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# Poultry feed fortified with moringa leaves and tumeric leaves to produce functional eggs: a review

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**Abstract** - Human population is growing every day, and their diets often contain far less protein per day than is advised. The poultry business has faced difficulties, particularly in the tropics and in developing countries, due to the shortage and high price of poultry feeds, which make up 60–80 percent of the total cost of poultry products. This reflects both the relatively low cost and the customer's need for these high-quality and secure items. Eggs are one of the high food's proteins. One of the advantages of egg protein compared to other animal protein its high digestibility, meaning every gram protein that enters will be digested in the body perfectly. A typical strategy to prevent these negative effects is to increase the intrinsic antioxidant content by the dietary insertion of natural antioxidants, such as feed fortification with a combination of moringa leaves and turmeric leaves. Nowadays, Moringa oleifera has mostly been employed on farm animals to improve their well-being and productivity. Because moringa leaves have well-established health benefits, they are frequently utilized as functional ingredients in chicken feed., the production of eggs that were higher in carotene and lower in cholesterol than the control eggs due to favourable impacts on the health of the hens and the quality of their eggs Turmeric, a plant with several medicinal use, belongs to the Zingiberaceae family and is known under the name Curcuma. Numerous research has documented the medicinal benefits of turmeric, notably its antioxidant properties. This review's objective was to analyse the antioxidant activity and cholesterol-lowering effects of functional eggs made with fortified moringa leaves and turmeric.

**Keywords:** antioxidant, cholesterol lowering effect, feed fortification, functional egg production, poultry

## 1 Introduction

Consuming a wide variety of nutrient-dense foods is important to ensure a well-balanced and healthy diet that promotes health, growth, and development. A healthy diet should include fresh fruits and raw vegetables as snacks instead of sugary snacks. The exact make-up of a healthy diet will vary depending on individual characteristics, cultural context, locally available foods, and dietary customs. However, a healthy diet should include a wide variety of nutritious foods, enough kilojoules for energy, carbohydrates as the preferred source, essential fatty acids, adequate protein, fat-soluble and water-soluble vitamins, essential minerals, and foods containing plant-derived phytochemicals. It is

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important to avoid overly processed products that contain bleached, white flour, and foods with added sugar [1]. There is a growing demand for functional and enriched foods that provide various beneficial effects in addition to the essential nutritive and non-nutritive compounds important to human health [2].

The occurrence of an increase in cholesterol levels in the body plays a role in the development of free radicals that exceed the body's antioxidant capacity, leading to an increased risk of various diseases such as cancer, diabetes, and heart disease. As the prevalence of degenerative diseases increases, the consumption of foods high in antioxidants and low in cholesterol becomes a necessity for every individual. Free radicals and oxidative stress are known to be detrimental to human health, causing damage to cells and genetic material. The body generates free radicals during the process of turning food into energy, and they can also be formed after exercising or exposure to cigarette smoke, air pollution, and sunlight. A diet low in saturated fats and high in fiber and plant foods can substantially reduce the risk of developing heart disease. Excessive consumption of saturated fat or trans-fat increases the risk of heart disease and other chronic diseases [3].

Additives to animal feed are compounds that are intended to improve the quality and/or performance of food [4]. Herb additives, which are phytogenic and plant-derived medicinal compounds, have been found to be a possible replacement for antibiotics that promote growth [5]. The application of herbal supplements in poultry feed can provide a natural alternative to antibiotics and help to improve the overall health and productivity of birds. In addition, the addition of probiotics to poultry feed has been shown to improve the production of eggs in chickens [6]. Moringa is a plant that can tolerate severe dry and cold conditions and grows on a large scale. All parts of the plant can be used for commercial or nutritional purposes and have a favourable nutritional profile. Plant leaves can be used to treat malnutrition because they are a rich source of vitamins, minerals, and useful phytochemicals. Moringa leaf extracts have anti-inflammatory, antibacterial, anti-inflammatory, antioxidant, and anti-cancer effects. Growth-promoting antibiotics can be replaced by moringa, and probiotics added to poultry feed can improve the quality of chicken eggs produced. [7].

The phytoestrogens found in turmeric can influence the hypothalamic-hypophyseal-ovarian axis and interact with the endocrine system. Estrogen is essential for the growth of follicles in ducks. Cholesterol and other yolk components are widely distributed in the follicles that grow in numerous of them, ultimately reducing the amount of cholesterol in the eggs that are produced. The phytoestrogen in turmeric can affect estrogen levels in ducks, which can affect follicle development and cholesterol concentrations in eggs. The use of turmeric as a food additive in poultry foods has been studied and has been shown to have potential health benefits, including antioxidant, anti-inflammatory, and antimicrobial properties [8, 9]. However, the use of turmeric in poultry feed should be carefully monitored to avoid any adverse effects on poultry health and productivity.

Limited studies have been carried out on the supplementation of Moringa leaves and turmeric in poultry diet, focusing mainly on egg quality and the fatty acid composition of the eggs. The addition of turmeric and Moringa leaves extract to poultry feeding is assumed to increase egg production and egg quality. However, the use of these supplements in poultry feed should be carefully monitored to avoid any negative effects on bird health and productivity.

## 2 Materials and methods

The literature review is the methodology used to write this article. Library sources come from scientific articles and supporting papers from the internet. The literature search was carried out online using the journal provider website registered on Google scholar in the form of electronic journals.

## 3 Results and discussion

The aim of the study was to determine the effects of Moringa oleifera on the performance, mineral contents, cholesterol, and β-carotene levels of laying hens. Two hundred and forty homogeneously weighted, healthy laying hens were used in the study in a completely randomized design with four treatments and six replications. The study's findings demonstrated that providing powdered moringa leaves significantly increased egg production, mass, feed efficiency, yolk colour, shell thickness, and the amount of β-carotene and magnesium in the yolk. On the other hand, feed consumption efficiency was unaffected. Meals with 2-6% Moringa leaf powder had significantly lower yolk cholesterol levels. The results of the study showed that laying hens' egg production, egg mass, feed efficiency, yolk color, shell thickness, and yolk contents of calcium, magnesium, and β-carotene were all improved when 4-6% Moringa leaf powder was added to their meals. On the other hand, it decreased yolk cholesterol levels [10].

The addition of turmeric had varying effects on the fatty acid composition of the eggs, egg production, and egg quality. Turmeric supplementation improved the amount, quality, or content of unsaturated fatty acids in the eggs. According to the study, supplementing a duck's diet with probiotics and turmeric at 2% and 4% can increase both the number and caliber of eggs the ducks lay [9,11]

Elkhair et. al [12] examined the effects of supplementing with Moringa oleifera seed powder on heat-stressed Japanese laying quail. The discoveries showed that adding 0.3% of Moringa seed powder to quail meal extensively expanded the birds' flexibility to warm pressure. The supplementation of Moringa seed powder further developed egg quality. The reproductive pattern-related mRNA expressions of ESR2, FSHR, and STAR were significantly increased in the group that received 0.3 percent Moringa seed powder as a supplement. By incorporating Moringa oleifera seed powder into the diet of Japanese laying quail, egg quality and their ability to withstand heat stress can both be improved.

In a different study on quail, the performance and quality of eggs were examined in relation to a cinnamon and turmeric powder mixture. According to the study (Fawaz et al., 2022), adding the mixture to the diet increased the weight, thickness, and color of the eggs. The impacts of enhancing with turmeric powder on the performance, blood biochemical boundaries, and egg quality boundaries of laying hens were analyzed in another examination. According to the study, taking turmeric powder at doses of 0.25 percent and 0.5 percent could lower blood triglycerides and increase blood antioxidant activity. Then again, in common natural circumstances, it could lessen laying hen efficiency [11]. Turmeric contains phytoestrogens that can animate egg creation and egg weight in laying hens [12].

The leaves of Moringa oleifera trees contain countless tannins, as well as specific enemy of supplement parts and a high convergence of dry matter (DM) and rough protein (CP) (251 g/kg). For ruminants as well as non-ruminants, this makes the plant an incredible stockpile of protein. The dietary substance of M. oleifera seeds and leaves was examined by the Relationship of True Scientific Physicists [13], and the discoveries are displayed in Table 1. As per Gurnani et al. [14] how much all out flavonoids and complete phenolic intensifies in the M. oleifera seed and leaf blend was determined.

Lipid oxidation can be prevented by the active ingredient in this plant, which has antioxidant activity. The liquid chromatography-mass spectrometry (LC-MS) analysis results, also known as the mass spectrometry chromatography, were obtained from a sample of 49 students. The highest percentage of phenolic and phenolic compounds in curcumin ($C_{21}H_{20}O_6$) is 7.798%; on the contrary, the highest percentage of phenolic and flavonoid compounds found in curcumin derivatives, namely Dimethoxy-curcumin ($C_{20}H_{18}O_5$) and Bisdemethoxy-curcumin ($C_{19}H_{16}O_4$) were 2.277% and 4.115% respectively [15].

**Table 1.** *M. oleifera* seeds and leaves subjected to a determined analysis

| Products (g/kg) | DM | Ash Content | CP | Ether Extract | CF |
|---|---|---|---|---|---|
| Sprouts | 965 | 33.9 | 395.8 | 394 | 46 |
| Foliage | 934 | 137.5 | 270.1 | 62 | 215 |
| Total phenolic and total flavonoid content of the seed and leaf combination | | | | | |
| Whole phenolics (mg GAE/g) 65.24 | | | | | |
| Flavonoids content (mg QE/g) 17.58 | | | | | |

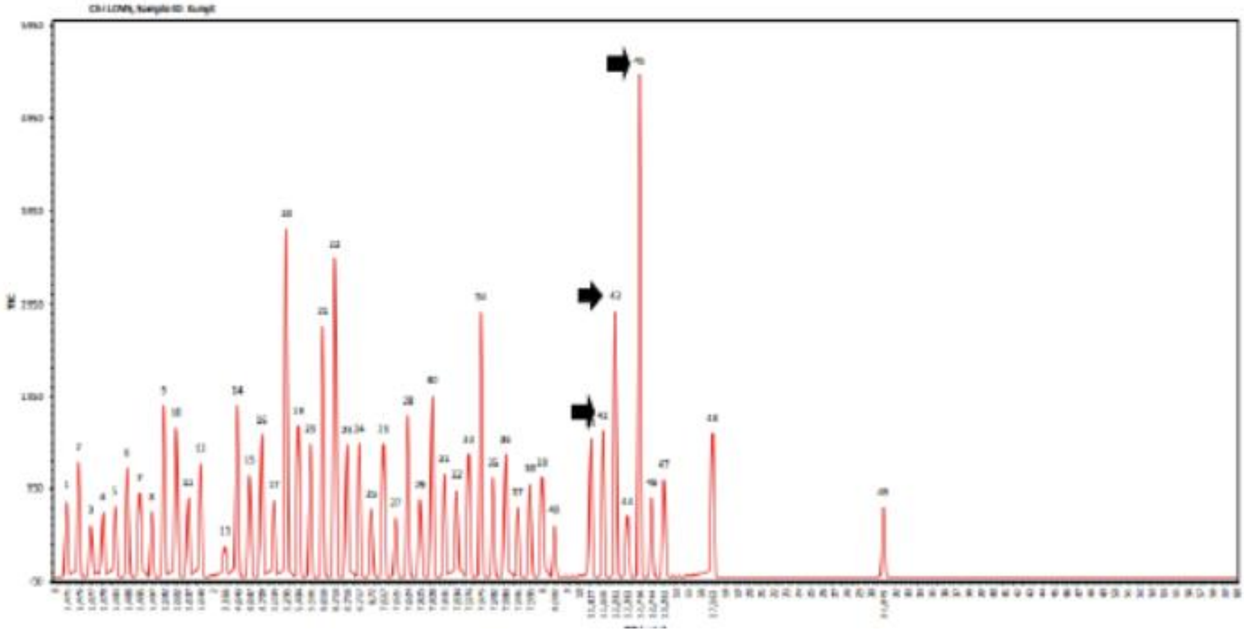

**Fig. 1.** The results of the LC-MS analysis are consistent with the main contents, which are curcumin with the number 45, desmethoxycurcumin (43), and bis desmethoxycurcumin (42) as shown on the table.

PASS software is used to analyse the powdered chemical composition of turmeric rhizomes, which may have antioxidant potential based on probability activity values (Pa score). Eleven compounds—Ascorbic acid, Quercetin, β Carotene, Arabinose, Bis-Desmethoxycurcumin, Desmethoxycurcumin, Curcumin, Caffeic acid, Cinnamic acid, Letestuianin A, and Calebin A—have a Pa value > 0.3, according to the prediction service. Compounds with a Pa value greater than 0.3 are considered to have biological actions within the body, including in this instance, potential as an antioxidant is implied.

Ashour et al. [16] stated that M. oleifera's impacts on production performance are displayed in Table 2. Egg weight, feed conversion ratio, and feed intake were not impacted by the quantity of dietary moringa leaves, seeds, or their combination. But as compared to the other groups, MS dramatically boosted egg production and egg mass. Egg weight and feed conversion in Vanaraja laying hens were not considerably impacted by the addition of M. oleifera leaf meal at 1%–2% of the base diet [17]. This contradicts the findings of Olugbemi et al. [18], who discovered that substituting 20% of the meal from moringa leaves for sunflower seeds in the diets of chicken layer birds resulted in a notable drop in the number of eggs produced and their overall weight. When fed a diet that included 5% M. oleifera seed meal, Japanese quails [19] observed that the birds' feed consumption decreased as compared to the control group. Previous study authors believed that ML up to 10% will not adversely affect the number of eggs produced by laying birds. [18]. But adding more ML than 10% might be harmful since it raises the antinutritional factor content, increases dustiness, and decreases protein and energy digestion.

**Table 2.** The impact of nutritional interventions on the production performance of laying Japanese quails

| Products | Control | MS | ML | MSL | SEM | P Value |
|---|---|---|---|---|---|---|
| Meal Consumption (g/d/bird) | 33.54 | 33.23 | 33.09 | 33.67 | 0.10 | 0.14 |
| Feed conversion ratio (g/g) | 3.18 | 2.83 | 3.20 | 3.02 | 0.20 | 0.07 |
| Egg production (%) | 78.95bc | 83.41a | 76.93c | $81.73^{ab}$ | 0.88 | 0.01 |
| Egg weight (g) | 13.39 | 14.07 | 13.50 | 13.63 | 0.16 | 0.49 |
| Egg mass (g/day/bird) | 10.57b | 11.74a | 10.38b | 11.14ab | 0.06 | 0.03 |

The baseline diet served as the control; MS, ML, and MSL fed 1 g of Moringa seeds and 1 g of leaves per kg of body weight, respectively. The standard error mean is SEM. a–d: Means in the same row that have a similar superscript letter or no superscript letter after them do not differ substantially ($p < 0.05$).

Table 3 illustrates the primary impacts of CPL and TRP supplementation on productive performance. The result demonstrated that TRP supplementation had not significantly (P>0.05) effect on quail productivity. HDP and FCR were significantly (P<0.05) impacted by crude protein level. The HDP of quails fed meals containing 24 and 21% crude protein was higher (P<005) than that of quails fed diets containing 18% CPL. A crude protein level of 24% produced the greatest FCR, a CPL of 18% produced the lowest, and a level of 21% produced the intermediate FCR. While CPL had a substantial influence (P<0.05), TRP supplementation had no significant effect (P>0.05) on the cost of feed per kilogramme of eggs. When quails were fed an 18% CPL diet as opposed to diets containing 21 and 24 percent CPL, the feed cost per kilogramme of eggs was higher (P<0.05) for the former group. Income increased when 21 and 24% CPL foods were used rather than an 18% CPL diet (P<0.05) when feeding quails, although TRP addition did not significantly affect revenue (P>0.05). (Odunsi et al., 2023). Foods containing 24 and 21% CP elevated HDP more than diets containing 18% CP, according to the major relationship between CP and TRP and productive performance response. This suggests that HDP was significantly impacted by differences in protein levels. Japanese quails fed meals containing 20 and 25% CP lay more eggs and had more HDP than quails fed diets containing 15% CP, according to Muhammad et al.'s research [21] results (Ri et al., 2005) [22]

**Table 3.** Primary of CPL and Supplementation with Turmeric Powder on Japanese Quail Productivity

| Parameters | TRP | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **without** | **with** | **p.value** | **SEM** | **24CPL** | **21CPL** | **18CPL** | **p.value** | **SEM** |
| Hen day | 75.38 | 76.26 | 0.385 | 0.70 | 77.78 | 77.47 | 72.21 | 0.000 | 0.86 |
| Feed intake (g/d) | 29.19 | 29.67 | 0.574 | 0.59 | 28.75 | 29.84 | 29.70 | 0.524 | 0.73 |
| Initial weight (g) | 152.40 | 153.60 | 0.331 | 77.28 | 153.10 | 151.90 | 154.2 | 0.391 | 94.65 |
| Final weight (g) | 191.60 | 191.40 | 0.749 | 1.18 | 192.30 | 192.20 | 190.6 | 0.697 | 1.44 |
| Weight gain (g/d) | 0.56 | 0.54 | 0.623 | 0.03 | 0.56 | 0.56 | 0.52 | 0.642 | 0.04 |
| Egg weight (g) | 10.09 | 10.11 | 0.954 | 0.16 | 10.16 | 10.12 | 10.01 | 0.864 | 0.20 |
| FCR (kg, feed/kg egg) | 3.86 | 3.85 | 0.935 | 0.10 | 3.64 | 3.80 | 4.11 | 0.037 | 0.11 |
| Feed cost (kg egg,N) | 441.20 | 443.10 | 0.289 | 65.30 | 440.60 | 442.61 | 458.20 | 0.042 | 47.10 |
| Revenue (N/tray) | 258.80 | 256.90 | 0.301 | 75.80 | 259.40 | 259.40 | 244.80 | 0.020 | 25.90 |

Note: The means on the same row with different superscripts differ significantly (P<0.05). powdered turmeric root, combined SEM and CPL.

This also noted that quails fed a diet containing 24% CP produced more eggs than quails fed a diet containing 16% CP (26). The main effects of CPL include higher feed costs per kilogram of eggs and lower revenue when feeding an 18% CPL diet. This is because the diet's reduced CP content had a detrimental effect on egg weight. Quails given an 18% CP diet showed decreased egg weight, but not significantly, and this might eventually result in a decrease in overall income. Similar results were seen by Adeyemo et al., [22] in layers fed a diet containing 13% CP, in terms of both egg weight and quantity.

The results of the trial showed that eggs tasted better when they were mixed with turmeric powder. Higher supplementation dosages of turmeric powder decreased the fat and Quail eggs' cholesterol content. The quail eggs treated with turmeric powder showed reduced fat and cholesterol levels, which might be partly explained by the eggs' enhanced development of follicles. As more follicles develop, the primary components of the yolk—cholesterol and fat—will be spread among more expanding follicles, resulting in a lower amount of these substances in each egg. Table 4 shows that the quail eggs treated with 54 mg/quail/day of turmeric powder had an 11.15% reduction in cholesterol to 915.707 mg/dL. The control quail egg had an average cholesterol content of 1030.6 mg/dL. In comparison to the control quail eggs, the average fat content dropped to 11.233 mg/dL in the birds that got a daily dosage of 54 mg of turmeric powder. This is a 10.76% decrease in fat content. Still, the protein concentrations rose when the egg was mixed with turmeric powder. The protein found in egg yolks and albumen is combined to form egg protein. The protein known as albumen is produced, expelled, and deposited in the magnum by the tubular gland cells and epithelial cells of the reproductive tract. Turmeric powder contains a chemical called curcumin, which helps to promote the production of proteins. The control quail's eggs had an increase in average egg protein content of 4.27% to 13.11 mg/dL when it was administered 54 mg of turmeric powder per quail per day [24]. Turmeric powder increased the amount of water and ash in the eggs. According to Yuwanta [24] and Etches [25], the water content of the egg will double twice during the reproductive canal, reaching 3.5 to 7 grams of water for every gram of protein.

**Table 4.** Proximate Analysis of The First Layer Egg of Quail Supplemented with Various Dosages of Numeric Powder Supplementation.

| Parameters | Doses of Turmeric Powder (mg/quail/day) | | | | |
|---|---|---|---|---|---|
| | | 0 | 13.5 | 27 | 54 |
| Fat (mg/dL) | | 12.587 a | 11.920b | 11.546c | 11.233d |
| Protein (mg/dL) | | 12.573 a | 13.027b | 13.123b | 13.110b |
| Cholesterol (mg/dL) | | 1030.600a | 1010.047b | 988.260c | 915.707d |
| Ash (mg/dL) | | 0.487a | 0.587b | 0.643c | 0.683c |
| Water (mg/dL) | | 72.690a | 72.980ab | 73.920ab | 74.197b |

Note: Indicators of significant variations appear differently within the same row (P<0.05).

# 4 Conclusion

The distribution of lipids to different organs was enhanced by supplementing with turmeric powder up to 54 mg/quail/day (containing 7.97% curcumin) by employing ovarian follicles, belly fat deposition, and enterohepatic recirculation. The usage of 1 g/kg of moringa seeds is advised for lipid profile (triglycerides and cholesterol). Birds fed a meal supplemented with M. oleifera seed exhibited notably lower concentrations. M. oleifera seed was added to the meal, and the birds on this diet showed noticeably reduced amounts.

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