ANALYSIS OF BODY WEIGHT AND MEASUREMENTS IN BROILER CHICKENS USING A CORRELATION MATRIX: THE EFFECT OF MILLED DRIED GINGER

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ABSTRACT
This study investigated the impact of 0.5% dried milled ginger supplementation on the growth performance of Arbor Acre and Ross 308 broilers, focusing on the correlation between body weight and linear body measurements across various growth stages. It was conducted at a private farm in Zaria, Nigeria, where 180-day-old broiler chicks were randomly allocated into three replicate groups, with diets formulated to meet NRC (2000) nutritional recommendations. Body weight was measured weekly, while linear parameters, including keel length, body girth, and wing length, were recorded biweekly. Statistical analysis was performed using Pearson's correlation coefficients in SPSS Version 25. The results revealed distinct growth dynamics across the breeds. Arbor Acre broilers demonstrated significant correlations between body weight and keel length (0.71) and wing length (0.68) during early growth stages, emphasizing skeletal development as critical to weight gain. Conversely, Ross 308 broilers displayed robust early growth, characterized by strong correlations with body girth (0.84) and body length (0.70) at week 2 but shifted focus to metabolic and physiological processes in later stages, with weakened correlations observed by week 6. The findings indicate that ginger supplementation promotes growth by enhancing skeletal and metabolic traits, with varying impacts across breeds and growth phases. Recommendations include emphasizing early supplementation for Arbor Acre and Ross 308 broilers.

Keywords: Broiler performance, Dried ginger, Skeletal growth, Correlation

INTRODUCTION

The global poultry industry is a crucial contributor to the agricultural sector, providing a significant source of animal protein for human consumption (Ahiwe *et al*., 2019). To sustain this demand, enhancing poultry growth performance while maintaining health and efficiency is essential. Broiler chickens are extensively raised for meat production due to their rapid growth rate and high feed conversion efficiency, making them an ideal subject for nutritional studies (Habibu *et al*., 2020). Nutritional strategies, including the incorporation of phytogenic feed additives, have gained prominence as alternatives to synthetic growth promoters due to concerns about food safety and antimicrobial resistance (Kakar *et al*., 2022).

One phytogenic additive receiving increasing attention is ginger (*Zingiber officinale*), valued for its bioactive components such as gingerols, shogaols, and zingerone, which exhibit antioxidant, antimicrobial, and anti-inflammatory properties (Yulistiani *et al*., 2023). These properties have the potential to improve growth performance and overall health in broiler chickens (Hossain *et al*., 2021). However, the exact physiological mechanisms through which ginger influences growth parameters, including body weight and morphological traits, remain underexplored, creating a gap in the current understanding of its application in poultry diets (Iqbal *et al*., 2021).

The problem persists where farmers and researchers seek to optimize growth performance while ensuring economic sustainability and animal welfare. Conventional feed additives often fail to balance these aspects, leading to the need for alternative approaches that support optimal growth while meeting consumer demands for healthier, more sustainable poultry production (Abdurrahman *et al*., 2020). Therefore, this study aimed to analyze the effects of milled dried ginger supplementation on broiler chickens' body weight and body measurements using correlation matrix analysis.

MATERIALS AND METHODS

Experimental site

The study was conducted on a private farm in Graceland, Sabon Gari Local Government, Zaria, Kaduna state. The farm site is located on Latitude 11° 12"N and Longitude 7° 68"E. The climate is characterized by well-defined dry and wet seasons with a mean annual rainfall ranging from 700 - 1400 mm. The average minimum and maximum daily temperature vary from 15.6°C during the cold season and 38.5°C during the hot season. The area is characterized by a relative humidity of 36% in dry season and 78.5% for wet season as stated by the Institute for Agricultural Research Metrology Station (IARMS, 2024)

Experimental birds and management

One hundred and Eighty (180) day-old broiler chicks of mixed sexes were purchased in reputable farms in Ibadan, Oyo state, comprising Ninety (90) Abor acres chicks and Ninety (90) Ross 308 chicks. The birds were placed on an experimental diet of 0.5% milled dried ginger and were replicated three times with thirty birds in each replicate in a completely randomized design. Feed and water were supplied *ad libitum.* A Standard vaccination regime and strict biosecurity were maintained on the farm throughout the experiment. The experiment lasted for six weeks. The experimental diet which contained 0.5% milled dried ginger at both starter and finisher phases was both isonitrogenous and isocaloric according to the requirement guidelines of NRC (2000) recommendations as presented in Table 1.

Data collection

Body weight (BW) was taken weekly and other body measurements (Linear body measurements) were taken forth-nightly (at weeks 2, 4, and 6 respectively). Body weight was taken using a sensitive digital scale (10kg Camry Electronic Digital Scale, Taiwan), and linear measurements were taken using a metre tape. The linear measurements taken were the Body length (BL), Body girth (BG), Thigh length (TL), Shank Length (SL), Keel length (KL) and Wing length respectively.

Statistical analysis

Correlation between body weight and the linear measurements was determined by the use of the Pearson's method (Falconer,1989), implemented in SPSS Version 25 (IBM SPSS). Pearson correlation coefficients among the body measurements were calculated for each of the broiler chicken fed 0.5% milled dried ginger which was used to generate the correlation matrix.

RESULT AND DISCUSSION

The correlation matrix for Arbor Acre and Ross 308 broiler breeds fed a 0.5% milled dried ginger diet at Week 2 revealed significant positive correlations between body weight and skeletal measurements as presented in Table 2, Thigh length (0.69), Keel length (0.71), and Wing length (0.68). Ross 308 broilers at Week 2 displayed strong positive correlations between body weight and body girth (0.84), body length (0.70), and thigh length (0.63). The robust association with these traits indicates that ginger supplementation significantly enhances early development through improved metabolic and skeletal efficiency. Similar findings by El-Katcha *et al*. (2021) reinforced the effectiveness of such dietary regimens in supporting comprehensive growth during the initial stages of life. These findings highlight that skeletal dimensions directly influence body weight gain, underscoring their importance in the growth process. Previous research corroborates this relationship, as skeletal traits such as keel and wing length have been identified as critical predictors of broiler body weight during the early growth phase (Adeyemi *et al*., 2022). The strong correlations suggest that skeletal development, particularly in features that aid mobility and structural support, is crucial for achieving optimal growth outcomes in Arbor Acre chickens during early development stages.

Table 3 shows the body morphometry correlation matrix of Arbor Acre and Ross 308 broiler breeds fed 0.5% milled dried ginger diet at week 6. Arbor Acre broilers demonstrated weak or no significant correlations between body weight and most traits, with negative correlations observed for wing length (-0.25) and thigh length (-0.11). Ross 308 broilers showed strong correlations between body weight and body girth (0.81) and wing length (0.54), while negative correlations were noted for thigh length (-0.09) and wing length (-0.42).

These observations suggest a stabilization phase with reduced focus on external growth and an emphasis on functional traits such as metabolic capacity. Research by Rahayu *et al*. (2022) supports the notion

that advanced stages of growth involve prioritizing energy utilization for internal processes over skeletal expansion, aligning with the findings in Ross 308 chickens. The diminishing impact of the 0.5% ginger diet on weight-related traits in Arbor acre could be attributed to birds entering a maintenance phase, as reported in similar research by El-Katcha *et al*. (2021) and Awang *et al*. (2020).

Table 1: Ingredient composition for the broiler diets fed 0.5% milled dried ginger

Ingredients	Starter Diet	Finisher Diet
Maize	53.50	60.50
Wheat bran	0.00	2.00
Groundnut cake	17.00	11.00
Soybean meal	25.00	22.00
Bone meal	2.50	2.50
Limestone	0.70	0.70
Lysine	0.10	0.10
Methionine	0.20	0.20
Salt	0.25	0.25
Premix	0.25	0.25
Ginger	0.50	0.50
Total	100.00	100.00
Calculated analysis		
Metabolizable Energy (Kcal/kg)	2905.47	2919.96
Crude Protein (%)	23.05	20.03
Ether Extract (%)	4.06	3.93
Crude Fibre (%)	3.56	3.39
Calcium (%)	1.39	1.06
Phosphorus (%)	0.48	0.50
Lysine (%)	1.21	1.19
Methionine (%)	0.53	0.51
Cost (₦/kg)	607.36	772.36

Table 2: Correlation matrix of Arbor acre and Ross 308 broiler fed 0.5% milled dried ginger diet at week 2

	BW	BG	BL	TL	SL	KL	WL
BW	1	0.84**	0.70**	0.63**	0.52**	0.40	0.54**
BG	0.50	1	0.75**	0.79**	0.68**	0.33	0.46**
BL	-0.30	-0.06	1	0.72**	0.47*	0.43*	0.46*
TL	0.69**	0.35	-0.33	1	0.59**	0.22	0.43*
SL	0.31	0.53	-0.17	0.19	1	0.73	0.62**
KL	0.71**	0.59	0.15	0.40	-0.01	1	0.35
WL	0.68**	0.16	-0.33	0.49	0.44	0.07	1

BW: Body weight; BG: Body girth; TL: Thigh length; SL: Shank length; KL: Keel length: WL: Wing length; *p<0.05; **p<0.01
Values above diagonal represent Ross 308, values below diagonal represent Arbor acre

Table 3: Correlation matrix of Arbor acre and Ross 308 broiler fed 0.5% milled dried ginger diet at week 6

	BW	BG	BL	TL	SL	KL	WL
BW	1	0.81**	0.23	-0.09	0.35	0.42*	0.54**
BG	0.45	1	0.28	-0.25	0.56**	0.36	0.70**
BL	0.01	0.14	1	0.15	-0.15	-0.34	0.09
TL	-0.11	0.34	0.01	1	-0.47*	0.13	-0.42*
SL	0.03	0.29	-0.31	0.19	1	0.55*8	0.74**
KL	0.09	-0.06	-0.15	0.51	0.11	1	0.34
WL	-0.25	0.23	-0.26	0.38	0.48	-1.1	1

BW: Body weight; BG: Body girth; TL: Thigh length; SL: Shank length; KL: Keel length: WL: Wing length; *p<0.05; **p<0.01
Values above diagonal represents Ross 308, values below diagonal represents Arbor acre

CONCLUSION

The inclusion of 0.5% dried milled ginger in broiler diets influences growth differently across Arbor Acre and Ross 308 breeds, varying with their growth stages. Arbor Acre broilers benefit most in weeks 2 showing significant skeletal development, particularly in keel length, before growth plateaus by week 6. Ross 308 broilers exhibited strong early growth, with a later shift toward metabolic and internal physiological focus, suggesting the need for dietary adjustments after week 6.

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