Meat quality characteristics in Japanese quails fed with Mentha piperita plant

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Abstract. In current study, the effect of different levels of Mentha piperita plant (MPP) on meat quality characteristics in Japanese quail was investigated. 180 quails were carried out in completely randomized design with three levels of MPP (0, 1.5 and 3 percentage). Four replicates with 15 quails were allocated to each experimental treatment. At the end of experiment, after slaughter and evisceration two birds from each replicate of the treatment, the carcasses of the birds were kept in a refrigerator (2-4°C) for 24 hours. Meat quality parameters including the brightness, yellowness and redness of colors, water holding capacity (WHC), acidity (pH), thiobarbituric acid-reacting substances (TBARS) and intramuscular fat (IMF) were performed on breast meat samples. The results showed that yellowness, redness and thiobarbituric acid-reacting substances (TBARS) affected by diets containing MPP (p<0.05). There was no significantly difference for the rest of meat quality traits such as brightness, WHC, pH and IMF.

Key Words: Japanese quail, Mentha piperita plant, meat quality.

Introduction
Japanese quail (Coturnix japonica) is one of the smallest birds used for egg and meat production. Quail is in the genus Coturnix, family Phasianidae and order Galliformes (Sharma et al. 2000). The Japanese quail is now a well-established animal model in biology and a bird used for intensive egg and meat production mainly in Asia and Europe but also in the Middle East and America (Minvielle 2004). Addition to inadequate supply and consumption of animal protein, there has been a resurgence of interest in improving the physicochemical and sensory properties of meat, as well as its storage life. The benefits of meat quail including high protein, polyunsaturated fatty acids and essential trace minerals and fat. Because of high metabolic activity in this bird, the amount of glycogen stored in muscles increased, resulting in high quality. Medicinal plant showed positive effects on the performance and meat quality parameters in broiler (Horton et al. 1991; Freitas et al. 2001; Bampidis et al. 2005). Some medicinal plants were found to have natural effects, for example, Mentha piperita characterized by their volatile oils that are of great economic importance, antimicrobial, antioxidant, phenolic substances, lectins and polypeptides in its structures (Souri et al. 2004; Jazani et al. 2009). Hence, they are cultivated as industrial crops in several countries. Wood & Enser (1997) recommended the use of dietary antioxidants to reduce lipid peroxidation in the feed and animal, and to preserve product quality. Recent research on antioxidants has focused on naturally occurring molecules to eliminate consumers’ concerns about the safety and toxicity of the synthetic counterparts. In this respect, herbs and their extracts with antioxidant capacity are being tested to improve animal performance and the quality and shelf life of meat products there from (Lopez-Bote et al 1998; Simitzis et al. 2008). There are a few reports on the antioxidant property of Mentha (Dorman et al. 2003; Marinova & Yanishlieva 1997; Zheng & Wang 2001) but its application in meat quality has not been studied, especially in Japanese quail. The aims of the present study were to investigate the effect of Mentha piperita in meat quality parameters of Japanese quail.

Material and Method
In this experiment that started 1 day following until 42 days, the birds were randomly assigned, according to their initial body weights, into 3 groups with 4 replicates of 15 birds. All the groups were subjected to similar management practices (brooding, lighting, feeding and watering) throughout the experiment except the diets offered. Control group with no MPP supplement, T2 and T3, received 1.5% and 3% MPP, respectively. Ingredients and chemical compositions of the basal diet are shown in Table 1. The diets were formulated using NRC (1994) guidelines and contained 24% protein and 2900 kcal/kg ME. Birds were provided with feed and fresh water for ad libitum consumption. At the end of experiment, two birds (male) from each replicate of the treatment (8 birds per each dietary treatment and 24 birds in total) were selected randomly and were submitted to 6 h of feed withdrawal prior to slaughter. After slaughter and evisceration, the carcasses of the birds were kept in a refrigerator (2-4°C) for 24 hours. Meat quality traits consisting ultimate pH (pHu), redness (a*), yellowness (b*), lightness (L*), water holding capacity (WHC), intramuscular fat percentage (IFP) and extent of lipid oxidation was evaluated as thiobarbituric acid-reacting substances (TBARS) were measured. All measurements of meat quality traits were performed on breast meat samples. The ultimate pH was measured with a portable pH-meter (Model HI 99163, Hanna Instruments, USA). The color of breast muscle was determined by a colorimeter (Lovibond CAM-system 500).
Water holding capacity was measured using the method represented by Bouton et al (1971). Intramuscular fat percentage (IFP) of a small sample of the breast muscle, pectoral minor, was measured by means of extraction in a Soxhlet apparatus with petroleum ether (AOAC, 2005). TBARS was determined by the modified method of Ke et al (1977). 10 grams of minced breast samples were homogenized for 2 min with 95.7 mL of distilled water and 2.5 mL of 4N HCl. The mixture was distilled until 50 mL was obtained. Then, 5 mL of the distillate and 5 mL of TBA reagent (15% trichloroacetic acid, 0.375% thiobarbituric acid) were heated in a boiling water bath for 35 min. After cooling under running tap water for 10 min, the absorbance was measured at 538 nm against a blank. TBARS values were obtained by multiplying optical density by 7.843. Oxidation products were quantified as malondialdehyde equivalents (mg MDA kg⁻¹ muscle).

The obtained data growth performance and carcass composition were subjected to statistical analysis using the general linear model (GLM) procedures of the SAS software (SAS Institute, 2004). Significant differences among the means of treatments were determined by using Duncan test.

**Discussion**

Acidity (pH) value is one of the most important factors that affect protein solubility, water holding capacity, moisture retention, drip loss and cooking loss, but it is normally in the range of 5.6 to 6.5 (Ranken 2000). Birds fed control diet had higher pH than other treatments. While, diet containing MPP insignificantly affected breast pH values of Japanese quail. The breast muscle from birds fed with MPP supplement (T1 and T2 diets) showed significantly lower total thiobarbituric acid-reacting substances (TBARS) values than the breast muscle of birds fed the control diet (Table 2), indicating that the antioxidative activity in the breast muscle of Japanese quail can be increased by dietary MPP. Although there was no significant difference between treatments but the linear decrease was observed for intramuscular fat percentage in the breast meat of birds fed the control diet than quail fed the dietary MPP. These results showed that decrease in values of lipid content had the lowest TBARS concentration which agree with other reports (Apte & Morrissey 1987; Onibi 2006; Gbenga et al 2009) that breast muscle with lowest lipid content had the lowest TBARS concentration and thigh muscle which had the highest lipid content, oxidized most. The product used in the current appeared to have a measurable impact on color values of breast meat. The color of muscle tissue was lighter from breast muscle with a lower pH in accordance with other studies on broilers (Fletcher 1999). Classification for lightness values of meat is controversial in the literatures. While Qiao et al (2002) classified as follows: lighter (pale, L* >53), normal (48< L*<51) and darker (dark, L*<46), Petracchi et al (2004) reported that corresponding values were L* >56, 50< L*<56 and L* <50, for broilers, respectively. Based on these values and results, the L*, a*, and b* values for all treatments were in a larger range reason of differences could be qualified by the method of estimation, population, sample size and environmental effects.

### Table 1. Ingredients and chemical composition of base diet fed to Japanese quails

<table>
<thead>
<tr>
<th>Ingredients (Percentage)</th>
<th>Amount</th>
<th>Calculated chemical component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn (CP= 7.89%)</td>
<td>50.5</td>
<td>Metabolizable energy (kcal/kg) 2900</td>
</tr>
<tr>
<td>Soybean meal (CP= 43.68%)</td>
<td>42.03</td>
<td>Crude Protein, % 24</td>
</tr>
<tr>
<td>Fish meal (CP=55.32)</td>
<td>3</td>
<td>Calcium, % 0.8</td>
</tr>
<tr>
<td>Soy oil</td>
<td>2.07</td>
<td>Availability P, % 0.3</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>0.32</td>
<td>Sodium % 0.15</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.16</td>
<td>Lysine % 1.39</td>
</tr>
<tr>
<td>Salt</td>
<td>0.3</td>
<td>Methionine % 0.5</td>
</tr>
<tr>
<td>Vitamin premix b</td>
<td>0.25</td>
<td>Methionine + cysteine % 0.88</td>
</tr>
<tr>
<td>DL-Methionine</td>
<td>0.12</td>
<td>-</td>
</tr>
</tbody>
</table>

1 Calculated composition was according to NRC (1994)
2 Mineral premix Premix supplied for 2.5 kg: Mn, 165350 mg; Fe, 250000 mg; Zn, 249000 mg; Cu, 40000 mg; iodine, 1600 mg; choline chloride, 335350 mg.
3 Vitamin Premix supplied for 2.5 kg: vitamin A, 9000000 IU; vitamin D₃, 2000000 IU; vitamin K₃, 4000 mg; vitamin B₁, 1800 mg; vitamin B₂; 8250 mg; vitamin B₃; 10000 mg; vitamin B₅; 30000 mg; vitamin B₆; 3000 mg; vitamin B₉; 1250 mg; vitamin B₁₂; 1500 mg; biotin, 5000 mg.

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In red meats, a bright red colour is perceived by consumers as being indicative of freshness, while consumers discriminate against meat which has turned brown in colour. The rate of discoulouration of meat is believed to be related to the effectiveness of oxidative processes. Dietary supplementation with MPP effectively controlled loss of desirable colour (increase redness and reduce yellowness), lipid oxidation and accumulation of metmyoglobin. Metmyoglobin formation and the accumulation of lipid oxidation products were linearly related and positively correlated (Faustman et al 1989). Analysis of data showed that yellowness were lower and surface redness were higher in breast muscle from Japanese quail fed diet containing MPP, compared with Japanese quails fed basal diet (control) (p<0.05). No consistent trend in the pH and water holding capacity (WHC) of the meat was also similar to that reported by Jang et al (2008) for meat from broiler chickens fed a dietary medicinal herb extract mix.

### References


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