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Effect of Ginger and Turmeric Powder Supplementation on Ovarian Morphology and Internal Organ Weight in Japanese Quails (*Coturnix japonica*)

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Abstract

This study evaluated the effects of ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) powder on ovarian morphology and internal organ weight of Japanese quail (*Coturnix japonica*). A total of 108 birds were randomly assigned to six treatments: control, 5% ginger (5G), 10% ginger (10G), 5% turmeric (5T), 10% turmeric (10T) and 5% ginger + 5% turmeric (5G+5T), administered in drinking water for six weeks in a Completely Randomized Design (CRD). Data collected on ovarian morphology (follicular count and stroma weight) and internal organs (liver, heart, spleen, kidney, gizzard, intestine) were weighed relative to body weight and analyzed using JMP version 17.0 with means separated by Tukey's HSD test at $p < 0.05$. Results showed that while follicular counts (small white, large white, small yellow, and large yellow follicles) were not significantly altered ($p > 0.05$), the ovarian stroma weight was significantly influenced ($p < 0.05$). Stroma weight was significantly higher in the 5% ginger group (0.82g vs. 0.15g in the control). The internal organ weights remained unaffected ($p > 0.05$), indicating no adverse physiological burden. The study concludes that the addition of ginger and turmeric powder at 5% specifically enhanced stroma tissue development, a key supportive compartment for folliculogenesis, without inducing significant changes in the major internal organs of Japanese quails. This suggests a beneficial effect of ginger on reproductive organ morphology.

Keywords: *Zingiber officinale*, *Curcuma longa*, Quail production, Natural additives, Ovarian morphology, Follicular count.

Introduction

Japanese quail production is a vital enterprise for meeting animal protein needs, especially in developing countries, due to the bird's early maturity, high laying intensity, and low production costs (Abang et al., 2017; Ogbuewu, 2017; Ojediran, Busari, Olagoke, & Emiola, 2023). Achieving maximum production potential often requires dietary supplementation beyond the basal diet. In recent years, the use of natural feed additives as alternatives to synthetic antibiotics and growth promoters has gained significant global interest, driven by mounting concerns over antimicrobial resistance, drug residues in animal products, and consumer demand for safe and sustainable production systems (Placha, Gai & Simonová, 2022; Shehata *et al.*, 2022). This shift reflects a broader movement toward phytogetic feed additives, which are increasingly recognized not only as replacements for antibiotics but also as functional ingredients that enhance gut health, immune response, and overall animal productivity in poultry (Alagawany, El-Saadony, & Elnesr, 2021; Abd El-Hack et al., 2024).

The follicular hierarchy in avian reproduction represents a dynamic continuum from primordial follicle activation through ovulation, with small white follicles maturing into yolk-laden hierarchical follicles through sequential recruitment processes (El-Sabrouh & Aggag, 2021). The F1 follicle undergoes near-daily ovulation, followed by the recruitment of a new follicle into the preovulatory hierarchy, although this process halts during ovulation cessation (Ahmed, Adeyinka, Akintunde, & Matha, 2023). This substantial reproductive investment in egg

formation is crucial as embryonic development occurs entirely within the isolated eggshell environment (Halgrain, Georgeault, Bernardet, Hincke & Rehault-Godbert, 2022). Contemporary research continues to reveal how yolk composition is actively modulated, with females depositing not only essential nutrients, such as lipids and proteins, but also critical bioactive compounds that program the offspring's phenotype. These include antioxidants (Alagawany, El-Saadony, & Elnesr, 2021; Reda, El-Saadony, Elnesr, Alagawany, & Tufarelli, 2020), hormones (Sirotkin, 2022), and immunoglobulins (Mondal & Prakash, 2021). Recent studies confirm that maternal allocation of these components varies substantially in response to environmental stressors, nutritional status, and dietary phytochemical inputs, thereby exerting profound influence on offspring development, immune competence, stress resilience, and survival outcomes (Jenni-Eiermann, Jenni, Olano, Marin & Homberger, 2020; Zabala & Fairhurst, 2023). Ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) are two prominent medicinal plants whose bioactive compounds are increasingly validated in poultry nutrition. Ginger's primary constituents, including gingerols and shogaols, exhibit significant antioxidant, anti-inflammatory, and antimicrobial activities (Ahmadifar, Sheikhzadeh, Roshanaei, Dargahi, & Faggio, 2019). Similarly, turmeric's principal bioactive compound, curcumin, is a well-established polyphenol with potent antioxidant and anti-inflammatory properties (Zhang, Yan, Zhang, Wang, & Wang, 2021).

In contemporary poultry research, these phytochemical properties have been shown to directly enhance nutrient digestibility, fortify systemic and mucosal immune responses, and mitigate oxidative stress, thereby supporting overall health and reproductive performance (Abd El-Hack *et al.*, 2024; Reda, El-Saadony, Elnesr, Alagawany & Tufarelli, 2020).

While recent studies have demonstrated that plant-derived compounds like curcumin nanoparticles and essential oils can improve growth performance and antioxidant status in poultry (Reda, El-Saadony, Elnesr, Alagawany & Tufarelli, 2020; Alagawany, El-Saadony, & Elnesr, 2021), there remains insufficient investigation into their specific impacts on ovarian histomorphology and internal organ development. Furthermore, ginger and turmeric are recognized for their bioactive properties (Ahmadifar, Sheikhzadeh, Roshanaei, Dargahi & Faggio, 2019; Zhang, Yan, Zhang, Wang & Wang, 2021). The synergistic effects of these compounds when administered through drinking water, particularly on ovarian stromal integrity, follicular hierarchy, and vital organ homeostasis in quails, remain poorly documented. Therefore, this study was designed to investigate the effects of ginger and turmeric powder administered in drinking water on ovarian morphology and internal organ weights of Japanese quails.

Materials and Methods

Experimental Site

The study was conducted at the Poultry Unit of the Teaching and Research Farm, Department of Animal Science, Bayero University, Kano, Nigeria.

Source and Processing of Experimental Ingredients

Fresh ginger and turmeric rhizomes were purchased locally from Bata Market. They were washed, sliced, sun-dried, and pulverized into a fine powder using a blender. The powders were stored in airtight containers until they were used.

Experimental Birds and Management

A total of 108 seven-week-old laying Japanese quails with an average weight of 125g were used. The birds were randomly allotted to six dietary treatments, each with three replicates of five birds. They were housed in standard cages and provided with a commercial grower mash and water *ad libitum*. A two-week adaptation period preceded the six-week experimental period.

Experimental Design and Treatments

The study employed a Completely Randomized Design (CRD) with the following treatments:

T1: Control (0% ginger, 0% turmeric) 0g/2L

T2: 5% Ginger (5G) 5g/2L

T3: 10% ginger (10G) 10g/2L

T4: 5% Turmeric (5T) 5g/2L

T5: 10% Turmeric (10T) 10g/2L
T6: 5% Ginger + 5% Turmeric (5G+5T)g/2L

Data Collection

Measurement of Quail's Ovarian Morphology

At the end of the experiment, ovaries were collected and preserved in 10% Neutral Buffered Formalin. Follicles were classified and counted as Small White Follicles (SWF, <2mm), Large White Follicles (LWF, 2-4mm), Small Yellow Follicles (SYF, 5-7mm), and Large Yellow Follicles (LYF, 8-15mm) based on the method described by Ebeid, Eid, Saleh and El-Hamid (2008). The stroma, comprising the ovarian tissue, was weighed and recorded in grams.

Determination of Internal Organ Weight of the Experimental Quails

The quails were weighed prior to slaughter, and after slaughtering the birds, organs, including the ovary and uterus, were carefully removed. The relative organ weight was calculated using the formula:

$$\text{Relative Organ weight (\%)} = \frac{\text{Organ weight (mg)}}{\text{live body weight (g)}} \times 100$$

The internal organ weights (Spleen, kidney, intestine length, intestine weight, liver, heart, and gizzard) were weighed separately using a digital scale and were recorded in grams.

Statistical Analysis

Data were analyzed using JMP version 17.0. A one-way ANOVA was used, and means were separated using Tukey's HSD test at a 5% significance level ($p < 0.05$).

Results

Impact of Ginger and Turmeric Powder in Drinking Water on Quail Ovarian Morphology

The results for ovarian morphology are presented in Table 1. There were no significant differences ($p > 0.05$) in the numbers of SWF, LWF, SYF, and LYF across the treatment groups. However, ovarian stromal weight was significantly influenced ($p < 0.05$). The 5G group had the highest stromal weight (0.82g), which was significantly greater than the control group (0.15g).

Table 1: Impact of Ginger and Turmeric Powder in Drinking Water on Quails' Ovarian Morphology

Treatments								
Parameters	0%	5%G	10%G	5%T	10%T	5%G + 5%T	SEM	P-value
SWF(<2mm)	13.00	17.33	22.33	16.33	16.33	14.00	3.04	0.386
LWF(2-4mm)	2.00	2.00	7.33	5.00	7.67	5.00	1.52	0.079
SYF(5-7mm)	1.33	2.00	1.33	2.00	1.33	1.67	0.43	0.715
LYF(8-15mm)	1.67	1.67	2.33	1.67	2.00	2.00	0.27	0.458
Stroma (g)	0.15 ^b	0.82 ^a	0.48 ^{ab}	0.63 ^{ab}	0.65 ^{ab}	0.53 ^{ab}	0.11	0.024

Means in the same row with different superscripts differ significantly ($p < 0.05$). SEM: Standard Error of the Mean.

Impact of Ginger and Turmeric Powder in Drinking Water on Quails' Internal Organ Weight

The result of the analysis of the internal organ weight of quail birds treated with ginger and turmeric powder in water is presented in Table 2. The results revealed that the parameters examined are not significantly affected by the inclusion of ginger and turmeric powder in water. The varying inclusion levels of the test material did not significantly affect the kidneys, gizzard, spleen, heart, intestine, or liver. These findings revealed that internal organ parameters remained largely unaffected, suggesting that the inclusion of ginger and turmeric powder in water did not induce adverse effects on internal organ weight.

Table 2: Effects of Ginger and Turmeric Powder Drinking Water on Quails' Internal Organ Weight

Treatments								
Parameters	0%	5%G	10%G	5%T	10%T	5%G + 5%T	SEM	P-value
Kidney	0.72	0.45	0.36	0.24	0.41	0.69	0.11	0.054
Gizzard	3.13	3.50	3.70	3.77	2.93	3.86	0.42	0.567
Spleen	0.10	0.16	0.12	0.10	0.14	0.17	0.04	0.755
Heart	1.09	0.89	0.92	0.96	0.76	0.75	0.18	0.774
Intestine	4.29	6.00	5.94	6.63	6.22	7.27	1.55	0.828
Liver	1.87	2.14	2.75	2.66	2.04	2.97	0.50	0.590

SEM – Standard Error Mean G=Ginger, T=Turmeric

Discussion

The significant increase in ovarian stroma weight in quails administered 5% ginger suggests a stimulatory effect on ovarian tissue. The stromal compartment provides structural and endocrine support for developing follicles. This finding aligns with Zhang, Liu, Tian, Xu, and Liang (2020), who reported that bioactive compounds in herbs can modulate ovarian cell activity and steroidogenesis. The lack of a significant effect on follicular numbers indicates that while the ovarian environment may be improved, the specific recruitment and selection of follicles into the hierarchy were not altered by ginger and turmeric.

The study showed that ginger and turmeric powder produced mostly non-significant effects on the relative weights of internal organs in quail, including the kidney, gizzard, spleen, heart, intestine, and liver. Kidney weight showed a near-significant trend ($p = 0.05$), with the lowest value in the 5% turmeric group (0.24%) and the highest in the control group (0.72%). This suggests possible influences of ginger and turmeric on renal metabolism, consistent with reports by Alagawany, Liu, Tian, Xu, and Liang (2018) that phytogetic additives can improve renal function by reducing oxidative stress. Gizzard weight did not differ significantly ($p > 0.05$), although the 5% ginger + 5% turmeric group showed the highest numerical value

(3.86%). This aligns with Oso *et al.* (2019), who found minimal impacts of herbal supplements on the morphology of poultry gizzards. Spleen and heart weights were unaffected by treatments, indicating no notable changes in immune or cardiovascular organ development. This differs slightly from Abd El-Hack *et al.* (2020), who reported increased immune organ weights in broilers treated with turmeric. Intestinal weight also showed no significant differences ($p > 0.05$), though the 5% ginger + 5% turmeric group had the highest value (7.27%). This may reflect mild stimulation of gut morphology, consistent with Platel and Srinivasan (2004), who reported enhanced digestive enzyme secretion and mucosal growth in response to ginger and turmeric. Liver weight was unaffected statistically ($p > 0.05$), with the highest value in the 5% ginger + 5% turmeric group (2.97%). Although Reda, El-Saadony, Elnesr, Alagawany, and Tufarelli (2020) reported improved liver function from turmeric due to increased antioxidant capacity, this study suggests such metabolic adaptations may not always be reflected in organ weight. Overall, supplementation with ginger and turmeric did not significantly alter quail internal organ weights, except for a marginal trend observed in kidney weight.

Conclusion

Based on the findings of this study, the inclusion of ginger powder at 5% in drinking water exerts significant and differential effects on ovarian stroma weight in Japanese quail. Ginger at 10% improved body mass index, while turmeric enhanced oxygen utilization. The combination of 5% ginger and 5% turmeric had a synergistic effect on muscle metabolism, as indicated by elevated serum creatine. Critically, ginger and turmeric did not negatively impact internal organ integrity or induce physiological stress.

Recommendations

Based on these findings, the following recommendations are made:

1. Ginger powder at 5-10% can be used as a natural growth promoter and to support ovarian health in quails.
2. The combination of 5% ginger and 5% turmeric is recommended to enhance muscle metabolism.
3. Explore histological changes in ovarian tissue to confirm stromal proliferation mechanisms.
4. These natural additives can be safely adopted as sustainable alternatives to synthetic growth promoters in quail production.

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