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Turmeric (*Curcuma Longa*) as a Natural Feed Additive on Egg Laying Performance and Egg Quality of White Dekalb Layer Chickens

Galvez, Michael John I*

[1] *College of Agriculture, Nueva Ecija University of Science and Technology, Gabaldon Campus, Gabaldon, Nueva Ecija, 3131, Philippines*
*Corresponding author's email: mgalvez@ineust.ph.education

Abstract. The effects of dried turmeric *(Curcuma longa)* supplementation on the egg laying performance and egg quality of White Dekalb layer hens were investigated in this study. Using a completely randomised design with 48 hens distributed to four dietary treatments, each replicated three times, a 56-day feeding trial was carried out at the Nueva Ecija University of Science and Technology – Gabaldon Campus. The treatments were: T1 – 0 g of turmeric per kg of feed (control), T2 – 5 g per kg of feed, T3 – 10 g per kg of feed, and T4 – 15 g per kg of feed. The parameters measured were hen-day egg production, feed conversion ratio, egg yolk colour, egg weight, egg classification, and economic returns. The results showed no significant effect ($p > 0.05$) in hen-day egg production and feed conversion ratio; nonetheless, hens fed 5 g/kg consistently showed best performance. By the eighth week, hens on a 15 g/kg feed supplementation showed highly significant effect ($p < 0.01$) in yolk colour and egg weight. Economic analysis showed that, particularly at 5 g and 15 g/kg feed, turmeric supplementation produced higher net returns than the control group. Finally, supplementation of dried turmeric at 5–15 g/kg of feed can improve specific aspects of egg quality and profitability without adverse effect on laying performance.

Keywords: Curcuma longa; Feed additive; Layer chicken; Turmeric supplementation; Yolk pigmentation

1. Introduction

The global poultry industry is constantly exploring more sustainable ways to boost productivity, improve product quality, and increase profitability, all while reducing dependence on synthetic additives (Bist et al., 2024). Among the alternatives gaining attention are natural feed additives, which have shown potential to enhance both animal health and overall performance. One such additive is turmeric *(Curcuma longa),* a medicinal plant widely recognized for its bioactive compounds, particularly curcumin, which offers strong antioxidant,

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anti-inflammatory, and antimicrobial benefits (Dono, 2014). Given these properties, turmeric holds promise as a supplement that could support poultry health, improve feed efficiency, and positively influence egg quality.

Egg production continues to play a vital role in the poultry industry, with a strong focus on maximizing laying performance and improving characteristics like yolk pigmentation and shell strength, both critical factors for consumer satisfaction and market value. In this regard, natural additives such as turmeric are especially appealing because they provide a way to achieve these goals without the potential risks associated with synthetic compound.

Despite the promising results reported in international studies, research under Philippine production conditions remains limited. This gap highlights the importance of conducting local studies to assess the practical benefits and cost-effectiveness of turmeric as a feed additive. In response to this, the present study aims to evaluate the effects of dried turmeric supplementation at different inclusion levels on the laying performance, egg quality, and economic returns of White Dekalb layer chickens. Specifically, it seeks to: (1) determine the egg-laying performance in terms of average hen-day egg production and average feed conversion ratio; (2) assess egg quality based on average yolk color, average egg weight, and average egg classification; and (3) evaluate the economic benefits of turmeric supplementation. The findings are expected to provide valuable insights for the practical application of turmeric in enhancing the productivity and profitability of egg production in the Philippines.

2. Methodology

2.1. Experimental Design

The study employed a Completely Randomized Design (CRD) to evaluate the effects of turmeric supplementation on the performance and egg quality of White Dekalb laying hens. Forty-eight (48) hens were randomly assigned to four dietary treatments, each with four replicates and four birds per replicate. The treatments were as follows: T1 – 100% commercial feed (control); T2 – 5 g turmeric per 1000 g commercial feed; T3 – 10 g turmeric per 1000 g commercial feed; and T4 – 15 g turmeric per 1000 g commercial feed. The feeding trial lasted for eight (8) weeks, with the first week serving as the baseline period without supplementation.

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2.2. Preparation of Dried Turmeric

Fresh turmeric rhizomes were thoroughly cleaned to remove dirt and debris. After washing, the rhizomes were sliced thinly using a sharp knife and then sun-dried for three days until approximately 15% moisture content was achieved. The dried turmeric slices were subsequently crushed into small particles before being mixed into the commercial layer feeds at the designated inclusion levels for each treatment.

2.3. Housing and Management

The birds were reared under uniform environmental conditions in 3-tier battery cages, with each cage equipped with a linear feeder and an automatic nipple drinker to provide ad libitum access to water. A 16-hour light and 8-hour dark photoperiod was maintained throughout the experiment, using natural daylight and supplementary artificial lighting from 6:00 PM to 10:00 PM. Sanitation measures included twice-weekly cleaning and disinfection of cages, feeders, and drinkers, with weekly removal of droppings.

2.4. Feeding Management

The birds were fed commercial layer mash containing 16% crude protein. Each hen received 110 g of feed daily, distributed in three feedings at 6:00 AM, 1:00 PM, and 5:00 PM. Experimental diets were fed ad libitum throughout the study based on the assigned treatments.

2.5. Data Collection

The production performance of the laying hens was evaluated through hen-day egg production (HDEP) and feed conversion ratio (FCR). Hen-day egg production was calculated by dividing the total number of eggs produced by the total number of hen-days, then multiplying the result by 100 to express it as a percentage. Feed conversion ratio was determined by dividing the total feed intake by the total egg mass produced during the experimental period.

Egg quality was assessed through yolk color, egg weight, and egg classification. Yolk color was measured weekly using the DSM Yolk Color Fan, by randomly selecting and scoring 12 eggs per treatment. Egg weight was recorded daily using a digital weighing scale, with abnormal eggs such as broken, shell-less, or soft-shelled eggs excluded from the data. Egg classification was based on the Philippine National Standard (PNS, 2005) guidelines, categorizing eggs as

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Peewee (<45 g), Small (46–56 g), Medium (57–68 g), Large (69–79 g), Extra Large (80–91 g), and Jumbo (>92 g).

The total production cost, which included only feed and turmeric supplement costs, was subtracted from the gross sales derived from the eggs to calculate the net returns for each treatment group.

2.6. Statistical Analysis

All data collected were subjected to Analysis of Variance (ANOVA) following a Completely Randomized Design. Differences among treatment means were tested using the Least Significant Difference (LSD) test at a 5% probability level.

3. Results and Discussion

3.1. Laying Performance of Layer Chicken

The laying performance of layer chickens was measured using the average hen-day egg production and average feed conversion ratio.

3.1.1. Average Hen-Day Egg Production (%)

Table 1 shows the average hen-day egg production across four treatments during the 1st, 4th, and 8th weeks. Treatment 2 (5g turmeric/1000g feed) achieved the highest production in the 1st and 8th weeks (97.62%), while Treatment 1 (0g Turmeric/1000g Feed – Control) showed consistently high production throughout. Treatment 3 (10g turmeric) recorded the lowest percentages across all weeks, whereas Treatment 4 (15g turmeric) showed an increasing trend over time.

Statistical analysis revealed no significant differences ($p > 0.05$) among treatments, indicating that turmeric supplementation had no statistically significant effect on egg production. Nevertheless, observable trends suggest that 5g turmeric supplementation may help sustain high production, while higher dosages could exert a delayed positive impact. These findings contrast with those of Azouz (2019), who reported improved egg production with turmeric supplementation, but are consistent with Park et al. (2012), who found no significant effects.

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Table 1. Average Hen-Day Egg Production (%)

Treatment	1st Week^{ns}	4th Week^{ns}	8th Week^{ns}
Treatment 1 – 0g Turmeric/1000g Feed (Control)	94.05	96.83	97.62
Treatment 2 – 5g Turmeric/1000g Feed	97.62	96.03	97.62
Treatment 3 – 10g Turmeric/1000g Feed	94.05	89.68	90.48
Treatment 4 – 15g Turmeric/1000g Feed	89.29	94.05	95.24

ns – not significant

3.1.2. Average Feed Conversion Ratio (FCR)

Table 2 presents the average feed conversion ratio (FCR). Treatment 2 (5g Turmeric/1000g Feed) demonstrated the best overall FCR, with values of 1.94, 1.92, and 1.88 in the 1st, 4th, and 8th weeks, respectively. This suggests that the inclusion of 5 grams of turmeric per 1000 grams of commercial feed may enhance feed efficiency over time. Treatment 4 (15g Turmeric/1000g Feed) also showed improvements in FCR, with values from 2.13 in the 1st week to 1.94 in the 4th week and 1.92 in the 8th week, indicating that a higher dosage of turmeric might have a delayed but positive effect on feed conversion. On the other hand, Treatment 3 (10g Turmeric/1000g Feed) showed a slight decline in FCR values, with a gradual increase from 2.04 in the 1st week to 2.10 and 2.11 in the subsequent weeks, suggesting a decrease in feed efficiency. Treatment 1 (0g Turmeric/1000g Feed – Control) exhibited no significant improvement.

No significant differences ($p > 0.05$) were observed, which is consistent with the findings of Van Phuoc et al. (2019), Malekizadeh et al. (2012), and Gumus et al. (2018).

Table 2. Average Feed Conversion Ratio (FCR)

Treatment	1st Week^{ns}	4th Week^{ns}	8th Week^{ns}
Treatment 1 – 0g Turmeric/1000g Feed (Control)	2.07	1.97	2.03
Treatment 2 – 5g Turmeric/1000g Feed	1.94	1.92	1.88
Treatment 3 – 10g Turmeric/1000g Feed	2.04	2.10	2.11
Treatment 4 – 15g Turmeric/1000g Feed	2.13	1.94	1.92

ns – not significant

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3.2. Egg Quality

The effect of dried turmeric feeding was measured based on average egg yolk color, egg weight, and egg size classification.

3.2.1. Average Egg Yolk Color

Table 3 shows the average egg yolk color. Treatment 4 (15g turmeric/1000g feed) showed the most significant improvement in yolk color, with values of 11.00 and 11.67 in the 4th and 8th weeks. Treatment 3 (10g turmeric/1000g feed) also showed improvements, reaching 10.78 and 10.75 in the 4th and 8th weeks. Treatment 2 (5g turmeric/1000g feed) displayed moderate increases, with yolk color progressing from 9.00 to 10.13. Treatment 1 (0g Turmeric/1000g Feed – Control) had the lowest values, starting at 9.33 and declining to 8.80 by the 8th week.

Statistical analysis showed no significant differences ($p > 0.05$) in the 1st week, but highly significant differences ($p > 0.01$) appeared in the 4th and 8th weeks. Post-hoc analysis indicated that birds fed with 15g turmeric/1000g feed had the highest yolk color, significantly outperforming the others. These results support Samia et al. (2018), which stated that turmeric supplementation significantly enhances yolk color, likely due to its curcumin content, a natural pigment and antioxidant.

Table 3. Average Egg Yolk Color

Treatment	1st Week^{ns}	4th Week**	8th Week**
Treatment 1 – 0g Turmeric/1000g Feed (Control)	9.33	8.94^{c}	8.80^{d}
Treatment 2 – 5g Turmeric/1000g Feed	9.00	9.61^{b}	10.13^{c}
Treatment 3 – 10g Turmeric/1000g Feed	9.83	10.78^{a}	10.75^{b}
Treatment 4 – 15g Turmeric/1000g Feed	9.33	11.00^{a}	11.67^{a}

ns – not significant

** – highly significant

Means with the same letter are not significantly different at 0.01 level, LSD

3.2.2. Average Egg Weight

Table 4 presents the average egg weight recorded. Treatment 4 (15g turmeric/1000g feed) showed the highest egg weight, reaching 60.23g in the 8th

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week. Treatment 2 (5g turmeric/1000g feed) also showed consistent improvements in egg weight, with values increasing from 58.00g to 60.09g. Treatment 3 (10g turmeric/1000g feed) displayed intermediate results, while Treatment 1 (0g Turmeric/1000g Feed – Control) had the lowest egg weights, declining from 56.63g to 55.47g.

Statistical analysis revealed no significant differences ($p > 0.05$) in the 1st and 4th weeks, but there were highly significant differences ($p < 0.01$) in the 8th week, with Treatment 4 showing significantly higher egg weights compared to Treatment 3 and the control, but similar to Treatment 2. These results suggest that turmeric supplementation at 15 grams per 1000 grams of feed can significantly improve egg weight, with Treatment 2 also showing benefits. Treatment 3's lower efficacy suggests that 10 grams of turmeric may not be as effective. These findings are consistent with the studies by Riasi et al. (2012) and Park et al. (2012), which also reported improvements in egg quality with turmeric supplementation, but contrast with the results of the study by Malekizadeh et al. (2012).

Table 4. Average Egg Weight (g)

Treatment	1st Week^{ns}	4th Week^{ns}	8th Week**
Treatment 1 – 0g Turmeric/1000g Feed (Control)	56.63	57.63	55.47^{c}
Treatment 2 – 5g Turmeric/1000g Feed	58.00	59.57	60.09^{ab}
Treatment 3 – 10g Turmeric/1000g Feed	57.59	58.98	58.46^{b}
Treatment 4 – 15g Turmeric/1000g Feed	58.03	60.10	60.23^{a}

ns – not significant

** – highly significant

Means with the same letter are not significantly different at 0.01 level, LSD

3.2.3. Average Egg Size Classification

Table 5 presents the average egg classifications. In Treatments 1 (0g Turmeric/1000g Feed – Control) and 3 (10g turmeric/1000g feed), egg classification remained Medium (M) throughout the study. However, Treatment 2 (5g turmeric/1000g feed) shifted from Medium to Large (L) classification by the 8th week. Similarly, Treatment 4 (15g turmeric/1000g feed) transitioned from Medium to Large classification starting from the 4th week and maintained this classification through the 8th week.

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These findings suggest that the addition of 15 grams of turmeric per 1000 grams of feed (Treatment 4) consistently produced larger eggs, particularly from the 4th week onward. Treatment 2 (5 grams turmeric) also promoted larger eggs, though the shift occurred more gradually. Meanwhile, Treatment 3 and the Control maintained medium-sized eggs throughout the study period.

Table 5. Average Egg Size Classification

Treatment	1st Week	4th Week	8th Week
Treatment 1 – 0g Turmeric/1000g Feed (Control)	M	M	M
Treatment 2 – 5g Turmeric/1000g Feed	M	M	L
Treatment 3 – 10g Turmeric/1000g Feed	M	M	M
Treatment 4 – 15g Turmeric/1000g Feed	M	L	L

M – medium

L – large

3.3. Cost and Return Analysis

Table 6 presents the cost and return analysis of egg production across four treatments. Treatment 4 (15 grams turmeric per 1000 grams feed) generated the highest revenue at PHP 4,199.57, followed by Treatment 2 (5 grams turmeric) at PHP 4,163.43, and the Control (Treatment 1) at PHP 4,088.13. Treatment 3 (10 grams turmeric) had the lowest revenue at PHP 3,793.63.

Expenditures for commercial feeds and turmeric additives were similar across treatments, with Treatment 4 incurring the lowest feed cost at PHP 2,362.08. The cost of turmeric additives ranged from PHP 125.00 (Treatment 2) to PHP 375.00 (Treatment 4). Total expenditures were nearly identical, between PHP 2,735.04 (Control) and PHP 2,737.00 (Treatment 4).

Net income was highest in Treatment 4 at PHP 1,462.57, followed by Treatment 2 (PHP 1,427.71) and the Control (PHP 1,283.09). Treatment 3 had the lowest net income at PHP 1,057.23.

These results shows the economic benefits of turmeric supplementation, especially at higher levels (15 grams), improving both revenue and net income while maintaining cost-effective production.

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Table 6. Cost and Return Analysis in Philippine Peso (PhP)

Items	Treatments			
	1	2	3	4
A. Revenues				
Egg sales	4,088.13	4,163.43	3,793.63	4,199.57
B. Expenditures				
Commercial layer feeds	2,735.04	2,610.72	2,486.40	2,362.08
Feed additive (Turmeric)	0.00	125.00	250.00	375.00
Total Expenditure (PHP)	**2,735.04**	**2,735.72**	**2,736.40**	**2,737.00**
Total Gross Income (PHP)	**4,018.13**	**4,163.43**	**3,793.63**	**4,199.57**
Total Net Income (PHP)	**1,283.09**	**1,427.71**	**1,057.23**	**1,462.57**

Egg sales were based on the prevailing market prices and the actual sizes of eggs harvested per treatment.

Feed costs were based on the actual commercial feed consumption, excluding the intake of feed additive.

Feed Additives costs were based on the actual cost incurred in the collection and preparation of feed additives.

4. Conclusions

This study found that although turmeric supplementation did not lead to significant changes in hen-day egg production or feed conversion ratio (FCR), it did bring clear improvements in yolk color and egg size distribution over time. Adding 15 grams of dried turmeric per 1000 grams of feed showed the best results, with notable enhancements in yolk pigmentation, egg weight, and income. These outcomes suggest that turmeric can be a valuable, natural feed additive for improving egg quality and boosting profitability.

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