

EFFECT OF DIETARY GINGER (*Zingiber officinale*) ON SEMEN QUALITY AND GROWTH PERFORMANCE IN NOILER COCKS

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ABSTRACT

This study evaluated the effects of graded dietary levels of milled ginger on semen characteristics and growth performance of Noiler cocks. Thirty-six (36) Noiler cocks were used in an eight-week experiment arranged in a Completely Randomized Design (CRD). The birds were allocated to four dietary treatments with varying levels of dried milled ginger: T1 (0% control), T2 (0.5%), T3 (1.0%), and T4 (1.5%) with nine (9) birds per treatment. Semen volume, colour, mass activity, motility, concentration, and live sperm percentage were assessed. Growth parameters monitored included initial weight, final weight, total weight gain, daily weight gain, total feed intake, and feed conversion ratio (FCR). Results revealed that Semen quality parameters showed a significant ($p < 0.05$) dose-dependent response. The 1.5% ginger inclusion (T4) yielded the optimal results, producing semen with the highest sperm motility (4.25), concentration ($4.55 \times 10^6/\text{ml}$), and an outstanding live sperm percentage (89.75%). In stark contrast, growth

Introduction

The global shift towards sustainable and antibiotic-free poultry production has intensified the search for natural feed additives that can enhance productivity, health, and welfare (Dhama *et al.*, 2022). Among the most promising alternatives are phytogenic feed additives plant-derived compounds from herbs, spices, and their extracts—which are valued for their antimicrobial, antioxidant, anti-inflammatory, and digestive-stimulating properties (Zhai *et al.*, 2021). These additives not only aim to replace synthetic growth promoters but also offer the potential to address specific physiological challenges in modern poultry farming.

performance was best in the control group (T1), which achieved the highest final weight (4.10 kg), total weight gain (0.65 kg), daily weight gain (0.0086 kg/day), and the most efficient FCR (82). All ginger-supplemented groups exhibited significantly poorer weight gain and feed efficiency, with the worst FCR recorded at the 1.0% inclusion level (97.67). The study reveals a clear physiological trade-off: a 1.5% dietary inclusion of milled ginger significantly enhances semen quality, making it beneficial for breeding cocks, but simultaneously suppresses growth and feed efficiency, rendering it unsuitable for cocks reared primarily for meat. The application of ginger in Noiler cock nutrition must, therefore, be purpose-specific based on the production objective.

Keywords: *Zingiber officinale*, phytogenic additive, semen characteristics, sperm motility, feed conversion ratio, Noiler chicken, growth-performance trade-off.

Ginger (*Zingiber officinale* Roscoe) is a rhizome with a well-documented history in traditional medicine and is increasingly recognized in animal nutrition as a potent phytogenic. Its bioactive constituents, primarily gingerols and shogaols, exhibit strong antioxidant and anti-inflammatory activities (Zhang *et al.*, 2023). In poultry, dietary ginger has been reported to modulate gut health, improve nutrient absorption, and enhance antioxidant status, which can indirectly influence overall vitality and resistance to stressors (El-Hack *et al.*, 2022). Notably, the antioxidant capacity of ginger is of particular interest for male reproduction, as oxidative stress is a primary factor compromising sperm quality, leading to reduced motility, viability, and fertilizing potential in avian species (Khan *et al.*, 2024; Surai & Fisinin, 2022). Despite these promising attributes, the application of ginger in poultry nutrition is not without complexity. Phytogenics often exhibit dose-dependent and system-specific effects. A compound that enhances one physiological system (e.g., reproduction) may simultaneously exert neutral or even suppressive effects on another (e.g., somatic growth) due to differential metabolic partitioning or hormonal interplay (Ogbuewu *et al.*, 2023; Nwafor *et al.*, 2024). Therefore, a holistic evaluation that considers both productive and reproductive parameters is essential to determine the true utility and optimal dosage of any phytogenic additive.

The Noiler chicken, a dual-purpose breed developed for improved meat and egg production under low-input systems in tropical regions, represents a valuable genetic resource for smallholder farmers. Optimizing the management of Noiler cocks is crucial, as they serve dual roles: as sources of meat and as essential contributors to flock fertility and genetic improvement. However, there is a pronounced scarcity of scientific data on

targeted nutritional strategies, particularly involving phytochemicals like ginger, to enhance the semen quality and overall performance of Noiler cocks.

This study was therefore designed to bridge this knowledge gap. It aims to comprehensively evaluate the effects of graded dietary levels of milled ginger on both the semen characteristics and the growth performance of Noiler cocks.

Experimental site

The research was conducted at teaching and research poultry farm of Department of Animal Health and Production, Federal polytechnic Bauchi, Bauchi State of Nigeria. Bauchi is located at latitude 13.3N and Longitude 90 45E. It has elevation of altitude 690.20 above sea level. Moreover, Bauchi state has two distinct seasons. The Rainy season from May to September with average annual rainfall varies between 600-1300mm, while the temperature ranges from 18.33°C-40.39°C. As April being hottest month and January the coldest month. Relative humidity is highest in August having the value of 66% and lowest in February with 16.5% (Oyeniran *et al.*, 2022).

Experimental Birds

A total of thirty-six (36) adult Noiler cocks were purchased from reputable poultry in Bauchi, Bauchi State, Nigeria. Before the commencement of the experiment, the Cocks were allowed two (2) weeks adjustment period to get acclimatized.

Experimental design

The cocks were allotted to four treatment groups in a completely randomized design (CRD) with three replicate per treatment having 3 birds in each replicate. They were kept individually in a battery cage house that was thoroughly cleaned, washed, disinfected and each cage labelled. Feed and water were supplied *ad libitum*.

Experimental Diets

The experimental diets consist of a standard Commercial feed, in which dried milled Ginger (*Zingiber officinale*) was included as additive thus, formed the experimental diet at different level of inclusion (0g, 0.5g, 1.0g, & 1.5g) which were coded as T1, T2, T3 & T4 respectively.

Source of feeds, test sample and experimental material

The Standard commercial feed was purchased from recognized feed dealers in Yelwa Market Bauchi Nigeria while Ginger (*Zingiber officinale*) was purchased from Wunti market. Both markets are located in Bauchi metropolis, Bauchi State, Nigeria.

Processing of the test sample

The test sample (*Zingiber officinale*) was clean by removing debris in it. The clean sample was allowed for 14 days to properly dried under shed, then milled using a grinding machine until a powdery form was obtained. The powder was packaged and stored for the research purpose.

Data Collection

Data were collected for determination of the following semen characteristics parameters: Semen samples were collected weekly for 6 weeks, after four weeks feeding trial by abdominal massage as described by Hafez (1987) in the determination of semen characteristics. Volumes, Semen colour, Semen Mass activity Semen Motility, Percentage of live/Dead and Concentration

Semen Characteristics

The inclusion of milled ginger significantly ($p < 0.05$) influenced the semen characteristics of Noiler cocks (Table 1). Semen volume followed a quadratic pattern, with the highest volume (0.44 ml) recorded at the 1.0% inclusion level, which was significantly greater than all other treatments. This high-volume semen was notably watery in consistency. The 0.5% and 1.5% inclusion levels produced milky semen with moderate volumes (0.26 ml and 0.22 ml, respectively), both superior to the control (0.01 ml).

Sperm quality parameters indicated a clear optimal dose. Mass activity and sperm motility were significantly highest at the 1.5% inclusion level (3.0 and 4.25, respectively), matching or exceeding the control. The 1.0% level resulted in the poorest mass activity and motility. Sperm concentration was also significantly highest at 1.5% (4.55×10^6 /ml). The most pronounced effect was on sperm viability. The percentage of live sperm increased with ginger inclusion, peaking dramatically at 89.75% for the 1.5% group, which was significantly higher than the 63.25% at 1.0% and the ~30% in the control and 0.5% groups.

Growth Performance

The growth performance of Noiler cocks was significantly ($p < 0.05$) affected by dietary ginger supplementation (Table 2). Birds in the control group (0.0% ginger) demonstrated superior growth, achieving the highest final body weight (4.10 kg), total weight gain (0.65 kg), and daily weight gain (0.0086 kg/day). All ginger-supplemented groups had significantly lower final weights and gains. Feed intake was highest at the 1.0% inclusion level (4040 g) and lowest in the control group (3467 g). Consequently,

the feed conversion ratio (FCR) was most efficient (lowest) in the control group (82). FCR was significantly poorer (higher) in the 0.5% and 1.0% treatment groups (97 and 97.67, respectively), with the 1.5% group showing intermediate efficiency (85.5).

DISCUSSION

The results of this study demonstrate that milled ginger acts as a powerful nutraceutical for enhancing semen quality in Noiler cocks but imposes a clear trade-off by suppressing somatic growth performance. This dichotomy highlights the complex, dose-dependent bioactivity of phytogetic feed additives in avian physiology.

The dramatic improvement in sperm viability, concentration, and motility at the 1.5% inclusion level is the most significant finding. This aligns with the well-established antioxidant properties of gingerols and shogaols, the primary bioactive compounds in ginger (Khan *et al.*, 2024; Zhang *et al.*, 2023). Oxidative stress is a major cause of sperm membrane lipid peroxidation and DNA fragmentation, leading to reduced motility and viability (Surai & Fisinin, 2022). By effectively scavenging reactive oxygen species (ROS) within the reproductive tract and testes, ginger likely protects the structural and functional integrity of sperm cells during spermatogenesis and epididymal storage. This protective mechanism is supported by similar findings where dietary antioxidants improved rooster semen profiles (Adewole & Oke, 2023; Blesbois, 2023). The poor semen quality at the 1.0% level, characterized by watery consistency and low motility, suggests a potential transient pharmacological or irritant effect at this specific dose. This may involve an alteration in seminal plasma composition from the accessory glands, such as the prostate and bulbourethral glands, before the system adapts or before the optimal antioxidant threshold is reached at 1.5% (Nwafor *et al.*, 2024). This non-linear response underscores the importance of dosage precision when using phytogetics.

Conversely, the consistent negative impact on growth performance indicates that the metabolic effects of ginger differ markedly for reproductive versus somatic tissues. The significantly higher feed intake in ginger-fed birds (especially at 0.5% and 1.0%), which did not translate to better weight gain, resulted in a significantly worse FCR. This indicates a reduction in metabolic efficiency for growth. Ginger is known to possess thermogenic properties and can stimulate digestive secretions and metabolic rate (El-Hack *et al.*, 2022). In growing cocks, this heightened metabolic activity may partition energy and nutrients away from protein deposition (muscle growth) and towards heat production (thermogenesis) and the hepatic metabolism of ginger's bioactive compounds (Ogbuewu *et al.*, 2023). This energetic diversion explains the reduced weight gain despite higher feed consumption. The superior FCR and growth in the control group underscore that the standard diet was optimally balanced for anabolic

processes, without the metabolic "cost" or diversion induced by ginger supplementation (Adeyemi & Oke, 2023).

Table 2. Performance of Noiler cocks fed Dried Milled Ginger as feed additive

Treatments	Initial weight	Final Weight Gain	Total Weight Gain	Daily Weight Gain	Total Intake	Feed Conversion ratio
0.0%	3.45 ^a	4.10 ^a	0.65 ^a	0.0086 ^a	3466.67 ^d	82 ^c
0.5 %	2.73 ^c	3.03 ^c	0.303 ^c	0.0067 ^b	3953.33 ^b	97 ^a
1.0%	2.93 ^b	3.23 ^b	0.37 ^b	0.0067 ^b	4040 ^a	97.67 ^a
1.5%	2.80 ^c	3.30 ^b	0.50 ^b	0.005 ^c	3620 ^c	85.5 ^b
SEM	0.03	0.04	0.04	0.00	9.76	0.41

Means in the same row with different superscript are significantly different ($P < 0.05$)
LOS= Level of significance. SEM= Standard error of means

Table 1: Effect of Inclusion Levels of Milled Ginger as Feed Additive on Semen Characteristics of Noiler Cocks

Treatment	Semen vol. (ml)	Semen Colour (X10 ⁶)	Mass activity (%)	Motility (%)	Concentration (%)	Percentage live semen (%)
0.0%	0.01 ^c	Creamy	3.0 ^b	3.75 ^b	4.08 ^b	31.75 ^c
0.5%	0.26 ^b	Milky	3.0 ^b	4.25 ^a	4.05 ^b	29.75 ^c
1.0%	0.44 ^a	Watery	2.0 ^c	2.75 ^c	3.93 ^b	63.25 ^b
1.5%	0.22 ^b	Milky	3.0 ^a	4.25 ^a	4.55 ^a	89.75 ^a
SEM	0.02	0.00	0.13	1.29	0.14	6.05

Means in the same row with different superscript are significantly different ($P < 0.05$)
LOS= Level of significance. SEM= Standard error of means

Conclusion

A 1.5% dietary inclusion of milled ginger significantly enhances semen quality, making it beneficial for breeding cocks, but simultaneously suppresses growth and feed efficiency, rendering it unsuitable for cocks reared primarily for meat.

Recommendation

Application of ginger in Noiler cock nutrition must, therefore, be purpose-specific based on the production objective.

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