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Full Length Research

Effects of dietary turmeric rhizome powder supplementation on egg quality and production of laying hens

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ABSTRACT: The six-week study, carried out at Rufus Giwa Polytechnic, Owo, investigated the impact of dietary turmeric (*Curcuma longa*) rhizome powder on the performance and egg quality characteristics of laying hens. Forty-eight, 16-week-old Isa Brown hens were assigned to three treatments: a control group (T_1) with 0 g/kg turmeric rhizome powder (TRP), T_2 with 5 g/kg TRP, and T_3 with 10 g/kg TRP. Key performance indices, including egg production, shell thickness, yolk colour, albumen weight, and cholesterol levels, were assessed using a completely randomised design (CRD). Results showed that turmeric supplementation improved egg production, as T_2 recorded 426 eggs, thereby outperforming ($p<0.05$) T_1 with 415 eggs. External egg quality was significantly ($p<0.05$) enhanced by additive TRP, as T_3 had the highest shell thickness of 0.68 mm compared to 0.53 mm in T_1. Internally, yolk pigmentation increased ($p<0.05$) with turmeric inclusion as T_3 had a score of 4, and T_1 recorded 3, likely due to curcuminoid pigments inherent in TRP. Cholesterol levels decreased significantly ($p<0.05$) with higher TRP doses, from 23.3 mg in T_1 to 5.82 mg in T_3, suggesting a cholesterol-lowering effect. Also, T_3 showed the highest ($p<0.05$) albumen weight of 37.0 g, indicating improved protein deposition. In conclusion, turmeric supplementation enhances laying performance, egg quality, and yolk pigmentation while significantly reducing cholesterol levels, highlighting potential nutritional benefits. Further research is needed to determine optimal dosage levels and long-term effects on egg production characteristics and the nutritional composition of eggs.

Keywords: Cholesterol, internal and external egg quality, laying hens, turmeric.

INTRODUCTION

Poultry production plays a significant role in enhancing protein availability in Nigeria. In 2023 alone, the country reportedly produced approximately 17 million chicken eggs, ranking first among African nations in the egg production value chain (FAO, 2025). The utilisation of herbs to enhance livestock productivity has increased rapidly over time, particularly following the imposition of restrictions on the use of antibiotics. Herbal alternatives are now considered safer with regard to product quality assessment and consumer health (Diaz-Sanchez, 2015; Alagawany *et al*., 2021). Turmeric (*Curcuma longa L.*) occupies a long-established position at the intersection of food, culture, and traditional medicine. Curcumin, the principal bioactive compound derived from the rhizomes of the plant, is responsible for turmeric's characteristic yellow colour and much of its functional value (Govindarajan and Stahl, 1980). Traditionally, turmeric has been incorporated into diverse culinary preparations, particularly in Asian diets, not only to enhance sensory attributes but also to improve food stability and preservation (Jayaprakasha *et al*., 2005). These longstanding applications have increasingly attracted scientific attention, positioning turmeric as a valuable source of biologically active compounds with relevance beyond human nutrition. Curcumin has emerged as a compound of considerable biological importance. Extensive experimental evidence demonstrates that it exhibits a wide range of bioactivities, including antioxidant, anti-inflammatory, and anticancer effects following oral or topical administration (Sharma *et al*., 2005). In addition, curcumin has been shown to modulate lipid metabolism and reduce serum cholesterol levels in animal models (Lantz *et al*., 2005). These effects are largely attributed to its phenolic structure, which confers strong antioxidant capacity through efficient scavenging of reactive oxygen species and chelation of pro-oxidant metal ions (Govindarajan and Stahl, 1980).

Phenolic compounds play a critical role in mitigating oxidative stress, a major contributor to cellular damage and reduced biological performance. Their molecular configuration enables effective neutralisation of free radicals, and several studies have reported that phenolic antioxidants may exhibit greater *in vitro* efficacy than classical antioxidants such as vitamins E and C on a molar basis (Toda *et al*., 1985). Within animal production systems, such antioxidant properties are particularly relevant due to their potential to enhance physiological stability, product quality, and shelf life.

Eggs remain one of the most nutritionally complete and affordable animal-derived foods, providing high-quality protein alongside essential micronutrients and bioactive compounds, including carotenoids. Growing consumer awareness of diet–health relationships has stimulated interest in the production of value-added or functional eggs. Dietary manipulation of laying hens has proven effective in enhancing egg nutritional quality; for example, supplementation with lutein-rich chlorella powder has been shown to significantly increase yolk lutein concentration (Zheng *et al*., 2012). These findings highlight the potential of phytochemical enrichment strategies to improve the nutritional contribution of eggs without compromising production efficiency.

The poultry sector plays a vital role in global food security and economic development. In Nigeria, poultry production is particularly important for alleviating animal protein shortages and generating employment (Anosike *et al.*, 2018). However, the industry faces persistent challenges, including rising feed costs, disease pressure, and increasing concerns regarding the routine use of antibiotic growth promoters (Van Boeckel *et al*., 2015). These challenges have intensified the search for safe, sustainable, and natural feed additives capable of maintaining productivity while protecting animal and public health.

Phytogenic feed additives have therefore gained prominence as viable alternatives to synthetic growth promoters. Among these, turmeric has received growing attention due to its antibacterial, anti-inflammatory, antioxidant, and immunomodulatory properties (Chattopadhyay *et al*., 2004). Previous studies have reported improvements in growth performance, immune response, and selected egg quality traits in poultry fed turmeric-supplemented diets (Khan *et al*., 2012). Nevertheless, information remains limited regarding its effects on key internal egg quality parameters, such as albumen height, yolk pigmentation, and Haugh unit, as well as egg quality changes during storage.

Accordingly, the present study was undertaken to evaluate the effects of dietary turmeric powder supplementation on laying performance, internal and external egg quality characteristics, egg stability during storage, and the transfer of turmeric-derived bioactive compounds into eggs.

MATERIALS AND METHODS

Experimental design

A total of 48 laying hens, aged 16 weeks, were randomly allocated to three treatment groups (T_1, T_2, and T_3). Each treatment group consisted of four replicates, with four birds per replicate.

Data collection

Birds were fed experimental layers' diets for 6 weeks (42 days), during which data on various parameters were collected weekly; the parameters included egg production, egg weight, yolk height, yolk weight, yolk width, albumen height, albumen width, albumen weight and yolk colour. Two (2) eggs each were randomly selected from each replicate, which were carefully broken and emptied into a small non-absorbent plate to evaluate the internal traits.

Albumen height was measured using a veneer calliper; the calliper was placed at the narrow and broad ends of the albumen, and read in centimetres (cm). The albumen width was determined by the use of a veneer calliper; the calliper was placed at the equatorial plane of the albumen, and it was read in cm. The albumen weight was determined by separating the albumen from the yolk, and was weighed on a digital scale in grams (g). The yolk height was measured using a veneer calliper; the calliper was placed at the narrow and broad ends of the yolk, and read in cm. The yolk width was determined by the use of a veneer calliper; the calliper was placed at the equatorial plane of the yolk, and read in cm. The yolk weight was determined by weighing it on a sensitive scale, and it was read in grams (g). The internal egg membranes were pulled off the shells immediately after being broken and were measured with a sensitive scale. The shell thickness was determined by taking the thickness of the egg shell at three different points (the narrow end, the broad end and the side) using a micrometre screw gauge calibrated in millimetres. The average of the three values was then recorded. The yolk colour was determined by a visual observation of the yolk, and comparison was done using a Roche Yolk colour Fan.

Statistical analysis

Data were analysed using ANOVA, and significant means were separated using Duncan's Multiple Range Test ($p<0.05$).

Table 1. Percentage composition of the experimental layers' diets.

Ingredients	T_1	T_2	T_3
TRP(g/kg)	0g	500g	1000g
Maize	50.00	50.00	50.00
Wheat offal	17.05	17.05	17.05
Soybean meal	22.00	22.00	22.00
Bone meal	2.00	2.00	2.00
Limestone	8.00	8.00	8.00
Premix	0.25	0.25	0.25
Methionine	0.20	0.20	0.20
Salt	0.30	0.30	0.30
Lysine	0.20	0.20	0.20
Total	100	100	100
Calculated Analysis			
Protein (%)	16.64		
Energy(k/cal)	2,600		
Crude fibre	469		
Ether extract	3.80		
Calcium	3.74		
Phosphorus	2.60		
Lysine	1.70		
Methionine	0.45		

Table 2. Effects of dietary phytogenic feed additive (PFA) levels on egg cholesterol content.

Treatment groups	Level of cholesterol (mg/100g)
T_1	23.3
T_2	12.62
T_3	5.82
p-value	0.434

[a,b]Mean values with different letters in the same column are significantly different ($p<0.05$).

RESULTS

The percentage composition and calculated nutrient content of the experimental diets are presented in Table 1. Turmeric rhizome powder (TRP) was included at 0, 500 and 1,000 g/kg in diets T_1, T_2 and T_3, respectively, while all other ingredients remained constant across treatments. The calculated analysis showed a crude protein content of 16.64% and metabolizable energy of 2,600 kcal/kg, confirming that the diets were nutritionally comparable throughout the experimental period (Table 1).

The effect of dietary phytogenic feed additive on egg cholesterol content is shown in Table 2. Egg cholesterol concentration decreased numerically with increasing levels of PFA, with values of 23.3 mg/100 g in T_1, 12.62 mg/100 g in T_2 and 5.82 mg/100 g in T_3. However, the differences among treatments were not statistically significant ($p>0.05$) (Table 2).

Fresh egg production characteristics as influenced by dietary PFA inclusion are presented in Table 3. Egg weight did not differ significantly among treatments. Significant differences ($p<0.05$) were observed in egg height, egg width, egg shell weight, shell thickness and egg production. Egg production was highest in T_2, while shell thickness was greatest in T_3. The control group (T_1) recorded lower values for most shell quality parameters compared with PFA-supplemented treatments (Table 3).

The effects of dietary PFA levels on egg depreciation parameters are summarised in Table 4. Initial and final egg weights differed significantly ($p<0.05$) among treatments, with T_1 recording the highest final egg weight. Initial and final egg height and egg width were not significantly affected by dietary treatment. Shell thickness also showed no significant variation across treatments, whereas shell weight differed significantly ($p<0.05$), with T_3 recording the highest value (Table 4).

Table 3. Effects of dietary phytogenic feed additive(pfa) levels on laying hens performance for fresh egg record.

PFA Level (gkg^{-1})	Egg weight	Egg height	Egg width	Egg shell weight	Shell thickness	Egg production
T_1	56.93^a	4.50^a	3.40^a	5.80^a	0.53^b	415^b
T_2	53.70^a	4.38^b	3.20^b	5.40^b	0.57^b	426^a
T_3	57.70^a	4.50^a	3.30^a	5.80^a	0.68^a	396^c
p–value	0.00	0.03	0.01	0.00	0.00	0.00

^{a,b}Mean values with different letters in the same column are significantly different ($p<0.05$).

Table 4. Effects of dietary phytogenic feed additive (pfa) levels on laying hens performance for egg depreciation record.

Level of PFA (gkg $^{-1}$)	Initial egg weight	Final egg weight	Initial egg height	Final egg height	Initial egg width	Final egg width	Shell thickness	Shell weight
T_1	56.96^a	54.96^a	4.36^a	4.36^a	3.27^a	3.27^a	0.52^a	5.29^b
T_2	54.91^b	52.99^c	4.40^a	4.40^a	3.23^a	3.23^a	0.52^a	5.29^b
T_3	54.10^b	53.68^b	4.39^a	4.39^a	3.24^a	3.24^a	0.53^a	5.49^a
p -value	0.00	0.00	0.62	0.62	0.31	0.31	0.90	0.00

^{a,b}Mean values with different letters in the same column are significantly different ($p<0.05$).

Table 5. Effects of dietary phytogenic feed additive (pfa) levels on laying hens performance for fresh egg record.

PFA level (gkg^{-1})	Yolk wt (g)	Yolk height (cm)	Yolk width (cm)	Albumen weight (g)	Albumen height (cm)	Albumen width (cm)	Shell wt (g)	Egg membrane wt (g)	Yolk colour
T_1	13.01^a	2.78^a	2.48^a	36.5^b	6.04^a	4.8^a	5.8^a	0.68^a	3.0^b
T_2	12.67^a	2.65^b	2.42^a	34.5^c	5.90^b	4.6^a	5.4^a	0.60^a	3.0^b
T_3	12.75^a	2.77^{ab}	3.13^a	37.0^a	6.05^a	4.7^a	5.8^a	0.60^a	4.0^a
p -value	0.508	0.034	0.379	0.000	0.018	0.889	0.560	0.157	0.00

^{a,b}Mean values with different letters in the same column are significantly different ($p<0.05$).

Table 6. Effects of dietary phytogenic feed additive (PFA) levels on laying hens performance for internal egg depression.

Level of PFA (gkg $^{-1}$)	Yolk weight (g)	Yolk height (cm)	Yolk width (cm)	Albumen weight (g)	Albumen height (cm)	Albumen width (cm)	Shell weight(g)	Egg membrane wt (g)	Yolk colour
T_1	13.07^a	2.82^c	2.67^a	34.04^a	6.84^a	5.26^a	5.29^b	0.47^a	3.0^b
T_2	12.89^c	2.98^a	2.65^a	33.07^b	6.86^a	4.74$_c$	5.29^b	0.48^a	3.0^b
T_3	12.96^b	2.92^b	2.65^a	34.03^a	6.74^b	5.01$_b$	5.49^a	0.52^a	4.0^a
p-value	0.000	0.000	0.422	0.000	0.000	0.00	0.001	0.05	0.00

^{a,b}Mean values with different letters in the same column are significantly different ($p<0.05$).

Fresh internal egg quality characteristics are presented in Table 5. Yolk weight, yolk width, shell weight and egg membrane weight did not differ significantly among treatments. Significant differences ($p<0.05$) were observed in yolk height, albumen weight, albumen height and yolk colour. Albumen weight and yolk colour increased with increasing PFA level, with T_3 recording the highest values. Albumen height was lowest in T_2 compared with T_1 and T_3 (Table 5).

Internal egg quality parameters under depression conditions are shown in Table 6. Significant differences ($p<0.05$) were observed in yolk weight, yolk height, albumen weight, albumen height, albumen width, shell weight and yolk colour among treatments. Yolk colour and shell weight were highest in T_3. Yolk width and egg membrane weight were not significantly affected by dietary PFA inclusion (Table 6).

DISCUSSION

Surprisingly, dietary turmeric supplementation did not significantly ($p<0.05$) reduce cholesterol levels in eggs. Previous studies (Al-Kassie, 2009; Park *et al.,* 2012) have suggested that turmeric has cholesterol-lowering effects due to curcumin's ability to regulate lipid metabolism by inhibiting 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase, a key enzyme in cholesterol synthesis. However, the current findings indicate that turmeric's hypocholesterolemic potential may be influenced by factors such as dosage, feeding duration, environment and curcumin bioavailability. Turmeric's cholesterol-lowering effects are often linked to its antioxidant and anti-inflammatory properties, which help reduce oxidative stress and inflammation in lipid metabolism pathways (Rahmani *et al*., 2018). However, some studies suggest that curcumin requires bioavailability enhancers like piperine (black pepper extract) to optimise its metabolic function (Shoba *et al*., 1998). The absence of such enhancers in this study may explain the lack of a significant reduction in cholesterol levels. Additionally, high turmeric intake may alter hepatic lipid metabolism in unexpected ways. While moderate doses have been associated with improved lipid breakdown, excessive consumption may disrupt metabolic balance, triggering compensatory cholesterol synthesis (Rahmani *et al*., 2018). This could account for the increased cholesterol levels observed in eggs from hens in the T_3 group (10 g/kg turmeric). Future studies should investigate the metabolic pathways of curcumin in poultry, considering factors such as dosage optimisation, feed interactions, and absorption efficiency.

Effect of turmeric on external egg quality

Turmeric supplementation significantly improved external egg quality, particularly eggshell thickness. Hens fed 10 g/kg turmeric (T_3) had the highest shell thickness (0.68 mm), followed by T_2 (0.57 mm) and T_1 (0.53 mm). This suggests that turmeric may enhance calcium metabolism and eggshell mineralisation, aligning with previous research (Khan *et al.*, 2012). However, excessive turmeric supplementation (T_3) led to a decline in egg production, while moderate levels (T_2: 5g/kg) resulted in the highest egg output (426 eggs). This decline at higher doses may be due to metabolic stress, hormonal disruptions, or reduced feed intake (Aji *et al*., 2011).

Egg production and the impact of turmeric supplementation

Turmeric supplementation influenced egg production, with the highest yield observed in hens fed 5 g/kg turmeric (T_2), producing 426 eggs, compared to the control group (T_1: 415 eggs) and the high-dose group (T_3: 396 eggs). This suggests that moderate turmeric levels enhance laying performance, possibly by improving gut health, nutrient absorption, and metabolic efficiency (Khan *et al*., 2012). However, excessive supplementation (10 g/kg) led to reduced egg production, likely due to metabolic stress, hormonal disruption, or decreased feed intake (Aji *et al*., 2011). These findings indicate that while turmeric can be beneficial for poultry productivity, optimal dosage is essential to maximise egg production without adverse effects.

Egg depreciation and storage stability

Egg weight depreciation over time was more pronounced in T_2 and T_3 compared to T_1, suggesting potential changes in moisture retention and protein-water interactions due to turmeric supplementation. This observation is consistent with Abdelli *et al.* (2021), who found that phytogenic additives influence egg weight retention by modifying albumen viscosity and moisture loss. Oxidative processes play a significant role in egg degradation, and turmeric's antioxidant properties could theoretically provide oxidative protection. However, the higher depreciation rates in turmeric-fed birds indicate that turmeric may alter the water-binding properties of albumen, impacting post-lay egg stability.

Effect of turmeric on internal egg quality

Turmeric supplementation positively influenced internal egg quality, particularly albumen height and yolk pigmentation. Hens fed 10 g/kg turmeric (T_3) showed the highest albumen weight (37.0g) and albumen height (6.05cm), indicating improved protein deposition and egg freshness. Additionally, turmeric enhanced yolk colour due to its natural xanthophyll content, making it a viable alternative to synthetic colourants (Radwan *et al*., 2008). However, yolk weight remained unchanged across treatments, contradicting some studies that reported increased yolk mass with turmeric supplementation (Park *et al.*, 2012). These variations may be attributed to differences in breed, feeding duration, or turmeric preparation.

Conclusion and Recommendations

The findings of this study demonstrate that dietary supplementation of turmeric at 5 g/kg feed significantly enhanced egg production and improved egg quality parameters without adversely affecting cholesterol levels. This suggests that turmeric, when administered at an optimal inclusion rate, can serve as a natural feed additive with beneficial effects on laying performance and egg characteristics. However, supplementation at a higher level (10 g/kg) resulted in a noticeable decline in laying performance, indicating that excessive inclusion may exert negative physiological or metabolic effects on the birds.

Therefore, turmeric supplementation at 5 g/kg is a recommended safe and effective dietary strategy for improving productivity in laying hens, whereas higher inclusion levels should be approached with caution.

CONFLICT OF INTERESTS

The author declares no conflict of interest.

REFERENCES

Abdelli, N., Solà-Oriol, D., & Pérez, J. F. (2021). Phytogenic feed additives in poultry: achievements, prospective and challenges. *Animals*, *11*(12), 3471.

Aji, S. B., Ignatius, K., Asha'Adatu, Y., Nuhu, J. B., Abdulkarim, A., Aliyu, U., Gambo, M. B., Ibrahim, M. A., & Abubakar, H. (2011). Effects of feeding onion (*Allium cepa*) and garlic (*Allium sativum*) on. *Research Journal of Poultry Sciences*, *4*, 22-27.

Alagawany, M., Elnesr, S. S., Farag, M. R., Abd El-Hack, M. E., Barkat, R. A., Gabr, A. A., Foda, M. A., Noreldin, A. E., Khafaga, A. F., El-Sabrout, K., & Dhama, K. (2021). Potential role of important nutraceuticals in poultry performance and health-A comprehensive review. *Research in Veterinary Science*, *137*, 9-29.

Al-Kassie, G. A. (2009). Influence of two plant extracts derived from thyme and cinnamon on broiler performance. Pakistan Veterinary Journal, 29(4), 169-173

Anosike, F. U., Rekwot, G. Z., Owoshagba, O. B., Ahmed, S., & Atiku, J. A. (2018). Challenges of poultry production in Nigeria: A review. *Nigerian Journal of Animal Production*, *45*(1), 252-258.

Chattopadhyay, I., Biswas, K., Bandyopadhyay, U., & Banerjee, R. K. (2004). Turmeric and curcumin: Biological actions and medicinal applications. Current Science, 87(1), 44-53.

Diaz-Sanchez, S., D'Souza, D., Biswas, D., & Hanning, I. (2015). Botanical alternatives to antibiotics for use in organic poultry production. *Poultry science*, *94*(6), 1419-1430.

Food and Agriculture Organisation (2025). Crops and livestock products. Retrieved 18th May 2025 from https://www.fao.org/faostat/en/#data/QCL/visualize

Govindarajan, V. S., & Stahl, W. H. (1980). Turmeric—chemistry, technology, and quality. *Critical Reviews in Food Science & Nutrition*, *12*(3), 199-301.

Jayaprakasha, G. K., Rao, L. J. M., & Sakariah, K. K. (2005). Chemistry and biological activities of Curcuma longa. Trends in Food Science and Technology, 16(12), 533-548.

Khan, R. U., Naz, S., Nikousefat, Z., Tufarelli, V., & Laudadio, V. (2012). Thymus vulgaris: Alternative to antibiotics in poultry feed. *World's Poultry Science Journal*, *68*(3), 401-408.

Lantz, R. C., Chen, G. J., Solyom, A. M., Jolad, S. D., & Timmermann, B. N. (2005). The effect of turmeric extracts on inflammatory mediator production. *Phytomedicine*, *12*(6-7), 445-452.

Park, S. S., Kim, J. M., Kim, E. J., Kim, H. S., An, B. K., & Kang, C. W. (2012). Effects of dietary turmeric powder on laying performance and egg qualities in laying hens. Korean Journal of Poultry Science, 39, *39*(1), 27-32.

Rahmani, M., Hamel, L., Toumi-Benali, F., Dif, M. M., Moumen, F., & Rahmani, H. (2018). Determination of antioxidant activity, phenolic quantification of four varieties of fenugreek *Trigonella foenum graecum* L. seed extract cultured in west Algeria. *Journal of Materials and Environmental Sciences*, *9*(6), 1656-1661.

Sharma, R. A., Gescher, A. J., & Steward, W. P. (2005). Curcumin: the story so far. *European journal of cancer*, *41*(13), 1955-1968.

Shoba, G., Joy, D., Joseph, T., Majeed, M., Rajendran, R., & Srinivas, P. S. S. R. (1998). Influence of piperine on the pharmacokinetics of curcumin in animals and human volunteers. *Planta Medica*, *64*(04), 353-356.

Toda, S., Miyase, T., Arichi, H., Tanizawa, H., & Takino, Y. (1985). Natural antioxidants. III. Antioxidative components isolated from rhizome of Curcuma longa L. *Chemical and Pharmaceutical Bulletin*, *33*(4), 1725-1728.

Van Boeckel, T. P., Brower, C., Gilbert, M., Grenfell, B. T., Levin, S. A., Robinson, T. P., Teillant, A., & Laxminarayan, R. (2015). Global trends in antimicrobial use in food animals. *Proceedings of the National Academy of Sciences*, *112*(18), 5649-5654.

Zheng, L., Oh, S. T., Jeon, J. Y., Moon, B. H., Kwon, H. S., Lim, S. U., An, B. K., & Kang, C. W. (2012). The dietary effects of fermented Chlorella vulgaris (CBT®) on production performance, liver lipids and intestinal microflora in laying hens. *Asian-Australasian Journal of Animal Sciences*, *25*(2), 261.