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INFLUENCE OF USING DIFFERENT OIL SOURCES IN QUAIL NUTRITION ON MEAT COMPOSITION AND QUALITY PARAMETERS

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Abstract

In this study, effects of using different oil sources (sunflower oil, olive oil, fish oil, flax seed oil and nettle oil) in Japanese quail feeding on pH, colour, moisture, protein, fat, myoglobin, total iron, thiobarbituric acid reactive substances (TBARS) and fatty acid composition of quail meat were investigated. After two weeks of prefeeding period with standard diet, quails were fed with diet containing five different oil sources for a period of five weeks and slaughtered at the end of the seven weeks. After that, breast meat was removed from carcass and physico-chemical properties of quail meat were evaluated. The results indicated that the meat samples obtained from quails fed with diet containing olive oil and nettle oil had the highest pH levels compared to other groups ($p<0.05$). No significant differences for fat, protein and moisture levels, and colour values among treatment groups were determined. The lowest myoglobin and total iron levels were determined in meat samples obtained from quails received diet containing flax seed oil and nettle oil ($p<0.05$). As far as lipid oxidation is concerned, the highest TBARS values were found to be in meat samples obtained from quails received nettle oil ($p<0.05$). It was determined that the ratio of polyunsaturated (PUFA) and saturated (SFA) fatty acids were higher than 0.4 and the highest PUFA/SFA ratio was found in the meat samples obtained from quails received flax seed oil in diet ($p<0.05$). Furthermore, quail meat obtained from quails fed with fish oil and flax seed oil had higher eicosapentaenoic acid and docosahexaenoic acid compared to other groups ($p<0.05$). into quail diet.

Key words*: Quail, nutrition, oils, meat quality.*

INTRODUCTION

Animal products, in particular poultry meat, represent an important part of our diet. Poultry meat is distinguished for its low energy concentration and it has high nutrient density compared with other food substitutes(Hargis and Vanelswyk, 1993). Poultry meat is a good source of high biological value protein. Furthermore, it provides iron and zinc of high bioavailability in lower quantities than red meats, but important amounts compared with food of vegetable origin. Poultry meat has significant content of vitamins from group B such as thiamine, riboflavin, niacin and vitamin B_6, although vitamin B_{12} content is less than in other meats.

The demand of consumers for quail meat has increased in recent years due to the pursuit of economic and healthy meat. Quail meat which can be produced quickly and easily has been one of the most important alternatives for economic meat source.

The quails are the smallest species of game bird which are farmed as well. These are found in wild environment in Europe, Asia, America and Australia but commercial strains are farmed for meat and eggs worldwide. The most common specie of quail is Japanese quail (*Coturnix coturnix japonica*) which is used in commercial enterprises (Minvielle, 2004).

The quail meat may be considered as a competitive source against the broiler meat. According to some studies, it is believed that quail meat is nearly a chicken and even better than it. Quail meat includes 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 (Boni et al., 2010).

Researchers have focused on studies related with modification of poultry meat composition

using different strategies and thus to produce the useful food products for human health. One of the most effective methods is the use of dietary strategies to improve the quality of the poultry carcass and meat (Barroeta, 2007). This modification is to increase the amount of unsaturated FA, especially the omega 3 (n3) family which has beneficial effects on human health (Salainatcloustnobar et al., 2008). However, some studies indicated that increasing the unsaturation degree of the meat leads to organoleptic and nutritional problems and requires assessment of the oxidation processes of the lipid fraction (Lopez-Ferrer et al., 1999).
In the present study, the objective was to determine the effect of using different oil sources (sunflower oil, olive oil, fish oil, flax seed oil and nettle oil) in Japanese quail feed on pH, colour, moisture, protein, fat, ash, myoglobin, total iron, thiobarbituric acid reactive substances (TBARS) and fatty acid composition of quail meat.

MATERIALS AND METHODS

Animals and diet

250, 14 day-old Japanese quail (*Coturnix coturnix japonica*) were used in the experiment. The quails were obtained from Suleyman Demirel University, Faculty of Agriculture, Isparta, Turkey.
Quails were fed by launching feed containing 20% crude protein and 2900 kcal ME/kg energy for the first 2 weeks (prefeeding). The later 5 weeks, quails were fed by growing feed containing 20% crude protein, 2900 kcal ME/kg energy and 2% sunflower oil (S), olive oil (O), fish oil (F), linseed oil (L) and nettle oil (N). Treatments were applied under *ad libitum* feeding conditions.
The quails were slaughtered at the end of the seven weeks and carcasses were trimmed for breast meat (*Pectoralis major)* by removing skin, bones, and connective tissue. Breast meat samples within each group were vacuum packaged, and stored at -80°C pending further experimentation and analysis.

Analysis

pH measurements were carried out using Orion Model 420 digital pH meter (Orion, Boston, USA). The pH was determined after mixing a 10 g sample with 90 ml distilled water and equilibrating for 10 min. Moisture, protein, fat and ash of samples were determined according to procedures of AOAC (1995)and (AOAC, 2000). Colour measurement was taken with a Hunterlab model Precise Colour Reader TCR 200 (BAMR Ltd, Claremont, South Africa) colorimeter. Evaluation of oxidative stability was performed by measuring the formation of thiobarbituric acid reactive substances (TBARS). TBARS values of samples were determined according to Kilic and Richards (2003). Myoglobin, total iron content and fatty acid composition of samples were determined according to Topel (1949), EPA (2000) and Özer and Kiliç (2014).
The statistical evaluation of the results was performed using the SPSS 18.0.0 (SPSS Inc., Chicago, USA). The generated data were analysed by analysis of variance (ANOVA). Differences among mean values were established using the Duncan test and were considered significant when $P<0.05$.

RESULTS AND DISCUSSIONS

The proximate compositions of quail meat from are shown in Table 1. No significant differences for fat, protein and moisture levels, and colour values among treatment groups were determined.

Table 1. Proximate compositions of quail meats

Groups	Fat (%)	Protein (%)	Moisture (%)
S	5,03[a]	17,72[a]	72,16[a]
O	5,03[a]	18,05[a]	73,35[a]
F	5,02[a]	17,69[a]	73,54[a]
L	5,04[a]	18,10[a]	73,36[a]
N	5,04[a]	17,62[a]	72,41[a]
SEM	0,01	0,02	0,01

All values are the mean of three replicates, SEM: standard error of the mean
a, b (↓) Different letters within a column are significantly different.

TBARS and pH levels of quail meat are presented Figure 1. The results indicated that the meat samples obtained from quails fed with diet containing olive oil and nettle oil had the highest pH levels compared to other groups (P<0.05).

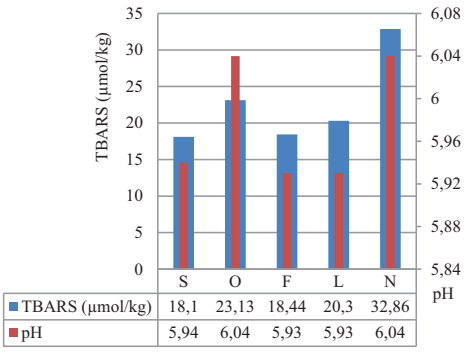

Figure 1. TBARS and pH levels of quail meats, All values are the mean of three replicates

As far as lipid oxidation is concerned, the highest TBARS values were found to be in meat samples obtained from quails received nettle oil (P<0.05). This observation could be related to PUFA and long fatty acid contents of meat. In a similar study, Barroeta (2007) indicated that chicken meat containing high PUFA is more the susceptibility of meat to oxidation.

Table 2. Myoglobin and total iron levels of quail meats

Groups	Total iron (mg/kg)	Myoglobin (mg/g)
S	128,2^{b}	1,70^{b}
O	131,3^{ab}	1,80^{ab}
F	129,3^{b}	1,93^{b}
L	117,4^{c}	1,19^{c}
N	116,4^{c}	1,21^{c}
SEM	0,11	0,06

All values are the mean of three replicates, SEM: standard error of the mean
a, b, c (↓) Different letters within a column are significantly different.

The lowest myoglobin and total iron levels were determined in meat samples obtained from quails received diet containing flax seed oil and nettle oil (P<0.05)
The fatty acid composition of quail meats is presented in Table 3. The results indicated that linoleic acid contents in the S and N group, oleic acid content of O group and linolenic acid content in the L group was higher compared with other groups.

Table 3. Fatty acid composition of quail meats

Fatty Acids	S	O	F	L	N
C10:0	0,47	0,29	0,68	0,27	0,37
C12:0	1,50	1,17	1,27	1,36	0,79
C16:0	19,89	17,25	22,26	16,50	17,70
C16:1	3,04	6,45	5,78	5,44	3,43
C18:0	20,04	19,27	18,01	19,09	21,68
C18:1	19,62	24,02	22,91	19,96	19,23
C18:2	22,60	19,89	17,90	20,20	25,16
C18:3	0,04	0,11	0,17	4,29	0,06
C20:0	11,53	10,22	5,85	9,21	11,52
C20:5(n-3)	0,10	0,01	1,26	0,98	0,04
C22:6 (n-3)	1,16	1,31	3,91	2,70	0,02
∑SFA	41,90	37,98	42,22	37,22	40,54
∑UFA	58,10	62,02	57,78	62,78	59,47
∑PUFA	35,43	31,55	29,09	37,39	36,81
PUFA/SFA	0,85	0,83	0,69	1,00	0,91

It was determined that the ratio of polyunsaturated fatty acids (PUFA) and saturated fatty acids (SFA) were higher than 0.4 and the highest PUFA/SFA ratio was found in the meat samples obtained from quails received flax seed oil in diet (P<0.05). Furthermore, quail meat obtained from quails fed with fish oil and flax seed oil had higher eicosapentaenoic acid (C20:5, n-3) and docosahexaenoic acid (C22:6, n-3) compared to other groups (p<0.05).

CONCLUSIONS

This study concluded that the use of sunflower oil, olive oil, fish oil, flax seed oil and nettle oil can be an effective strategy for modifying fatty acid composition, total iron and myoglobin content and susceptibility to oxidation of quail meat when incorporated in quail diet at the level of 2%.

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