MAS Journal of Applied Sciences
Uygulamalı Bilimler Dergisi
ISSN: 2757-5675
masjaps.com

OPEN ACCESS

DOI: http://dx.doi.org/10.5281/zenodo.8411240

Araştırma Makalesi / Research Article

Effects Of Turmeric Powder (*Curcuma longa* L.) As A Feed Additive On Slaughter Performance And Fatty Acid Profile In Japanese Quails

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Geliş Tarihi (Received): 13.06.2023 **Kabul Tarihi (Accepted)**: 28.07.2023

Abstract

This study aimed to investigate the impact of using Turmeric Powder (*Curcuma longa* L.) as a dietary supplement on slaughter performance and fatty acid profile in Japanese quails. To assess its effects, quails were fed diets containing various amounts of turmeric powder, a spice store commodity. The trial consisted of six repeated trials, where quails were divided into four experimental groups receiving diets supplemented with 0 g/kg (Control), 0.5 g/kg (T1), 2.5 g/kg (T2), and 5 g/kg (T3) of turmeric powder, respectively, for six weeks. At the end of the six-week feeding period, a total of 96 quails (24 per group, approximately equal to the group average) were selected for the study. Results showed a significant increase in wing weight and wing ratio in the T2 and T3 groups compared to the control group, while the thigh ratio was significantly lower in the T3 group. The T3 group exhibited the lowest saturated fatty acids (SFA) levels, whereas the T3 and T2 groups displayed the lowest monounsaturated fatty acids (MUFA) levels. All levels of turmeric supplementation led to a noteworthy increase in polyunsaturated fatty acids (PUFA) content. The lowest cholesterol content in breast meat was observed in the T3 group. In conclusion, the consumption of turmeric positively influenced the fatty acid profile of the breast meat, especially the incorporation of 5 g/kg turmeric resulted in reduced breast meat cholesterol content and improved product quality. This suggests that turmeric supplementation can enhance functional food production, contributing to human and animal health.

Keywords: Polyunsaturated fatty acids, meat quality, eicosenoic acid, linolenic acid, curcumin, feed additive

1. Introduction

Turmeric (*Curcuma longa* L.), derived from the rhizome of the *Curcuma longa* plant belonging to the Zingi Asteraceae family, is a tropical plant found in India and South Asia. It contains 80-95% curcuminoids, with curcumin being the compound responsible for its yellow colour. Curcumin, also known as turmeric or Indian saffron (Karaman and Köseler, 2017), is known for its various biological activities such as antioxidant, antimicrobial, antifungal, antimutagenic, and antidiabetic effects (Ürüşan and Bölükbaşı, 2020; Daily et al., 2016). Turmeric is rich in vitamins A, E, C, B1, B3, B9, and glutathione, and it contains significant amounts of phenolic and flavonoid compounds, making it a potent antioxidant plant (Çöteli and Karataş, 2017). The Oxygen Radical Absorption Capacity (ORAC) value, which indicates the antioxidant capacity of foods, is 44,776 in turmeric. With this value, turmeric ranks among the top spices with the highest antioxidant capacity (Karaman and Köseler, 2017). Turmeric increases the synthesis and release of beneficial bile acids in the liver, which enhances lipid digestion and absorption. It also stimulates the activities of lipase, amylase, and protease, enzymes responsible for accelerating digestion (Platel and Srinivasan, 2000). Furthermore, studies have reported that adding turmeric to the diet of chickens reduces the amount of saturated fatty acids (SFA) and increases the content of monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) in the thigh and breast meat (Khan et al., 2023). This study, aimed to determine the effects of adding different amounts of turmeric (0, 0.5, 2.5, and 5 g/kg) to the diets of Japanese quails for six weeks on carcass characteristics, breast meat fatty acid content, and cholesterol levels.

2. Materials and Methods

This research was conducted at the Poultry Unit of Siirt University Faculty of Veterinary Medicine, under the approval of the Siirt University Animal Experiments Ethics Committee (Approval No: 2021/04/29, Date: 26/11/2021). The study included a total of 96 quails, as presented in Table 1, with various group and feed characteristics. Japanese quails (*Coturnix coturnix japonica*) were divided into four main groups, each with six replications. The groups were fed experimental diets prepared by adding 0, 0.5, 2.5, and 5 g/kg of turmeric powder to commercial feed for six weeks. The commercial grower feed consisted mainly of corn, with wheat, wheat bran, full-fat soy, soybean meal, and meat and bone meal, containing 18.6% crude protein and 2756 kcal/kg metabolizable energy. Quails were provided with ad libitum access to feed and water throughout the study period. At the end of the study, 96 quails from each group were euthanized by cervical dislocation to determine carcass characteristics, breast meat fatty acid profiles, and breast meat cholesterol levels.

Table 1. Treatment groups Feedstuffs

Group	Group n	Slaughtered n	Feedstuffs
Control	6x20=120	24	Commercial broiler feed + 0 g/kg Turmeric
T1	6x20=120	24	Commercial broiler feed + 0.5 g/kg Turmeric
T2	6x20=120	24	Commercial broiler feed + 2.5 g/kg Turmeric
T3	6x20=120	24	Commercial broiler feed + 5 g/kg Turmeric

2.1 Carcass characteristics

Considering the average live weights of the Japanese quails at the end of the fattening period in each group, 24 quails per group, close to the group average, were selected for slaughter. Each of the selected quails was individually marked with a wing number. After slaughter, the weights of edible internal organs (heart, liver, gizzard) were recorded. For the second part of the slaughter process, eviscerated warm carcasses were kept at +4°C for 24 hours. Subsequently, the weights of eviscerated cold carcasses, wings, thighs, breast meat, neck and back were determined. Using these weight values, proportional (%) values were calculated as follows:

Wing ratio = (Wing weight / Eviscerated cold carcass weight) x 100

Thigh ratio = (Thigh weight / Eviscerated cold carcass weight) x 100

Breast ratio = (Breast weight / Eviscerated cold carcass weight) x 100

Neck + back ratio = (Neck + back weight / Eviscerated cold carcass weight) x 100

2.2 Fatty acid analysis and cholesterol analysis

For fatty acid composition analysis, approximately 100 g of breast meat was taken from the slaughtered animals and homogenized in a mixer. The meat samples were stored in a deep freezer at -18°C until analysis. The required fat for fatty acid composition analysis was extracted using the Folch method (Folch et al., 1957), and the fatty acid composition was determined using the TS EN ISO 12966-2 method. For cholesterol analysis, 2 grams of homogenized breast meat were weighed into a 15 ml test tube, containing 0.02 g of 5α-cholestan as an internal standard. Approximately 5 ml of methanolic KOH was added, and the tube was vortexed for 20 seconds. The test tube was placed in a water bath at 80°C for 15 minutes, with intermittent shaking for 5 seconds every 5 minutes. After cooling, about 1 ml of water and 5 ml of hexane were added to the tube and vortexed vigorously for 1 minute. The tube was then centrifuged at 7,000 rpm for 15 minutes, and the upper phase was collected for GC injection (Madzlan, 2008).

2.3 Statistical analysis

Statistical analysis of the data obtained in the study was performed using the One-way ANOVA test to determine whether there was a significant difference between the means of independent groups. The Duncan test, a multiple comparison test, was used to identify different groups and the significance of the differences. IBM SPSS Statistics 22 software package was utilized.

3. Results and Discussion

The slaughter characteristics of the quails are provided in Table 2, where it was determined that except for wing weight, wing ratio, and thigh ratio, different levels of turmeric supplementation did not significantly affect the characteristics ($P>0.05$). Wing weight and wing ratio were significantly higher in the T2 and T3 groups compared to the control group ($P<0.01$, $P<0.05$). The thigh ratio was significantly lower in the T1 group compared to the control and other groups ($P<0.05$). As seen in Table 2, heart weight, liver weight, gizzard weight, eviscerated cold carcass weight, breast weight, and neck + back weight increased numerically with the addition of turmeric, but these increases were statistically insignificant. Only the T2 group showed a numerical increase in thigh weight and breast ratio, which was also statistically insignificant. Some studies have reported that adding turmeric to diets does not affect the carcass characteristics of Japanese quails (Rasul et al., 2019; Kennedy et al., 2020). However, in another study, Khalil et al. (2022) found that adding 5 g/kg of turmeric to the diet improved carcass characteristics. Even when similar studies are conducted with the same plant or herb, different results can be obtained due to factors such as the region where the plant is grown, harvest time, plant part used, phenolic structure and concentration, storage conditions, product and oxidation conditions, and animal species (Malayoğlu, 2010). The fatty acid composition and cholesterol levels of quail breast meat are provided in Table 3. Different levels of turmeric supplementation resulted in significant increases in saturated fatty acids (SFAs) such as lauric acid, myristic acid, and pentadecanoic acid in the T2 group compared to the control and other turmeric groups (P<0.01; P<0.05). Monounsaturated fatty acids (MUFAs) such as oleic acid and eicosenoic acid were found to be significantly lower in the T1 and T2 groups (P<0.01; P<0.05). The levels of polyunsaturated fatty acids (PUFAs) such as linolenic acid and eicosatrienoic acid increased significantly in all three turmeric groups (T1, T2, and T3) (P<0.01; P<0.05).

Table 2. Results of Carcass Characteristics in Quails at the End of the Fattening Period

Group	Kontrol	T1	T2	T3	P Value
Heart Weight (g)	1.43±0.04	1.48±0.05	1.55±0.04	1.52±0.05	0.327
Liver Weight (g)	4.30±0.33	4.90±0.36	4.55±0.35	4.89±0.30	0.622
Gizzard Weight (g)	3.52±0.20	3.97±0.22	3.72±0.13	4.00±0.17	0.213
Carcass Part Weights and Ratios to Cold Carcass Weight, %					
Cold carcass (g)	113.48±2.27	118.11±3.10	116.69±2.10	120.53±3.53	0.355
Wing weight (g)	5.87±0.17c	6.31±0.16bc	6.53±0.18ab	6.85±0.22a	0.002
Leg weight (g)	26.05±0.52	26.18±0.71	26.19±0.53	27.77±0.84	0.212
Breast weight (g)	43.63±1.08	45.65±1.30	45.18±0.82	47.48±1.56	0.175
Back+neck weight (g)	36.93±0.90	38.46±1.13	37.96±0.84	37.41±1.12	0.731
Wing yield (%)	5.17±0.15b	5.34±0.12ab	6.00±0.11a	5.68±0.12a	0.025
Leg yield (%)	22.96±0.26a	22.17±0.24b	22.44±0.15ab	23.04±0.22a	0.013
Breast yield (%)	38.45±0.39	38.65±0.31	38.72±0.15	39.39±0.41	0.307
Back + neck yield (%)	32.54±0.48a	32.56±0.42a	32.53±0.38a	31.04±0.40b	0.029

SEM = Standard error of means; a,b = means with different superscripts on the same row differ (P<0.05) significantly

As a result, it was observed that adding 5 g/kg of turmeric to the diet reduced SFAs, while the levels of 0.5 and 2.5 g/kg of turmeric decreased MUFAs and all levels significantly increased PUFAs. Low lipid content and high PUFA concentrations are considered desirable nutritional attributes in animal products. The reduction in SFAs may be attributed to the lipid-lowering and lipolytic effects of medicinal plants, as suggested by Chithra and Leelamma (1999). The increase in PUFA content might be due to the antioxidant properties of turmeric, which block lipid peroxidation (Çöteli and Karataş, 2017). In contrast to the findings of this study, Ürüşan and Bölükbaşı (2020) reported in their study on broiler chickens that there was no significant change in SFA, MUFA, and PUFA. Similarly, Ashayerizadeh et al. (2023) stated that the addition of turmeric to quail diets decreased SFA and increased MUFA and PUFA. Khan et al. (2023) reported in their study that adding turmeric to broiler diets decreased SFA content in breast and thigh meat, while increasing MUFA and PUFA content, including linoleic (omega 6) and oleic acid (omega 9). In the current study, while the breast meat cholesterol levels in the T1 and T2 groups were similar to the control group, a significant decrease was observed in the T3 group (P<0.01).

Tablo 3. Fatty acid and Cholesterol values

Gruplar	Kontrol	T1	T2	T3	P Value
Lauric acid	0.0367±0.00b	0.0408±0.00b	0.0508±0.00a	0.0436±0.00ab	0.010
Tridecanoic acid	0.0908±0.01	0.0992±0.01	0.0900±0.02	0.0755±0.01	0.463
Miristic acid	0.4808±0.02b	0.4817±0.01b	0.5425±0.03a	0.4755±0.01b	0.052
Pentadecanoic acid	0.0625±0.01b	0.0775±0.01ab	0.0983±0.02a	0.0582±0.01b	0.029
Palmitic acid	21.1683±0.28	21.4908±0.18	21.7450±0.44	20.6882±0.18	0.084
Palmitoleic acid	5.7867±0.16	5.3200±0.15	5.4833±0.17	5.3400±0.13	0.139
heptadekanoic acid	0.1708±0.01	0.1808±0.01	0.1775±0.02	0.1855±0.01	0.784
heptadecenoic acid	0.0617±0.00	0.0517±0.00	0.0775±0.02	0.0600±0.00	0.496
Stearic acid	9.2533±0.28	9.6858±0.21	9.2333±0.24	8.9773±0.14	0.185
Oleic acid	30.7517±0.61a	28.9483±0.25b	29.0508±0.39b	30.4255±0.40a	0.007
Linoleic acid	24.6200±0.32	24.9358±0.11	25.3433±0.16	25.0882±0.19	0.117
Araşchidic Acid	0.2300±0.01	0.2175±0.01	0.2208±0.01	0.2382±0.01	0.098
Linolenic Acid	0.6775±0.03b	0.6850±0.01b	0.7258±0.01ab	0.7464±0.01a	0.013
Eicosenoic Acid	0.1692±0.01a	0.1475±0.01b	0.1450±0.01b	0.1782±0.01a	0.005
Eicosadienoic Acid	0.1758±0.01	0.1708±0.01	0.1658±0.01	0.1673±0.01	0.871
Behenic Acid	0.3342±0.02	0.2892±0.01	0.2900±0.02	0.3255±0.02	0.179
Eicosatrienoic Acid	4.7258±0.24b	6.0083±0.14a	5.5175±0.24a	5.6627±0.15a	0.001
Eicosapentaenoic Acid	0.0467±0.00	0.0525±0.00	0.0542±0.01	0.0673±0.01	0.057
Nervonic Acid	0.4550±0.03	0.4383±0.02	0.4075±0.03	0.4909±0.03	0.136
Docosahexaenoic Acid	0.6042±0.05	0.6792±0.05	0.5500±0.04	0.7045±0.03	0.078
SFA	31.8275±0.50ab	32.5613±0.17a	32.4483±0.45a	31.0042±0.16b	0.013
MUFA	37.2242±0.65a	34.9046±0.33b	35.1642±0.42b	36.6333±0.34a	0.001
PUFA	30.8500±0.45b	32.5300±0.25a	32.3567±0.35a	32.3600±0.20a	0.002
Cholesterol	37.4730±1.84ab	44.2912±3.40a	42.6380±3.55a	31.0559±1.52b	0.006

SEM = Standard error of means; a,b = means with different superscripts on the same row differ ($P<0.01$) significantly

4. Conclusion

Based on the results of this study, it can be concluded that the addition of different levels of turmeric to the diet did not significantly affect most characteristics except for wing weight, wing ratio, and thigh ratio. Additionally, there seemed to be partial improvements in carcass characteristics in the T2 and T3 groups compared to the control group and the T1 group. The addition of turmeric at different levels to the diet was observed to significantly increase the amounts of PUFAs such as linolenic and eicosatrienoic acids, thus enhancing the PUFA content of quail breast meat. Consequently, it is concluded that adding turmeric to the diet increases the content of polyunsaturated fatty acids, thereby improving meat quality, and it can be used as a dietary supplement in quail feed.

Declaration of Author Contributions

The authors declare that they have contributed equally to the article. All authors declare that they have seen/read and approved the final version of the article ready for publication.

Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

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To Cite: Özcan, C., Çimrin, T., Yakar, Y., Alaşahan, S., 2023. Effects Of Turmeric Powder (*Curcuma longa* L.) As A Feed Additive On Slaughter Performance And Fatty Acid Profile In Japanese Quails. *MAS Journal of Applied Sciences*, 8(4): 839–844.
DOI: http://dx.doi.org/10.5281/zenodo.8411240.