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Research Article

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^{0}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.

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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 (2-40°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).

Table 1. Ingredients and chemical composition of base diet fed to Japanese quails[a]

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

[a] Calculated composition was according to NRC (1994)

[b] Mineral premix Premix supplied for 2.5 kg: Mn, 165350 mg; Fe, 250000 mg; Zn, 249000 mg; Cu, 40000 mg; iodine, 1600 mg; choline cloride, 335350 mg.

[b] Vitamin Premix supplied for 2.5 kg: vitamin A, 9000000 IU; vitamin D_3, 2000000 IU; vitamin K_3, 4000 mg; vitamin B_1, 1800 mg; vitamin B_2; 8250 mg; vitamin B_3; 10000 mg; vitamin B_5; 30000 mg; vitamin B_6; 3000 mg; vitamin B_9; 1250 mg; vitamin B_{12}; 1500 mg; biotin, 5000 mg.

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, 2001). Significant differences among the means of treatments were determined by using Duncan test.

Results

Results of meat quality indicators (breast muscle) after application of MPP are shown in Table 2. Different letters in each column shows significant different ($P<0.05$). There was significant difference between treatments for redness (a*), yellowness (b*) and thiobarbituric acid-reacting substances (TBARS) in the breast muscle of birds fed the control diet and quail fed the dietary MPP. Highest intramuscular fat (6.81%) and lowest intramuscular fat (6.55%) were observed in group of birds fed basal diet and group of birds fed 3% MPP. pH, water holding capacity and intramuscular fat were not different among the treatment groups ($p > 0.05$).

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, $L^*<46$), Petracci *et al* (2004) reported that corresponding values were $L^*>56$, $50\leq L^*\leq 56$ 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 2. Effect of *Mentha piperita* plant on meat quality characteristics in Japanese quails

Treatment	pH	a *	b *	L *	WHC	TBA	IMF
0 MPP(Control)	6.19±0.26	5.56±0.54[b]	-1.93±0.05[a]	61.02±3.26	57.33±2.17	75.43±4.63[a]	6.81±0.53
1.5% MPP	6.07±0.36	7.17±0.49[a]	-1.17±0.06[b]	61.24±4.71	58.82±1.62	56.19±4.59[b]	6.79±0.34
3% MPP	6.10±0.17	7.47±0.32[a]	-1.03±0.05[b]	62.01±3.62	57.88±2.29	53.26±4.69[b]	6.55±0.23
Probability	0.49	0.02	0.04	0.57	0.49	0.49	0.49
Values in the same column with different superscripts are significantly different ($P < 0.05$)							

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 discolouration 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

Association of Official Analytical Chemists (AOAC), 2005. Official methods of analysis, association of official analytical chemists. Vol 1. Arlington, Virginia, USA.

Apte, S., Morrissey, P. A., 1987. Effect of water soluble haem and haemiron complexes on lipid oxidation of heated muscle systems. Food Chemistry 25:213-222.

Bampidis, V. A., Christodoulou, V., Florou-Paneri, P., Christaki, E., Chatzopoulou, P. S., Tsiligianni, T. A., Spais, B., 2005. Effect of dietary dried oregano leaves on growth performance, carcass characteristics and serum cholesterol of female early maturing turkeys. British Poultry Science 46:595–601.

Bouton, P. E., Harris, P. V., Shorthose, W. R., 1971. Effect of ultimate pH upon the water holding capacity and tenderness of mutton. Journal of Food Science 36:435-439.

Dorman, H. J. D., Kosar, M., Kahlos, K., Holm Y., Hiltunen, R., 2003. Antioxidant properties and composition of aqueous extracts from *Mentha* species, hybrids, varieties, and cultivars. Journal of Agricultural and Food Chemistry 51:4563–4569.

Faustman, C., Cassens, R. G., Schaefer, D. M., Beuge, D. R., Williams, S. N., Scheller, K. K., 1989. Improvement of pigment and lipid stability in Holstein steer beef by dietary supplementation with vitamin E. Journal of Food Science 54(4):858-862.

Fletcher, D. L., 1999. Broiler breast meat color variation, pH, and texture. Poultry Science 78:1323-1327.

Freitas, R., Fonseca, J. B., Soares, R. T. R. N., Rostagno, H. S., Soares, P. R., 2001. Utilization of garlic (*Allium sativum*) as growth promoter of broilers. Revista Brasileira de Zootecnia 30:761-765.

Gbenga E. O., Oluwatoyin E. A., Fajemisin N. A., Adetunji V. A., 2009. Response of broiler chickens in terms of performance and meat quality to garlic (*Allium sativum*) supplementation. African Journal of Agricultural Research 4:511-517.

Horton, G. M. J., Fennell, M. J., Prasad, B. M., 1991. Effects of dietary garlic (*Allium sativum*) on performance, carcass composition and blood chemistry changes in broiler chickens. Canadian Journal of Animal Science 71:939-942.

Jang, A., Liu, X. D., Shin, M. H., Lee, B. D., Lee, S. K., Lee, J. H., Jo, C., 2008. Antioxidative potential of raw breast meat from broiler chicks fed a dietary medicinal herb extract mix. Poultry Science 87:2382–2389.

Jazani, N. H., Zartoshti, M., Babazadeh, H., Alidaiee, N., Zarrin, S., Hosseini, S., 2009. Antibacterial effects of Iranian fennel essential oil on isolates of *Acinetobacter baumannii*. Pakistan Journal Biological Sciences 12:738-41.

Ke, P. J., Ackman, R. G., Linke, B. H., Nash, D. M., 1977. Differential lipid oxidation products in variouse parts of frozen mackerel. Journal of Food Technology 12:37-47.

Lopez-Bote, C. J., Gray, J. I., Gomaa, E. A., Flegal, C. J., 1998. Effect of dietary administration of oil extracts from rosemary and sage on lipid oxidation in broiler meat. British Poultry Science 39:235–240.

Marinova, E. M., Yanishlieva, N. V., 1997. Antioxidative activity of extracts from selected species of the family Lamiaceae in sunflower oil. Food Chemistry 58:245–248.

Minvielle, F., 2004. The future of Japanese quail for research and production. World's Poultry Science Journal 60:500-507.

Onibi, G. E., 2006. Dietary oil quantity and vitamin E supplementation II: Effect on carcass and meat quality of broiler chickens. Bowen Journal of Agriculture 3(1):106-115.

Petracci, M., Betti, M., Bianchi, M., Cavani C., 2004. Color variation and characterization of broiler breast meat during processing in Italy. Poultry Science 83:2086-2092.

Qiao, M., Fletcher, D. L., Northcutt, J. K., Smith D. P., 2002. The relationship between raw broiler breast meat color and composition. Poultry Science 81:422-427.

Ranken, M. D., 2000. Handbook of meat product technology. Oxford [England]; Malden, MA, USA: Blackwell Science.

Sharma, D., Rao, K. B. C. A., Totey, S. M., 2000. Measurement of within and between population genetic variability in quails. British Poultry Science 41:29-32.

Simitzis, P. E., Deligeorgis, S. G., Bizelis, J. A., Dardamani, A., Theodosiou, I., Fegeros K., 2008. Effect of dietary oreganooil supplementation on lamb meat characteristics. Meat Science 79:217–223.

Souri E., Amin, G., Dehmobed-Sharifabadi, A., Nazifi, A., Farsam, H., 2004. Antioxidative activity of sixty plants from Iran. Iranian Journal of Pharmaceutical Research 3:55-59.

Wood, J. D., Enser, M., 1997. Factors influencing fatty acids in meat and the role of antioxidants in improving meat quality. British Journal of Nutrition 78:49–60.

Zheng, W., Wang, S. Y., 2001. Antioxidant activity and phenolic compounds in selected herbs. Journal of Agricultural and Food Chemistry 49:5165–5170.

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