



EFFECT OF DIETS SUPPLEMENTED WITH GINGER (*Zingiber officinale*) POWDER ON GROWTH AND PHYSIOLOGICAL TRAITS OF JAPANESE QUAIL (*Coturnix coturnix japonica*)

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ABSTRACT

This study evaluated the effect of experimental diets supplemented with ginger (*Zingiber officinale*) powder on the growth performance and physiological traits of Japanese quail. A total of ninety-six two-weeks-old unsexed Japanese quail birds were randomly assigned to four experimental diets that contained 0, 0.5, 1.0 and 1.5% ginger powder respectively in a completely randomized design for six weeks. Results showed no significant effect ($p>0.05$) on final body weight, feed conversion ratio, and mortality. The feed intake was significantly influenced ($p<0.05$) by dietary treatments. Birds fed diet with 1.0% ginger powder had the highest daily weight gain (3.27 g), while those fed 1.5% ginger showed reduced feed intake (860g) and improved feed efficiency. Rectal temperature decreased ($p<0.05$) with increasing levels of ginger. Birds fed diet with 1.5% ginger powder had the lowest rectal temperature (39.9°C), while respiratory and pulse rates were unaffected. Dietary inclusion of ginger powder up to 1.5% is safe for Japanese quails and can improve feed efficiency and physiological stability.

Key words: Ginger, Supplementation, Growth, Physiology, Japanese quail

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INTRODUCTION

Poultry production is a critical component of Nigeria's agricultural economy, providing affordable animal protein and supporting rural livelihoods (FAO, 2022). Among poultry species, the Japanese quail (*Coturnix coturnix japonica*) has gained prominence as a research model and commercial bird due to its rapid growth rate, early sexual maturity, high egg production, and low space and feed requirements compared to conventional poultry (Taha, 2021).

Synthetic Antibiotic Growth Promoters (AGPs) have historically been used to improve growth and prevent subclinical infections (Fernández *et al.* 2023). However, their continuous use has led to antibiotic residues in animal products and the emergence of drug-resistant bacterial strains,

prompting global bans and restrictions on their use in animal feed (Castanon, 2007). This has accelerated interest in phytogenic feed additives plant-derived supplements with antioxidant, antimicrobial, and digestive-enhancing properties as safe and sustainable alternatives (Adeyemi *et al.*, 2021). Ginger (*Zingiber officinale*) is a widely available phytogenic additive containing bioactive compounds which are responsible for its antioxidant, anti-inflammatory, and digestive-stimulating properties (Ali *et al.* 2008). Despite demonstrated benefits in chickens and turkeys (Habibi *et al.*, 2016; Zhang *et al.*, 2009), evidence specifically targeting Japanese quail remains limited. This study therefore provides empirical evidence on the suitability of ginger powder as a natural growth promoter in quail production under

tropical conditions. The objective of this study was to evaluate the effect of dietary supplementation with different levels of ginger (*Zingiber officinale*) powder on the growth performance and physiological parameters of Japanese quail (*Coturnix coturnix japonica*).

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Poultry Unit of the Animal Science Livestock Teaching and Research Farm, Bayero University Kano (latitude 11°59'1.59" N; longitude 8°25'24.97" E), Ungogo Local Government Area, Kano State. The area has a tropical dry and wet climate with annual rainfall of 787–960 mm and temperatures between 21°C and 39°C (Olofin, 1987).

Experimental Birds

A total of ninety-six (96) two-week-old unsexed Japanese quail birds were

sourced from a reputable breeder in Kano State. Prior to chick placement, the brooding facility was thoroughly cleaned and disinfected to ensure optimal sanitary conditions. Upon arrival, the Japanese quail chicks were individually weighed and immediately provided with clean drinking water supplemented with glucose and vitality® to mitigate transportation-induced stress. During the brooding period, thermal comfort was maintained using six 100-Watts incandescent bulbs as the primary heat source.

Ginger Preparation

Dried ginger was purchased from Kurmi Market, Kano, and milled to a size of 5mm using a spiced milling machine. The ginger powder was incorporated into formulated diets at four inclusion levels: 0 (control), 0.5, 1.0, and 1.5% respectively.

Table 1: Composition (%) of experimental diets supplemented with ginger powder

Treatments	1	2	3	4
Ginger powder levels (%)	0	0.5	1.0	1.5
<i>Ingredients:</i>				
Maize	39.0	39.0	39.0	39.0
Soybean meal (44%)	41.3	41.3	41.3	41.3
Wheat offal	12.0	11.5	11.0	10.5
Bone meal	3.0	3.0	3.0	3.0
Salt	0.25	0.25	0.25	0.25
Limestone	2.0	2.0	2.0	2.0
Lysine	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1
Vitamin and mineral premix	0.25	0.25	0.25	0.25
Vegetable oil	2.0	2.0	2.0	2.0
Ginger powder	0	0.5	1.0	1.5
Total	100	100	100	100
<i>Chemical composition (%):</i>				
Crude protein	23.6	23.5	23.4	23.3
Crude Fiber	4.48	4.44	4.40	4.35
Ether extract	5.37	5.35	5.34	5.32
Calcium	1.85	1.85	1.85	1.85
Phosphorus	0.77	0.77	0.77	0.76

Experimental Design

The experiment was laid out in a Completely Randomized Design (CRD)

comprising of four dietary treatments with three replicates each, and eight birds per replicate. The feeding trial lasted six weeks.

Data Collection

Growth Performance indices

Initial body weights of the quail birds were recorded at the commencement of the experiment and subsequently measured on a weekly basis using a calibrated digital weighing scale. Final body weights were obtained at the end of the sixth week of the trial. The following growth performance parameters were determined:

The total body weight gain was calculated as the difference between final body weight and initial body weight.

The average daily weight gain was determined by dividing total body weight gain by the duration of the experimental period (days).

The total feed intake was estimated as the summation of the difference between the quantity of feed offered daily to the quails and the daily left overs.

The average daily feed intake was calculated by dividing total feed intake by the number of experimental days, while the feed conversion ratio was computed as the ratio of feed intake (g) to the body weight gain (g).

Physiological Parameters

The following physiological indices were evaluated:

Respiratory rate (breaths/min) of quail birds was determined by visually counting flank movements for 60 seconds using a stopwatch, and expressed as breaths per minute.

Rectal temperature was measured using a calibrated digital thermometer (accuracy ± 0.1 °C). The bird was gently lifted and the disinfected probe of the thermometer was gently inserted into the cloaca and held in place until a stable reading was obtained (approximately 60 s), after which the temperature was recorded.

The pulse rate (beats/min) was assessed using a stethoscope positioned beneath the wing (axillary region). Heartbeats were counted over a 60-second period using a stopwatch and expressed as beats per minute.

Statistical Analysis

Data obtained were subjected to one-way Analysis of Variance (ANOVA) using Genstat version 17. Means were separated using Tukey's procedure at 5% level of significance ($p < 0.05$).

RESULTS

Proximate composition of ginger (*Zingiber officinale*) powder

Table 2 below showed the proximate analysis of the ginger (*Zingiber officinale*) powder. It revealed a composition of 67.4% nitrogen-free extract, 10.6% crude fibre, 4.38% crude protein, and 95.8% dry matter.

Table 2: Proximate Composition of Ginger (*Zingiber officinale*) powder

Parameters	Concentration (%)
Crude Fiber	10.6
Crude Protein	4.38
Ether Extract	7.30
Ash	10.4
Nitrogen Free Extract	67.4
Dry matter	95.8

Growth performance of quail birds

Table 3 below showed the dietary supplementation with ginger (*Zingiber officinale*) powder did not significantly influence ($p > 0.05$), final body weight, or total body weight gain of Japanese quail across the treatment groups. The initial body weight observed were similar ($p > 0.05$) and ranged from 18.5 to 23.3g, while final body weight varied between 154 and 157g. Total body weight gain was comparable among treatments (132-137g), indicating that ginger inclusion up to 1.5% had no adverse on overall growth performance.

Average daily weight gain was not significant ($p > 0.055$) among treatments. Dietary ginger supplementation exerted a significant effect ($p < 0.05$) on feed intake parameters. Birds fed diet with 0.5% ginger powder recorded the highest feed intake (986g) and daily feed intake (23.5 g/bird/day), followed by those on 1.0%

inclusion. Conversely, the 1.5% inclusion level resulted in the lowest feed intake (20.5 g/bird/day).

Ginger supplementation did not significantly alter growth parameters such as

final body weight and weight gain, it influenced feed intake, with moderate inclusion levels (0.5–1.0%) promoting higher consumption, whereas higher inclusion (1.5%) reduced feed intake.

Table 3: Growth Performance of Japanese Quail Birds Fed diets with Ginger (*Zingiber officinale*) Powder

Treatments	1	2	3	4		
Ginger powder levels (%)	0	0.5	1.0	1.5	SEM	P
<i>Parameters:</i>						
Initial Weight	23.3	22.2	20.2	18.5	3.50	0.56
Final Weight	156	155	158	154	5.36	0.93
Body Weight Gain	132	133	137	136	6.30	0.83
Daily Weight Gain	3.11	3.17	3.27	3.23	0.14	0.07
Total Feed Intake	932 ^c	986 ^a	970 ^b	860 ^d	0.54	0.01
Daily Feed Intake	22.2 ^c	23.5 ^a	23.1 ^b	20.5 ^d	0.01	0.01
Feed Conversion Ratio	7.06	7.43	7.09	6.32	0.34	0.06

^{a-d}Mean values along the rows with different superscripts are significantly different (p<0.05)

SEM: Standard error of means

Physiological responses of quail birds

Dietary supplementation with ginger (*Zingiber officinale*) powder had no significant effect (p > 0.05) on respiratory rate (RR) or pulse rate (PR) of Japanese quail. The values of respiratory rate ranged from 67.7 to 70.0 breaths/min across treatments, while pulse rate varied between 369 and 374 beats/min, indicating that ginger inclusion did not markedly influence cardiorespiratory activity.

Rectal temperature (RT) was significantly affected (p < 0.05) by dietary treatments. Birds in the control group (0% ginger) recorded the highest RT (41.7°C), which was higher (p < 0.05) than values observed in quails fed ginger-supplemented diets. A progressive reduction in RT was observed with increasing levels of ginger inclusion, with the lowest values recorded at 1.0% (40.1°C) and 1.5% (39.9°C), which did not differ significantly (p > 0.05) from each other.

Table 4: Physiological response of Japanese quail fed diets with ginger (*Zingiber officinale*) powder

Treatments	1	2	3	4		
Ginger powder levels (%)	0	0.5	1.0	1.5	SEM	P
<i>Parameters:</i>						
Respiratory Rate (beats/min)	68.7	70.0	67.7	70.0	2.44	0.74
Rectal Temperature (°C)	41.7 ^a	40.6 ^b	40.1 ^c	39.9 ^c	0.20	0.01
Pulse Rate (beats/min)	369	372	371	374	5.77	0.77

^{a-c}Mean value along the rows with different superscripts are significantly different (p<0.05)

SEM: Standard error of means

DISCUSSION

*Proximate composition of ginger (*Zingiber officinale*) powder*

The proximate composition of ginger (*Zingiber officinale*) powder indicates that the fibre fraction contributes to structural polysaccharides that may support gut function, while the ash content indicates the presence of mineral elements. The relatively low crude protein content confirms that ginger is not a significant protein source in poultry diets. Its low moisture and high dry matter content are indicative of enhanced storage stability and reduced susceptibility to microbial deterioration.

Effect of dietary ginger powder on growth performance

This study evaluated the effects of dietary inclusion of ginger (*Zingiber officinale*) powder on growth performance of Japanese quails (*Coturnix coturnix japonica*). The findings indicated that ginger supplementation up to 1.5% did not significantly influence final body weight or total body weight gain, although it exerted a significant effect on feed intake parameters.

This observation is consistent with previous reports of other researchers on phytogenic feed additives, where improvements in growth performance are often variable and dependent on dosage and diet composition (Hashemi and Davoodi, 2011). Phytogenic additives are primarily recognized for their functional properties, including antioxidant, antimicrobial, and digestive-enhancing effects Greathead (2003).

Quail birds fed 0.5% and 1.0% ginger exhibited significantly higher feed intake compared to the control, whereas those fed 1.5% ginger showed a marked reduction in feed consumption. This indicates a dose-dependent response, where moderate inclusion levels enhance feed palatability and stimulate appetite. The improved feed intake at lower inclusion levels could be attributed to bioactive compounds such as gingerols and shogaols, which are known to stimulate

digestive secretions and improve gut motility (Zhang *et al.*, 2009).

Despite variations in feed intake, the absence of significant differences in weight gain suggests that nutrient utilization efficiency may have been maintained across treatments. Previous studies have reported that ginger enhances intestinal morphology, increases villus height, and promotes favorable gut microbiota balance, thereby improving nutrient absorption (Karangiya *et al.*, 2016). The results of this study also support the role of ginger (*Zingiber officinale*) as a phytogenic modulator of feed intake and digestive physiology. These findings highlight the importance of dosage optimization when incorporating phytogenic additives into quails' diets.

Effect of dietary ginger powder on physiological parameters

The present study demonstrated that dietary supplementation with ginger (*Zingiber officinale*) powder did not significantly influence respiratory rate or pulse rate in Japanese quails, suggesting that the inclusion levels evaluated did not impose any physiological stress. This observation is consistent with previous reports indicating that phytogenic feed additives, including scent leaf meal exert minimal effects on heart rate and respiration under non-stress conditions (Essien *et al.*, 2024). The stability of these parameters across treatments may indicate that the birds maintained homeostatic balance irrespective of dietary inclusion levels.

Rectal temperature was significantly reduced in ginger supplemented groups, with a clear dose-dependent decline observed as inclusion levels increased. This finding suggests a potential thermoregulatory benefit of ginger, which may be attributed to its bioactive compounds, including gingerols and shogaols. These compounds have been reported to possess antioxidant and vasodilatory properties, which can enhance peripheral heat dissipation and reduce metabolic heat load (Ali *et al.*, 2008). The observed hypothermic effect aligns with

earlier studies in poultry, where phytogetic additives were shown to mitigate heat stress by modulating oxidative status and improving thermal tolerance (Zhang *et al.*, 2009).

The reduction in rectal temperature without concurrent changes in respiratory rate further suggests that ginger may improve thermoregulation through improved antioxidant defense systems. This is particularly relevant under tropical production conditions, where elevated ambient temperatures often compromise quails' performance.

The findings indicate that while ginger supplementation does not significantly alter physiological indices, it exerts a beneficial effect on body temperature regulation of quail birds.

CONCLUSIONS

- Dietary inclusion of ginger (*Zingiber officinale*) powder at levels up to 1.5% did not adversely affect growth performance of Japanese quail (*Coturnix coturnix japonica*) birds.
- Ginger supplementation improved feed utilization efficiency and contributed to enhanced physiological stability.
- These findings suggest that ginger can be effectively utilized as a safe, natural phytogetic feed additive with potential to serve as an alternative to conventional antibiotic growth promoters in quail production systems.

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