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Marigold extract supplementation enhances laying performance in hens at peak production

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Abstract

The present study his study evaluated the effect of dietary supplementation with *Tagetes erecta* (marigold) petal extract on the laying performance of White Leghorn hens during peak production. Twenty-four hens aged 25-35 weeks were randomly assigned to two dietary groups: a control receiving a basal diet and a treatment receiving 550 mg kg⁻¹ marigold extract for 56 days. Productive performance was assessed through hen-day egg production (HDEP %), egg mass (g hen⁻¹ day⁻¹), feed intake, and feed conversion ratio (FCR).

Marigold supplementation improved HDEP (90.48±0.96 % vs 86.90±1.06 %), increased egg mass (46.70±0.78 vs 45.20±0.77 g hen⁻¹ day⁻¹), and significantly reduced FCR ($p<0.001$), without affecting feed intake. The results demonstrate that marigold petal extract enhances production performance and feed efficiency in layers, suggesting its potential as a sustainable phytogetic additive for poultry nutrition.

Keywords: Marigold extract, laying hens, egg production, feed conversion ratio, antioxidant

1. Introduction

Laying hens are vulnerable to oxidative stress due to intense metabolic changes during peak laying period (Wang *et al.*, 2024) ^[11]. Oxidative stress coupled with other commercial stressors during peak production leads to increased reactive oxygen species and reactive nitrogen species production. Oxidative stress and disrupted lipid metabolism pose significant threats to the health and performance of laying hens, leading to decreased egg output and compromised egg quality. This necessitated enhanced antioxidant support to maintain redox balance and optimal health, crucial for reproductive performance and overall productivity. Marigold (*Tagetes erecta*) petals are a rich natural source of carotenoids, flavonoids, and phenolic acids, including quercetagenin, which exhibits strong radical-scavenging capacity due to its polyhydroxylated structure (Yang *et al.*, 2025) ^[12]. While lutein supplements and marigold pigments are widely studied for yolk pigmentation and antioxidant enrichment (Singh *et al.*, 2008; Skřivan *et al.*, 2016; Grcevic *et al.*, 2019; Lokaewmanee *et al.*, 2011) ^[9, 10, 3, 6] little is known about the influence of crude marigold petal extract on production performance. Most prior work has relied on purified lutein rather than whole-extract preparations that contain synergistic phytochemicals capable of modulating oxidative metabolism. The present study was therefore undertaken to evaluate the effect of dietary marigold petal extract supplementation on egg production performance in White Leghorn layers during peak production. The study aims to extend the role of marigold beyond pigmentation, highlighting its potential as a natural feed additive to enhance productivity in laying hens.

2. Materials and Methods

2.1 Study location & design

The experiment was conducted at the Instructional Livestock Farm Complex, College of Veterinary and Animal Sciences, Pookode, Wayanad, to evaluate the effect of dietary supplementation of marigold (*Tagetes erecta*) petal extract on egg production performance in White Leghorn layers during peak production.

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A total of twenty-four hens aged 25-35 weeks were selected and maintained under uniform management conditions throughout the study. Birds were individually housed in laying cages with free access to feed and water under a standard 16 h light: 8 h dark photoperiod. A one-week adaptation period preceded the 56-day feeding trial.

Hens were randomly allotted into two dietary treatments with twelve birds in each group. The control group (T₁) received a standard basal layer diet formulated as per BIS (2007) [2] specifications, whereas the treatment group (T₂) was offered the same diet supplemented with lyophilised aqueous extract of *Tagetes erecta* petals at the rate of 550 mg kg⁻¹ feed (Skřivan *et al.*, 2016) [10].

2.2 Diet formulation and marigold extract preparation

The extract was prepared by soaking freshly collected petals in distilled water at 65-70 °C for 30-60 min, filtering through Whatman No. 1 filter paper, and lyophilising the filtrate to obtain a dry powder. Feed and water were offered *ad libitum* for both groups throughout the trial period.

2.3 Performance measurements (HDEP, egg mass, FCR)

Daily egg production was recorded, and hen-day egg production (HDEP %) was calculated as the number of eggs laid divided by the total number of hens, multiplied by 100. Egg mass (g hen⁻¹ day⁻¹) was computed by multiplying the

average egg weight by the number of eggs laid per hen per day. Feed intake was measured weekly, and feed conversion ratio (FCR) was expressed as kilograms of feed consumed per kilogram of egg mass produced.

Data were statistically analysed using the Student's t-test in SPSS v24.0 software. The results were expressed as mean ± standard error, and differences were considered statistically significant at $p < 0.05$.

3. Results and Discussion

3.1 Hen-day egg production (HDEP)

The weekly hen-day egg production (HDEP) of White Leghorn layers fed basal diet or diet supplemented with marigold petal extract is presented in Table 1 and illustrated in Figure 1.

The marigold-supplemented group consistently outperformed the control in hen-day egg production (HDEP) (Table 1, Figure 1). The difference emerged early in the trial and persisted, indicating a sustained effect. Previous studies on marigold or its carotenoids (mostly lutein) have focused mainly on yolk pigmentation (Skřivan *et al.* 2016; Grcevic *et al.* 2019) [10, 3] or reported no significant effects on production traits (Kim 2014; Rezaei *et al.* 2019) [4, 8]. Similar to our results, Yang *et al.* (2025) [12] reported that marigold supplementation significantly increased egg production rate in the late laying period.

Table 1: Weekly hen-day egg production (HDEP, %) of White Leghorn layers fed basal diet (Control) and diet supplemented with marigold petal extract (Mean ± SE).

Week	Control	Marigold extract	<i>p</i> -value
25	87.08±2.28	90.17±1.85	0.233 ns
26	87.22±1.65	90.63±1.53	0.196 ns
27	85.95±1.84	89.83±1.37	0.120 ns
28	86.27±1.54	91.15±1.12	0.041 *
29	87.30±1.79	90.70±1.27	0.118 ns
30	87.59±1.67	90.90±1.16	0.092 ns
31	86.88±1.75	90.62±1.08	0.073 ns
32	86.19±1.69	90.25±1.01	0.061 ns
Overall (56 days)	86.90±1.06 ^b	90.48±0.96 ^a	0.0139 *

NS-non-significant, * $p < 0.05$

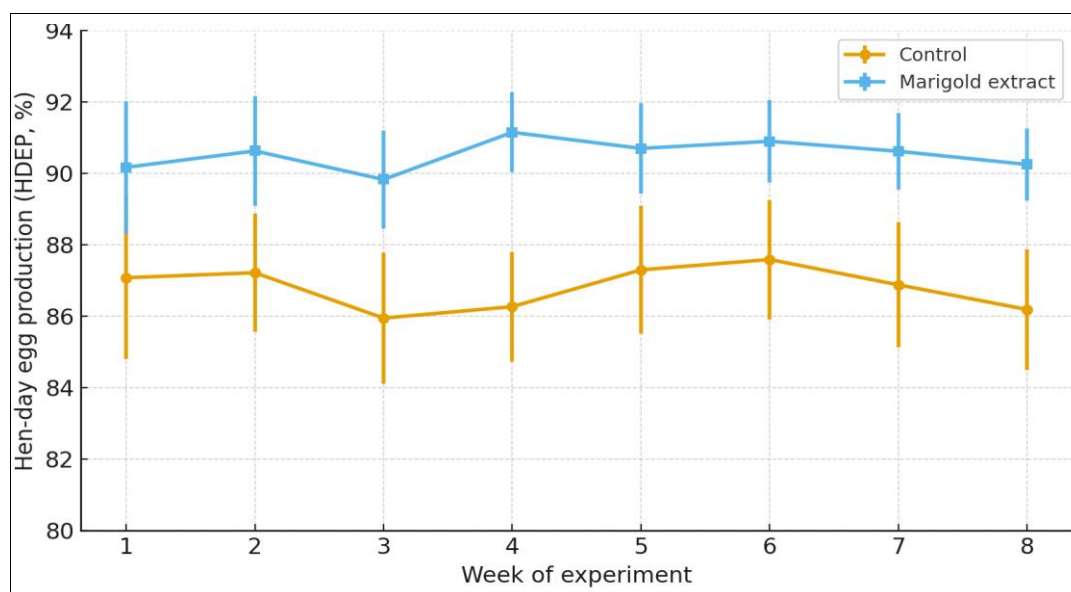


Fig 1: Weekly hen-day egg production (HDEP, %) of White Leghorn layers fed basal diet (Control) and diet supplemented with marigold petal extract (Mean ± SE).

3.2 Egg mass

Weekly egg mass values (g hen⁻¹ day⁻¹) are summarized in

Table 2 and represented graphically in Figure 2. Marigold-supplemented hens produced higher egg mass throughout the

experimental period compared to control birds. The increase was consistent across all weeks, with a mean overall egg mass of 46.70 g hen⁻¹ day⁻¹ for the marigold group versus 45.20 g hen⁻¹ day⁻¹ for controls. These results suggest improved nutrient utilization and possible enhancement in yolk formation efficiency under marigold supplementation. The increase in egg mass is in agreement with earlier reports that

natural antioxidants such as carotenoids and phenolic compounds improve egg yield and quality through reduction of oxidative stress in reproductive tissues. Some related studies with antioxidants (e.g. vitamin E, carotenoids, flavonoid-rich extracts) support such effects (Lee *et al.* 2021)^[5].

Table 2: Weekly egg mass (g hen⁻¹ day⁻¹) of White Leghorn layers fed basal diet (Control) and diet supplemented with marigold petal extract (Mean ± SE).

Week	Control	Marigold extract	P-Value
25	44.52±1.08	45.90±1.12	0.305 ns
26	45.02±0.94	46.33±0.91	0.281 ns
27	45.37±0.87	46.74±0.83	0.258 ns
28	45.46±0.82	47.06±0.79	0.190 ns
29	45.33±0.79	46.95±0.77	0.214 ns
30	45.18±0.76	46.88±0.74	0.189 ns
31	45.06±0.75	46.81±0.73	0.172 ns
32	45.01±0.73	46.76±0.72	0.168 ns
Overall (56 days)	45.20±0.77	46.70±0.78	0.174 ns

NS-non-significant

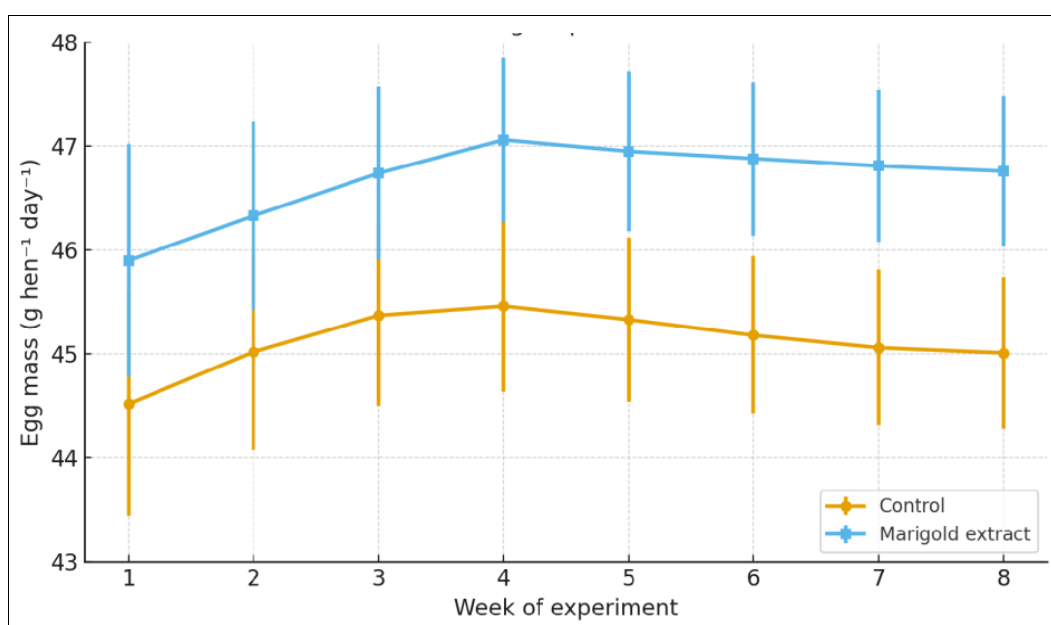


Fig 2: Weekly egg mass (g/hen/day) of white leghorn layers fed basal diet (Control) and diet supplemented with marigold petal extract (Mean ± SE).

3.3 Feed intake and feed conversion ratio (FCR)

The weekly feed intake and FCR values are presented in Table 3. Feed intake did not differ significantly between control and marigold-supplemented groups, indicating that dietary inclusion of marigold petal extract did not affect appetite or feed consumption. However, the FCR was significantly ($p < 0.001$) lower in the marigold group across all

weeks, reflecting improved feed efficiency. The findings align with the broader literature showing that marigold supplementation generally does not stimulate voluntary feed intake (Rajput *et al.*, 2012; Abdel-Wareth *et al.* 2023)^[7, 1] reported that 200 ppm marigold extract had no significant effect on feed intake.

Table 3. Weekly feed intake and feed conversion ratio (FCR) of White Leghorn layers fed control or marigold petal extract diet

Week	Feed Intake (kg hen ⁻¹ week ⁻¹) Control	Feed Intake (kg hen ⁻¹ week ⁻¹) Marigold	P-Value	FCR-Control	FCR-Marigold	P-Value (FCR)
25	0.756±0.00	0.752 ±0.00	0.184 (ns)	2.437±0.010	2.330 ±0.009	< 0.001***
26	0.757±0.00	0.753 ±0.00	0.166 (ns)	2.406±0.009	2.312 ±0.008	< 0.001
27	0.758±0.00	0.754 ±0.00	0.172 (ns)	2.393 ±0.008	2.304 ±0.008	< 0.001
28	0.759±0.00	0.754 ±0.00	0.158 (ns)	2.387±0.008	2.296 ±0.007	< 0.001
29	0.759±0.00	0.755 ±0.00	0.150 (ns)	2.391±0.008	2.299 ±0.007	< 0.001
30	0.760±0.00	0.755 ±0.00	0.147 (ns)	2.398±0.008	2.302 ±0.007	< 0.001
31	0.760±0.00	0.756 ±0.00	0.138 (ns)	2.404±0.008	2.307 ±0.007	< 0.001
32	0.761±0.00	0.756 ±0.00	0.132 (ns)	2.408±0.008	2.308 ±0.007	< 0.001
Overall (56 days)	0.759±0.001	0.754 ±0.00	0.184 (ns)	2.403±0.006	2.307±0.005	< 0.001

NS-non-significant, *** $p < 0.001$

This finding highlights the role of marigold bio actives in enhancing nutrient assimilation, antioxidant status, and energy metabolism. The reduced FCR aligns with the observed improvements in both HDEP and egg mass, confirming that dietary marigold supplementation contributes to better production efficiency during peak laying.

4. Conclusion

These findings highlight marigold petal extract as a natural feed additive capable of improving laying performance and feed efficiency during peak production, providing a sustainable alternative to synthetic performance enhancers.

Conflict of Interest

Not available

Financial Support

Not available

5. Reference

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