house with a light regimen of 16 hours light and 8 hours dark. Feed and water were provided ad libitum. The experiment was conducted for a duration of eight weeks. The content of the basal diet is shown in Table I. The basal diet was formulated to meet or slightly exceed the nutrient requirements recommended by the NATIONAL RESEARCH COUNCIL [37], and contained 12.15 MJ/kg Metabolisable Energy (ME) and 21.68% crude protein. The diet was free of antibiotics, coccidiostats and growth promoters. The nutrient composition of the basal diet, including moisture, crude protein, crude fat, crude fiber, crude ash, calcium and phosphorus contents was

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<tr>
<td>Full fat soybean</td>
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<td>Sunflower meal</td>
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<tr>
<td>Soybean meal</td>
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<tr>
<td>Meat and bone meal</td>
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<tr>
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</tr>
<tr>
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<td>Salt</td>
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<td>DL-Methionine</td>
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<td>Vitamin mineral premix²</td>
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Chemical composition

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<td>Crude fiber</td>
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<tr>
<td>Phosphorus</td>
<td>0.40</td>
</tr>
<tr>
<td>Metabolisable energy³ (MJ/kg)</td>
<td>12.15</td>
</tr>
</tbody>
</table>

Table I: Ingredients and chemical composition of the basal diet

*Added per kg of diet: retinol acetate, 4.1 mg; cholecalciferol, 0.075 mg; DL-a-tocopherylacetate, 11 mg; menadione, 1 mg; thiamin, 2.8 mg; riboflavin sodium phosphate, 5.8 mg; niacin, 44 mg; pyridoxine, 4 mg; cyanocobalamin, 0.026 mg; Ca-D-pantothenate, 8.8 mg; folic acid, 1 mg; choline, 220; biotin, 0.11 mg; Cu, 6 mg; I, 1.1 mg; Fe, 30 mg; Se, 0.1 mg; Mn, 60 mg; Zn, 30 mg³ Metabolisable energy content of diets was estimated using the equation devised by Carpenter and Clegg [33].
determined according to the AOAC [4]. Metabolisable energy of each diet was estimated using the following equation devised by Carpenter and Clegg [33]: ME, kcal/kg = 53 + 38 [(crude protein, %) + (2.25 x crude fat, %) + (1.1 x starch, %) + (sugar, %)]. Group feeding was applied for all treatment groups. Moreover, specific gravity values were considered when calculating the amount of myrtle oil to add to the diets. The specific gravity value of myrtle oil (0.8897 g/mL) was determined by the suppliers (NBT Company, Alanya, Turkey). The essential oils were extracted by hydrodistillation. Hydrodistillation is a simple form of steam distillation. High pressure steam is forced through crushed plant, picking up the oil. The vapor containing the oil is then condensed, producing a liquid containing a mixture of water and the plant oil. The oil is then separated from the water [7]. Then the composition of myrtle oil was determined by GS-MS. Myrtle oil was added to a small portion of the diet and then sprayed on to the total diet. All diets were prepared freshly every week.

LAYING PERFORMANCE

Quails were weighed individually at the beginning and end of the study. Eggs were collected daily and egg production was calculated on % production for egg numbers. Egg weight was recorded daily for each replicate. Feed consumption was recorded every two weeks. The feed conversion rate (FCR) was calculated as kilograms of feed per kilogram of eggs.

EGG QUALITY TRAITS

Twenty eggs from each group (five eggs from each replicate) were collected on the second, fourth, sixth and eighth weeks of the experiment to determine the quality of the interior and exterior of the eggs at monthly intervals. Egg quality traits were measured within 24 hours of collection. The eggs were examined for weight (g), length (mm), width (mm), egg shell thickness (mm), fracture strength, albumen index (%), yolk index (%), Haugh Unit (HU), egg shape index and yolk color index. Egg weights were measured to the nearest 0.1 g using a digital scale. Egg width, egg length, yolk width, albumen length and albumen width were measured by digital compass to the nearest 0.01 mm. Measurements of the shell thickness of dried shells with the membrane still intact were obtained from two sides in the equatorial region, as well as on the blunt and the pointed edges with a micrometer to the nearest 0.01 mm. Also, yolk and albumen heights were measured by micrometer to the nearest 0.01 mm. The egg yolk visual color score was determined by matching the yolk with one of the 15 bands of the “1961, Roch Improved Yolk Color Fan”. Egg quality traits were calculated using the following formulas [27,54]:

\[ \text{Shape index} (%) = \frac{\text{egg width (mm)} \times \text{egg length (mm)}}{100} \]
\[ \text{Yolk index} (%) = \frac{\text{yolk height (mm)} \times \text{yolk width (mm)}}{100} \]
\[ \text{Haugh Unit} = 100 \log \left( \frac{\text{albumen height (mm)} + 7.57 - 1.7 \times \text{egg weight}^{0.37} (g)}{2} \right) \]

DETERMINATION OF SERUM BIOCHEMICAL VALUES

At the end of experimental period, blood specimens collected from two animals per replicate, from a total of 10 animals, into dry tubes were centrifuged 1500 g for 15 minutes at 4°C. Then, the sera were stored at -18 °C for further analysis. The serum concentrations of calcium (Ca; limit of quantitation, 0.50 mmol/L; intra- and interassay coefficients of variation, 0.7% and 2.1%), alkaline phosphatase (ALP; sensitivity of assay, 1 U/L; intra- and interassay coefficients of variation, 0.8% and 2.9%), alanine aminotransferase (ALT; sensitivity of assay, 1 U/L; intra- and interassay coefficients of variation, 0.8% and 1.1%), aspartate aminotransferase (AST; sensitivity of assay, 1 U/L; intra- and interassay coefficients of variation, 0.7% and 2.9%), creatinine (sensitivity of assay, 1.52 µmol/L; intra- and interassay coefficients of variation, 1.1% and 1.6%), urea (sensitivity of assay, 0.357 mmol/L; intra- and interassay coefficients of variation, 1% and 1.6%), creatine kinase - MB (CK-MB; sensitivity of assay, 10 U/L; intra- and interassay coefficients of variation, 1.9% and 3.6%), albumin (sensitivity of assay, 0.2 g/L; intra- and interassay coefficients of variation, 1.5% and 3.6%, total cholesterol (sensitivity of assay, 0.0259 mmol/L; intra- and interassay coefficients of variation, 1.6% and 2.6%), high-density lipoprotein cholesterol (HDL-C; sensitivity of assay, 0.0259 mmol/L; intra- and interassay coefficients of variation, 1.7% and 2.2%) and low-density lipoprotein cholesterol (LDL-C; sensitivity of assay, 0.0259 mmol/L; intra- and interassay coefficients of variation, 1.5% and 2.2%) (Cormay, Poland) concentrations using autoanlyser (Tokyo Boeki Prestige 24i, Japan) [29,34,45]. Serum MDA [17] and β-carotene concentrations were determined using the method of [51] were determined with enzyme-linked immunosorbent assays and a spectrophotometric reader (MWGt Lambda Scan 200, Bio-Tek Instruments, USA). Precision of the assay was assured by use of a quality control sample, which was included on each plate.

ANALYZING EGGS MALONDIALDEHYDE (MDA) CONCENTRATIONS

Malondialdehyde was measured as a secondary oxidation product according to the TBA method described by [31] using spectrophotometry with some modifications. At the end of the experimental period, 100 egg yolk specimens (20 egg yolk specimens from each group) were tested. The lipid oxidation value of raw egg yolk specimens stored at +4°C was determined at 1., 7., 15., and 30. days of storage. A modified 2-thiobarbituric acid method was used, and the results were expressed as the amount of 2-thiobarbituric acid reactive substances (mg MDA). This method is based on observing the red color that is created by the oxidation of unsaturated fatty acids with thiobarbituric acid (TBA) after heating MDA. For the analyses, 10 g of the specimen was homogenized with distilled water in a blender and then transferred to a Kjeldahl.
USE OF MYRTLE OIL IN LAYING QUAILS DIET

Results

The ingredients and chemical composition of the diets are presented in Table I. The volatile oil composition of myrtle oil is summarized in Table II. The main active components of myrtle oil are α-pinene (31.2%), 1,8-cineole (24.2%) and limonene (13.8%).

It was observed that addition of 500 to 2000 mg/kg of M. communis L. oil to the diets had no effect on final LW; however, supplementation of 5000 mg/kg reduced the final LW in both male and female quails (p< 0.05). M. communis L. oil added diets did not alter feed consumption of the groups. Supplementation of 5000 mg/kg M. communis L. oil reduced egg production in whole study except second week (p< 0.001). However, supplementation of 1000 mg/kg M. communis L. oil to the diets increased egg production in entire study. Supplementation of 5000 mg/kg M. communis L. oil to the diets had negative effects on FCR during whole study although there was no difference in egg weight between groups (Table III).

During eighth week of experiment, it was found that eggshell thickness was 35.23 mm in control group, whereas the groups supplemented with 500, 1000, 2000 and 5000 mg/kg/day myrtle oil had 34.55, 33.78, 31.30 and 32.21 mm thickness, respectively. Furthermore, yolk color index in control and experimental groups (500, 1000, 2000 and 5000 mg/kg/day) were 6.1 and 7.80, 8.40, 7.80, 8.20, respectively. However, diet supplemented with myrtle oil doses of 2000 and 5000 mg/kg were decreased eggshell thickness (p< 0.05). But addition of myrtle oil to laying quail diets increased yolk color index at eight weeks. Other egg quality traits (fracture strength, haugh unit, shape index, yolk index and albumin index) were not affected by myrtle oil addition to the diets.

Biochemical results obtained during the study are shown in Table IV and egg yolk MDA concentrations are shown in Table V. As presented, the addition of myrtle oil to the diets decreased serum Ca concentrations (p< 0.01), whereas it increased urea (p< 0.001) and β-carotene (p< 0.001) concentrations in all groups. Supplementation with 5000 mg/kg myrtle oil was increased CK-MB activity (p< 0.001) and decreased albumin concentration (p< 0.05); during all doses (500-5000 mg/kg) of myrtle oil supplementation,
### Table III: Effects of *Myrtus communis* L. oil diets on laying performance

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<th>Dietary myrtle oil supplementation (mg/kg/day)</th>
<th>Initial live weights, g</th>
<th>Male</th>
<th>0</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>5000</th>
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<tbody>
<tr>
<td>Female</td>
<td>188.4 (181.1-195.6)</td>
<td>175.3 (165.9-178.5)</td>
<td>188.4 (180.2-193.4)</td>
<td>172.1 (168.1-176.3)</td>
<td>187.1 (179.8-193.2)</td>
<td>188.3 (182.5-194.5)</td>
<td>188.7 (183.1-196.7)</td>
<td>NS</td>
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<tr>
<td>Male</td>
<td>210.4 (203.9-211.0)</td>
<td>190.2 (183.3-197.8)</td>
<td>209.9 (204.7-216.4)</td>
<td>193.36 (185.5-193.3)</td>
<td>207.5 (198.6-214.3)</td>
<td>204.8 (202.1-213.2)</td>
<td>199.3 (193.8-205.0)</td>
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<th>Dietary myrtle oil supplementation (mg/kg/day)</th>
<th>Final live weights, g</th>
<th>Male</th>
<th>0</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>5000</th>
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<tr>
<td>Female</td>
<td>210.4 (203.9-211.0)</td>
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<td>188.4 (181.1-195.6)</td>
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<td>188.3 (182.5-194.5)</td>
<td>188.7 (183.1-196.7)</td>
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### Table IV: Effects of *Myrtus communis* L. oil diets on some serum biochemical values

<table>
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<tr>
<th>Dietary myrtle oil supplementation (mg/kg/day)</th>
<th>CK-MB (U/L)</th>
<th>Urea (mmol/L)</th>
<th>Albumin (g/L)</th>
<th>Total cholesterol (mmol/L)</th>
<th>HDL-C (mmol/L)</th>
<th>LDL-C (mmol/L)</th>
<th>Ca (mmol/L)</th>
<th>β-carotene (µmol/L)</th>
<th>MDA (µmol/L)</th>
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<td>0</td>
<td>2667 (2123-3212)</td>
<td>16.30 (12.18-21.13)</td>
<td>19.3 (16.5-19.8)</td>
<td>10.62 (9.30-14.97)</td>
<td>1.39 (0.46-2.07)</td>
<td>1.86 (1.53-2.09)</td>
<td>7.67 (6.80-8.52)</td>
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<td>500</td>
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<td>33.40 (24.00-42.11)</td>
<td>18.8 (16.4-19.7)</td>
<td>9.87 (9.30-10.26)</td>
<td>2.25 (1.86-3.57)</td>
<td>1.79 (1.53-1.91)</td>
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<td>3.76 (2.64-4.91)</td>
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<td>3.10 (2.53-4.08)</td>
<td>2.93 (2.56-3.31)</td>
<td>5.28 (4.94-5.57)</td>
<td>0.369 (0.294-0.396)</td>
<td>2.11 (1.88-2.82)</td>
</tr>
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</table>

**FCR**: Food conversion ratio (feed consumed, (g)/egg production (g)).

Letters (a, b, c, d) in the same line indicate significant differences between different letters. **NS** = not significant.
USE OF MYRTLE OIL IN LAYING QUAILS DIET

Franklin M. Brown Jr., Robert H. Oppenheimer, and Robert D. Bird


Egg yolk MDA concentrations were varied depending on storage time. The lowest MDA concentration (p<0.01) was observed on days 15th and 30th in the group received a daily diet supplemented with 2000 mg/kg of myrtle oil.

No differences were found in fertility rate, hatchability, early embryonic death, late embryonic death and submembraneal death at 4th and 8th weeks. During eighth week of the experiment, hatch performance was 65.8%, 70.0%, 78.3%, 64.2% and 54.3% in control and experimental groups (500, 1000, 2000 ve 5000 mg/kg myrtle oil), respectively. It was seen that the most increased (p<0.01) hatch performance was in the groups consumed a diet supplemented by 1000 mg/kg myrtle oil at week 8th.

Discussion

The aim of this study was to determine the effects of a diet supplemented with M. communis L. oil in the performance, egg quality, some serum biochemical values and lipid peroxidation of serum and egg, and hatchability in laying quails. The dosage range selected was between 500 and 5000 mg/kg on the basis of other essential oil studies [7,11,14,40] because there was no available data about myrtle oil supplementation of diets. M. communis L. oil used in this research, extracted from M. communis L. leaves which is rich in volatile oil as analysed composition showing high proportion of α-pinene (31.2%) and 1,8-cineole (24.2%) and moderate proportion of limonene (13.8%), linalool (8.8%) lesser proportion of α-terpineol / α-terpinyl acetate (4.9%), linalyl acetate (3.9%) and geraniol (1.4%). This content ratio; yolk color index increased in groups receiving myrtle oil, although 5000 mg/kg supplementation of myrtle oil, although 5000 mg/kg supplementation of myrtle oil suppressed it significantly at weeks 4th, 6th, 8th and during entire study. Thus, low FCR is related to low egg production.

In this research, we have observed that myrtle oil did not affect egg weight. However, it was observed that myrtle oil supplementation altered egg production and FCR depending on added quantity and consumption period. Other reports show that supplementation of rosemary, oregano, saffron [11] or oregano essential oil [22] to the diets did not alter egg production and FCR. On the contrary, it was reported that supplementation of 24 mg/kg essential oil mixture has improved FCR [14]. Supplementation of 5000 mg/kg myrtle oil to the diet has worsen FCR in whole study, whereas other quantities did not alter it. Egg production increased in whole study by supplementation of 500 and 1000 mg/kg of myrtle oil, although 5000 mg/kg supplementation of myrtle oil suppressed it significantly at weeks 4th, 6th, 8th and during entire study. Thus, low FCR is related to low egg production of the same group.

In the current study, no difference was found between groups in the internal quality parameters except yolk color index; yolk color index increased in groups receiving myrtle oil at week eight (Table IV). Similarly, it was reported that the addition of 20 mg/kg saffron [11] or 1% curcuma longa [40] to the diets improved yolk color. However, it was shown that the addition of 5000 mg/kg Rosmarinus officinalis or 5000 mg/kg Origanum vulgare to the diets did not change yolk color [11]. Yolk color depends on the deposition of carotenoids in the yolk [26]. There is a relation between plasma carotene concentrations and yolk color [10]. Higher plasma carotene concentrations in all groups in the present study as compared with the control were thought to be due to the effect of myrtle oil, which prevents the carotene in feed from degrading or maintains plasma carotene concentrations by its antioxidant activity.
effect. In the current study, it was concluded that improved yolk color was due to the effect of elevated plasma β-carotene concentrations in the myrtle oil supplemented group.

It was observed that egg shell thickness was decreased in addition of 2000 and 5000 mg/kg of myrtle oil to the diets in eight weeks (p<0.05, Table IV). BOLUKBASI et al. [8] reports that the addition of bergamot oil to the diets decreases shell index. However, some reports indicate that the addition of an essential oil to the diets increases egg shell thickness [5,36] or does not change it [22,24]. In the present study, it was found that the addition of myrtle oil to the diet significantly decreased serum Ca concentrations (p<0.05, Table V). A decrease in egg shell thickness may be due to a decrease in serum Ca concentrations. The major components of myrtle oil are 1,8-cineole, myrtyl acetate, α-pinene, myrtanol, limonenes and monoterpenes. It stops in vivo and in vitro bone resorption reversibly in rats [16]. It was reported that plasma Ca concentrations of hens were decreased depending on the added quantities of monoterpenes to the diet. Also, it has been reported that monoterpenes directly effect osteoclastic formation in homopoietic cells and blocks bone resorption [16]. The addition of myrtle oil related to low Ca concentrations in the current study, may be due to the blocking of intestinal absorption of Ca, accelerated kidney clearance and/or blocking bone resorption.

Serum total cholesterol concentrations (p<0.05) were decreased, whereas HDL-C (p<0.01) and LDL-C concentrations (p<0.05), which are included in the cholesterol profile, were increased depending on added quantity of myrtle oil to the diet (Table V). Similar to the current results, essential oils were shown to decrease serum cholesterol concentrations in previous studies [3,40]. It is reported that 3 hydroxy-3 methylglutaryl coenzyme A (HMG-CoA) reductase plays a key role in cholesterol synthesis and essential oils down regulate HMG-CoA and therefore shows a hypocholesteremic effect [32]. Similarly, it was observed that the addition of 25 to 100 mg/kg limonene to the diet inhibits hepatic HMG-CoA and reduces serum cholesterol concentrations [39]. However, BOLUKBASI et al. [9] report that the addition of bergamot oil does not reduce cholesterol concentrations.

It has been reported that AST, ALT and ALP are remarkable values for the detection of liver damage in birds [29,33,45]. There were no statistically significant (p>0.05) differences in serum indicators originating from the liver (ALP, ALT, AST) in this study. Enzyme CK has high activity in skeletal muscles and in the myocardium. The isoenzyme CK-MB is present in many tissues, mostly in the myocardium. CK is more active in skeletal muscles than in myocardium. An increase in serum CK and CK-MB activities is generally linked to defects in skeletal muscles and myocardium [29,52]. Elevated concentrations of CK-MB and urea indicate the presence of muscle tissue degeneration as well [29]. In the present study, CK-MB (p<0.001), urea (p<0.01) activities were raised, whereas albumin concentration decreased (p<0.05, Table IV) in the groups fed a diet supplemented with 5000 mg/kg myrtle oil showing that myrtle oil may be cause muscle degeneration. Also, decreased LW in these groups was in accordance with biochemical results.

In the present study, it was observed that yolk MDA concentrations were decreased on days 15th and 30th in all myrtle groups (p<0.001). It was reported that the antioxidant effects of aromatic plants are due to their phenolic compounds [48]. Phenolic compounds act as antioxidants by trapping free radicals, which reduces singlet oxygen formation by making compounds with metallic ions [42]. Also, 1,8-cineole α-pinen and β-pinenin, which are some major components of myrtle oil, are known to have antioxidant activity [53]. Similarly, antioxidant characteristic of myrtle oil was also reported [2]. Due to the presence of phenolic OH groups; these groups act as hydrogen donors to the peroxy radicals produced in the first step in lipid oxidation, thus retarding the formation of hydroxyl peroxide.

In the present study, it was observed that the addition of 1000 mg/kg M. communis L. oil to the diet increased the hatch performance statistically at eight weeks (p<0.01). ALI et al. [3] reported that individually added 1% thyme, 1% rosemary, 1% oregano and 0.5 to 1% curcuma longa to chicken diets increased fertility and hatchability. Oxidative metabolism increased, especially in the final few days before hatching, as a normal result of embryonic growth. It is reported that over increment lipid peroxidation may lead to tissue damage [49], whereas diets with added antioxidants may protect the embryo and therefore increase survival rate [50].

As a conclusion, this study suggested that myrtle oil supplementation, especially at a concentration of 500 and 1000 mg/kg may be considered a potential natural growth promoter. However, more studies are needed to define the

<table>
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<th>Dietary myrtle oil supplementation (mg/kg/day)</th>
<th>0</th>
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<th>1000</th>
<th>2000</th>
<th>5000</th>
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<td>0.07</td>
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Letters (a, b) in the same line indicate significant differences between different letters

Table V: Effects of Myrtus communis L. oil diets on egg yolk MDA concentration (mg MDA/kg specimen) in raw egg specimens at different storage times (at +4°C)
effect of myrtle oil supplementation on the performance of poultry with regard to environmental conditions, effective dosage, active oil substances, dietary ingredients and nutrient density. Furthermore, this study indicated that the use of myrtle oil as a natural antioxidant may improve poultry egg quality and may extend the shelf life of poultry egg products.

References


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