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Original Article

# The Effect of Turmeric (*Curcuma domestica*) And Papaya Leaves (*Carica papaya L.*) As Feed Additives on Yolk Color and Yolk Index of Quail Eggs (*Cortunix-cortunix japonica*)

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## ABSTRACT

The objective of this research was to investigate the effects of turmeric (Curcuma domestica) and papaya leaves (Carica papaya L.) on the yolk color and yolk index of quail eggs (Coturnix coturnix japonica). A total of 24 laying quails were divided into four treatment groups: P0 (standard feed), P1 (feed supplemented with 0.6% turmeric), P2 (feed supplemented with 0.25% papaya leaves), and P3 (feed supplemented with 0.6% turmeric and 0.25% papaya leaves). Yolk color and yolk index measurements were conducted by breaking open the eggs. The yolk color was assessed by comparing the egg yolk with a standardized yolk color fan to identify the closest match. The yolk index was determined by measuring the width of the yolk with calipers and the height of the yolk using a micrometer tripod. Analysis of variance (ANOVA) revealed significant differences among the treatment groups ($p < 0.05$). The effects of turmeric (Curcuma domestica) and papaya leaves (Carica papaya L.) significantly increased the yolk color and yolk index of quail eggs (Coturnix coturnix japonica).

Keywords: turmeric, papaya leaves, quail egg, yolk color, yolk index

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## Introduction

Quail eggs are a nutritious and considered economical source of animal protein that can help combat malnutrition in various communities. Their rich nutritional profile, including essential amino acids, vitamins, and minerals, makes them a valuable addition to diets. (Jeke *et al.*, 2018; Saeed *et al.*, 2025).

Eggs, including those from Quails are recognized for their comprehensive nutritional profile. They are rich in high-quality proteins which are evenly distributed between the egg white and yolk (Tarhan *et al.*, 2020). The yolk contains essential fatty acids, including monounsaturated and polyunsaturated fats (Bondoc *et al.*, 2023). Eggs are a significant source of vitamins such as A, D, E, K, B12, and choline. They also provide essential minerals like selenium, iron, phosphorus, and calcium (Fernandez & Andersen, 2015; Rakonjac *et al.*, 2024).

In Indonesia, Quail farming is recognized for its high egg production rates. Quails can produce approximately 250-300 eggs per bird annually and begin egg production at around 40


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days of age, which is a substantial output and also notably early compared to other poultry species. This early maturity allows for quicker turnover and more efficient production cycles, making quail farming a viable option for rapid protein supply (Indrayani *et al.*, 2019; Kostarev *et al.*, 2022; Batool *et al.*, 2023).

The yolk index is one of the quality factors of egg measured by the height and diameter of the egg yolk (Ayalew *et al.*, 2024). Haugh unit, albumen index and yolk index significantly influenced by storage time, storage conditions, and feed composition. Proper storage at lower temperatures and careful selection of dietary protein sources can help maintain egg quality over time. (Saleh *et al.*, 2020; Kryeziu *et al.*, 2024; Wang *et al.*, 2015).

Egg yolk color is a significant factor in consumer perception of egg quality, and several factors influence it, including diet, genetics, and environmental conditions (Rodriguez-Hernandez *et al.*, 2024, Zurak *et al.*, 2022). The yolk color fan, specifically the Roche Yolk Color Fan (RYCF), is a widely used method for assessing the color of egg yolks. This method involves visually comparing the yolk color to a standardized set of color strips, each assigned a specific score ranging from 1 (pale) to 15 (intense) (Sanchez-Rodriguez *et al.*, 2023).

The primary pigments responsible for yolk color are carotenoids, which hens obtain from their diet. The ratio of yellow and red carotenoids is crucial for achieving the desired yolk color (Zurak *et al.*, 2022).

Feed additives are ingredients mixed into livestock feed to enhance nutritional status, health, and productivity. These additives can include enzymes, probiotics, prebiotics, herbs, and organic compounds, which have been shown to improve feed digestibility, production performance, and animal health (Yusriani *et al.*, 2025; Alagawany *et al.*, 2024; Liu *et al.*, 2025; Alem, 2024). Various researches were developed to find safer additional feedstuffs, among others using natural herbal ingredients such as turmeric (*Curcuma domestica*) and papaya leaves (*Carica papaya* L.).

Turmeric has been shown to significantly enhance the yolk color of quail eggs. Studies indicate that turmeric supplementation in quail diets leads to a noticeable improvement in yolk pigmentation (Suwarta *et al.*, 2019; Silva *et al.*, 2018; Hanif *et al.*, 2023). Specifically, turmeric powder at various inclusion levels (0.5% to 2%) in sorghum-based diets resulted in significantly different yolk colors compared to control diets (Silva *et al.*, 2018). Additionally, a meta-analysis of turmeric powder supplementation in laying hens demonstrated a substantial increase in yolk color (SMD = 2.06; 95% CI: 1.32 to 2.80) (Hanif *et al.*, 2023). While turmeric improves yolk color, its effect on the yolk index is less clear. One study reported no significant impact on the internal quality of eggs, including the yolk index, when turmeric was added to the diet (Silva *et al.*, 2018).

Papaya leaves have been traditionally used to enhance appetite. This is supported by empirical evidence and traditional practices (Nugrahaningsih *et al.*, 2019; Das and Prasad, 2024). Papaya leaf extract has been shown to improve various aspects of egg quality. Papaya leaves are rich in xanthophylls and beta-carotene, which are beneficial for egg production. These carotenoids, including lutein and zeaxanthin, are deposited in egg yolks, enhancing their color and nutritional value (Kavtarashvili *et al.*, 2019; Surai and Kochish, 2020; Titcomb *et al.*, 2019). Beta-carotene in papaya leaves is a precursor to vitamin A, it improves yolk color and has antioxidant properties (Kavtarashvili *et al.*, 2019; Liu *et al.*, 2012; Surai and Kochish, 2020). The addition of papaya leaf extract to chicken feed enhances the yolk color index, making the eggs more appealing to consumers (Kavtarashvili *et al.*, 2019; Liu *et al.*, 2012; Mihrani *et al.*, 2023). The yolk index, which measures the height and diameter of the yolk, is improved with the inclusion of papaya leaf extract in the diet (Mihrani *et al.*, 2023; Lai *et al.*, 2020).

## Materials and methods

### *Research design*

The research subjects in this study consisted of 24 healthy, 18-week-old female quails (*Coturnix coturnix japonica*). The quails

were divided into four groups, each receiving different daily feed treatments. Each group consisted of six replicates.

The research design that used is factorial randomized design that consists of 4 treatments. It was conducted in Dusun Plosowesi, Desa Plosogeneng, Kecamatan Jombang, Kabupaten Jombang, Jawa Timur. The examination of egg yolk color and yolk index took place at the Veterinary Public Health Laboratory, Faculty of Veterinary Medicine, Airlangga University, Surabaya.

***Treatment***

P0 (control): 20 grams of standard feed
P1: standard feed + 0.6% turmeric (20 g standard feed + 1.2 g turmeric)
P2: standard feed + 0.25% papaya leaves (20 g standard feed + 0.05 g papaya leaves)
P3: standard feed + 0.6% turmeric + 0.25% papaya leaves (20 g standard feed + 1.2 g turmeric + 0.05 g papaya leaves).

***Preparation of feed making***

The feed additives used were turmeric (*Curcuma domestica*) and papaya leaves (*Carica papaya* L.) in powdered form. Both the turmeric and papaya leaves were washed, sliced, and sun-dried for 3–4 days until completely dry, then ground into powder and mixed with the feed. The quail feed used was a layer-phase ration (PP3) produced by PT Wonokoyo Jaya Corporindo.

***Adaptation Period***

The quails underwent a one-week adaptation period before the feed treatments were administered, which lasted for four weeks. During this treatment period, eggs were collected daily.

***Yolk Color and Yolk Index Measurement***

The egg yolk index is defined as the ratio of yolk height to yolk diameter. Measurements of yolk color and yolk index were obtained by breaking the eggs. Yolk color was assessed by comparing the egg yolk's color with the Roche Yolk Color Fan to identify the closest match. The yolk index was calculated by measuring the yolk's diameter with calipers and its height using a micrometer tripod.

***Data analysis***

Collection data of yolk color and yolk index of egg were tested by Analysis of Variant (ANOVA) on levels of significances 5%. If there any significance differences that real among treatment, it continued to Duncan Multiple Range Test. Analysis of Variant (ANOVA) and Duncan Multiple Range Test are facilities by SPSS (Statistical Program for Solution Service) version 20 for windows.

**Result**

***Yolk color value***

The measurement of yolk color was conducted to assess the effect of dietary supplementation with turmeric and papaya leaf powder. The results, presented in Table 1, show the mean and standard deviation of yolk color values across the different treatment groups. The control group (P0) had a mean yolk color score $6{,}20^{a} \pm 0{,}06$, while the treatment groups P1, P2, and P3 showed increased yolk color values of $7{,}28^{b} \pm 0{,}08$, $7{,}41^{c} \pm 0{,}15$, and $7{,}58^{d} \pm 0{,}09$, respectively. These results suggest an enhancement in yolk pigmentation due to the supplementation of turmeric and papaya leaf powder in the feed. It is important to note that treatments sharing the same superscript indicate no statistically significant differences ($p<0.05$) among them.

**Table 1.** The mean and standard deviation measurements on yolk color of quail egg which received turmeric and papaya leaf powder in feed

| Treatment | Yolk Color Of Quail Egg (X ± SD) |
|---|---|
| **P0** | $6{,}20^{a} \pm 0{,}06$ |
| **P1** | $7{,}28^{b} \pm 0{,}08$ |
| **P2** | $7{,}41^{c} \pm 0{,}15$ |
| **P3** | $7{,}58^{d} \pm 0{,}09$ |

Note: Different superscripts ($^{abcd}$) in the same column indicate a significant difference ($p<0.05$).

Based on the ANOVA test results for

yolk color of quail eggs, there were statistically significant differences among the treatment groups ($p<0.05$). Further analysis using Duncan's multiple range test revealed that the control group (P0) was significantly different from all treatment groups (P1, P2, and P3), indicating a notable effect of turmeric and papaya leaf powder supplementation on yolk color. Additionally, P1 was significantly different from P2 and P3, while P2 also showed significant differences from both P1 and P3. These findings confirm that each level of supplementation had a distinct impact on yolk pigmentation.

***Yolk index value***

The measurement of yolk index in quail eggs fed with turmeric and papaya leaf powder is presented in Table 2. The data show the mean and standard deviation values for each treatment group. The control group (P0) had a yolk index of $0,31^{a} \pm 0,01$, while the treatment groups P1, P2, and P3 recorded higher yolk index values of $0,33^{b} \pm 0,01$, $0,34^{c} \pm 0,01$, and $0,35^{d} \pm 0,01$, respectively.

**Table 2.** The mean and standard deviation measurements on yolk index of quail egg which received turmeric and papaya leaf powder in feed

| Treatment | Yolk Index of Quail Egg (X ± SD) |
|---|---|
| **P0** | $0,31^{a} \pm 0,01$ |
| **P1** | $0,33^{b} \pm 0,01$ |
| **P2** | $0,34^{c} \pm 0,01$ |
| **P3** | $0,35^{d} \pm 0,01$ |

Note: Different superscripts ($^{abcd}$) in the same column indicate a significant difference ($p<0.05$).

Statistical analysis using ANOVA indicated significant differences among the treatment groups ($p<0.05$). Further comparison using Duncan's multiple range test revealed that P0 was significantly different from P1, P2, and P3, demonstrating that supplementation influenced yolk index. Additionally, P1 was significantly different from P2 and P3, whereas P2 and P3 did not differ significantly from each other. These findings indicate that although higher levels of turmeric and papaya leaf powder enhanced the yolk index, the improvement leveled off between the P2 and P3 groups.

**Discussion**

The study investigated the effects of turmeric and papaya leaf as feed additives on the yolk color and yolk index of quail eggs. The results indicated that different treatment groups with varying amounts of turmeric and papaya leaves had significant effects on both yolk color and yolk index ($p < 0.05$). The addition of turmeric and papaya leaves to quail feed notably enhanced the yolk color and yolk index. A significant improvement in yolk color and yolk index of quail eggs was observed in treatment group P3, which utilized 0.6% turmeric and 0.25% papaya leaves.

***Yolk Color***

The control group (P0) had a mean yolk color score of 6.20, while the treatment groups (P1, P2, and P3) exhibited progressively higher scores (7.28, 7.41, and 7.58, respectively). This indicates a clear trend where dietary supplementation with turmeric and papaya leaf powder positively influences yolk color.

The primary determinant of yolk color is the xanthophyll (plant pigment) content in the diet consumed by the hens. This aligns with the assertion that nutritional factors play a significant role in determining yolk color. The main contributors to yolk pigmentation are carotenoids found in the hen's diet. These include both yellow and red carotenoid pigments, which are crucial for achieving the desired yolk color. Hens cannot synthesize carotenoids de novo and rely entirely on their dietary intake (Zurak, 2022).

The use of turmeric and papaya leaves to enhance the yolk color of quail eggs is supported by several studies focusing on the effects of curcumin and β-carotene, the active compounds in turmeric and papaya leaves, respectively. Curcumin, the primary active compound in turmeric, has been shown to improve yolk color in various studies. For instance, supplementation with curcumin at 200 mg/kg in the diet of laying hens significantly improved yolk color, along with other egg quality parameters such as

albumen height and eggshell thickness (Li *et al.*, 2024). Another study demonstrated that curcumin supplementation in quail diets improved the brightness and yellowness of the yolk color, indicating a positive effect on yolk pigmentation (Marchiori *et al.*, 2019).

Papaya leaves are rich in β-carotene, a precursor to vitamin A and a natural xanthophyll that contributes to the yellow-orange pigmentation in egg yolks. Carotenoids like β-carotene are known to be deposited in the egg yolk, enhancing its color. While specific studies on papaya leaves in quail diets are limited, the general role of β-carotene in yolk pigmentation is well-documented. Carotenoids from various sources, including vegetables and fruits, have been shown to improve yolk color in laying hens (Nour *et al.*, 2017).

The enhancement of yolk color is often associated with higher nutritional quality, as deeper yolk colors can indicate higher levels of carotenoids, which are beneficial for health. This could suggest that the inclusion of turmeric and papaya leaf powder in the diet of poultry may not only improve the aesthetic quality of the eggs but also their nutritional value. The ability to manipulate egg yolk color is indeed advantageous for meeting market demands.

***Yolk index***

The yolk index is a measure of the quality of the yolk, reflecting its viscosity and overall healthiness. A higher yolk index indicates a firmer yolk, which is often associated with better nutritional quality and freshness. The control group (P0) had a yolk index of 0.31, while the treatment groups (P1, P2, and P3) showed increased values (0.33, 0.34, and 0.35, respectively). This trend suggests that dietary supplementation positively affects yolk quality.

The interior characteristics of eggs, including the yolk index, Haugh Unit, and chemical composition, are vital for the egg product industry (Caner *et al.*, 2025). These parameters are influenced by various factors such as storage conditions, hen strain and age, and nutritional factors (Robert, 2004; Al-Obaidi *et al.*, 2020).

Supplementation with turmeric powder has been shown to affect yolk characteristics. Specifically, turmeric powder supplementation at various levels (0.25%, 0.5%, and 0.75%) has been associated with changes in yolk height and diameter (Mosayyeb Zadeh *et al.*, 2023, Hanif *et al.*, 2025; Ribeiro *et al.*, 2021).

Turmeric supplementation has been shown to increase egg production, egg weight, and egg mass in laying hens. Additionally, turmeric improved egg thickness and Haugh unit, which are indicators of egg quality (Fawaz *et al.*, 2023, Hanif *et al.*, 2023).

Papaya leaves are known for their various health benefits and applications, particularly in digestion and egg quality enhancement. Papaya leaves are rich in antioxidants and minerals such as potassium, calcium, magnesium, sodium, and iron, which contribute to their health-promoting properties (Choudhary *et al.*, 2025) Papaya peel powder supplementation in the diet of laying hens has been shown to improve yolk color and Haugh unit (Seriba *et al.*, 2020).

The improvement in yolk index values may imply enhanced nutritional quality of the eggs. A firmer yolk is often preferred by consumers and can indicate higher levels of proteins and other nutrients. This could make the eggs more appealing in the market, potentially leading to better consumer acceptance and higher sales. The results indicate that dietary supplementation with turmeric and papaya leaf powder significantly enhances the yolk index in quail eggs, suggesting improvements in egg quality. This has potential implications for both poultry farming practices and consumer health, warranting further investigation into the benefits and mechanisms of these dietary interventions.

## Conclusion

This study demonstrates that the addition of turmeric powder (0.6%) and papaya leaf powder (0.25%) to quail feed has a significant positive effect on both yolk color and yolk index in *Coturnix-coturnix japonica*. The enhancement in yolk pigmentation and yolk quality suggests that this combination of natural additives can serve as an effective dietary supplement to

improve the nutritional and visual quality of quail eggs. These findings highlight the potential of turmeric and papaya leaf powders as natural feed enhancers in poultry production.

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