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Influence of Dietary Supplementation with *Celosia argentea* (Soko) Stem, Oxytetracycline and Butylated Hydroxyanisole on Production Indices, Blood Chemistry, Carcass and Meat Quality in Broiler Chickens

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ABSTRACT

This study investigated the influence of dietary supplementation with Celosia argentea (soko) stem, oxytetracycline, and butylated hydroxyanisole (BHA) on production indices, blood chemistry, and carcass and meat quality in broiler chickens. A total of 240-day-old Ross 308 broilers were randomly assigned to four dietary treatments with six replicates and ten birds per replicate for a period of six weeks: Basal diet (T1), Basal diet with BHA and Oxytetracycline (T2), and two experimental groups with 0.25g/kg (T3) and 0.5g/kg (T4) of *Celosia argentea* stem powder, respectively. The phytochemical analysis indicated the presence of flavonoids, coumarins, glycosides, terpenoids, and phytic acid. Production indices did not differ significantly ($p > 0.05$). with supplemented birds showing higher weight gain, feed intake, and the best FCR. Blood chemistry results showed a hypocholesterolemic effect of Celosia argentea, with reduced cholesterol and LDL levels. ALT and AST were reduced, reflecting the feed additive's hepatoprotective effect. The supplemented diet did not significantly affect haematological indices. Carcass and meat quality showed no significant differences ($p > 0.05$) across treatments, with dressing percentage ranging from 69.81% (T1) to 74.89% (T2), suggesting that supplementation of Celosia argentea (soko) stem powder at up to 0.5g/kg diet may be a potential alternative to synthetic feed additives such as Butylated hydroxyanisole and oxytetracycline in broiler diets.

Keywords: Ross 308, Oxytetracycline, Celosia argentea, performance, serum, and meat quality

INTRODUCTION

In recent years, agricultural by-products and plant-derived additives have gained increasing attention as sustainable alternatives to synthetic feed additives in poultry production. Conventional additives such as antibiotics and synthetic growth promoters, though effective in enhancing growth performance, have raised global concerns due to their contribution to antimicrobial resistance a major public health threat (Zhao *et al*., 2021). Consequently, the use of antibiotic-based growth promoters has faced regulatory restrictions across many regions, including Europe and parts of Africa, reflecting growing consumer demand for antibiotic-free animal products (Van Boeckel *et al*., 2019).

This shift has stimulated the search for natural feed additives capable of improving animal performance while ensuring food safety. Among the most promising candidates are phytogenic compounds, probiotics, prebiotics, essential oils, and organic acids, which have demonstrated positive effects on gut health, nutrient utilisation, immune modulation, and pathogen control (Khan *et al*., 2022). Phytogenic substances derived from medicinal plants, in particular, are considered safe, eco-friendly, and effective alternatives to synthetic antibiotics (Al-Sagan *et al*., 2020).

Celosia argentea (commonly known as *soko*), a widely consumed leafy vegetable in West Africa, Asia, and parts of South America, belongs to the Amaranthaceae family and is rich in proteins, vitamins, minerals, and bioactive compounds. Traditionally valued for its nutritional and medicinal attributes, *C. argentea* exhibits strong antioxidant and antimicrobial properties. However, while its leaves are widely utilised as food, the stems are often discarded as waste. Nutritional studies have shown that the stems contain considerable amounts of crude protein, essential amino acids, fibre, and minerals such as calcium and iron, highlighting their potential as a low-cost feed supplement for poultry diets.

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The bioactive constituents of *Celosia argentea* may also improve meat quality by enhancing oxidative stability, flavour, texture, and shelf life, consistent with reports that phytogenic feed additives can improve product quality through their antioxidant and antimicrobial properties (He et al., 2015). In addition, using the stem component of this plant can reduce feed costs and support sustainable livestock production through waste valorisation and environmental conservation. Therefore, this study aimed to evaluate the effects of dietary supplementation with *Celosia argentea* (soko) stems, compared with synthetic additives, on growth performance, blood chemistry, carcass composition and meat quality characteristics of broiler chickens.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Poultry Research Unit of Al-Hikmah Research Farm in Igbaja, Nigeria.

Test Ingredient and Phytochemical Analysis

Fresh stems of *Celosia argentea* (soko) were sourced from local farms in Igbaja where the crop is commonly cultivated. After leaf removal during harvest, stems were cleaned to remove debris, trimmed, chopped, and oven-dried at 70 °C for 12 h to reduce moisture content. The dried stems were milled into fine powder using a blender to ensure uniform mixing with feed ingredients. Phytochemical analysis of *C. argentea* stem powder was performed following established procedures described by Sofowora (1993), Harborne (1998), and Ukwubile *et al*. (2017), and quantification was performed in duplicate on two individual samples; average values were then calculated.

Experimental birds and diet formulation

A total of 240 one-day-old Ross 308 broiler chicks were procured from a commercial hatchery in Ibadan, Nigeria. Birds were randomly allotted to 24 floor pens (1.5 m² each) lined with wood shavings (6 cm depth). Four dietary treatments were prepared as follows:

- T1: Basal diet (control, no additive)
- T2: Basal diet + 0.15 g/kg butylated hydroxyanisole (BHA) + 0.3 g/kg antibiotics (70% oxytetracycline, 30% neomycin)
- T3: Basal diet + 0.25 g/kg *C. argentea* stem powder
- T4: Basal diet + 0.5 g/kg *C. argentea* stem powder

Each treatment had six replicates with ten chicks per pen (n = 60 birds/treatment). The basal diet was formulated according to Ross Aviagen broiler nutrition guidelines, and its proximate composition was determined using AOAC (2000) procedures. Feed was prepared weekly in mash form, and supplements were preblended with a small portion of the basal diet before mixing with the remainder. Birds were vaccinated against Gumboro disease (days 7 and 14) and Newcastle disease (days 14 and 28). Brooding temperature was maintained at 34 °C during the first week and reduced by 3 °C weekly until 26 °C, which was sustained until the end of the 6-week feeding trial. Feed (a single-phase diet) and water were provided ad libitum throughout the experiment.

Growth Performance

Feed intake and body weight were recorded weekly per pen. Feed conversion ratio (FCR) was calculated as the ratio of feed consumed to body weight gain.

Blood Sampling and Analysis

At 42 days of age, blood samples were collected via brachial venipuncture into both EDTA and plain tubes. Serum was separated by centrifugation at 3000 g for 15 min at 10 °C. Haematological indices were determined using an automated haematology analyser (Sysmex K-1000, Sysmex Corp., Kobe, Japan). Serum lipid concentrations were quantified using ELISA kits (Abcam ab65390, Cambridge, UK), while alanine transaminase (ALT) and aspartate transaminase (AST) were measured using Randox diagnostic kits (Randox Laboratories, UK).

Slaughter and Carcass Evaluation

On day 42, two birds per pen were randomly selected after overnight feed withdrawal (water available ad libitum). Birds were slaughtered, defeathered, and eviscerated manually. Carcass weight and individual cut weights were recorded to calculate dressing percentage and the relative proportion of prime cuts.

Meat Quality Assessment

Breast muscles from two carcasses per replicate were excised, deskinned, and trimmed of external fat and connective tissue for quality evaluation.

Colour Measurement

After 30 min of blooming, colour coordinates (L*, a*, b*) were measured using a handheld colourimeter (CR-30, 45/0 geometry, 4 mm aperture) under D65 illuminant conditions, following the International Commission on Illumination (CIE, 1976) standards. The average of three readings per sample was used for analysis.

Drip, Chilling, and Cooking Losses

For each test, 6 g of breast meat samples were weighed (initial weight, I_w), treated according to the specified condition, and reweighed (final weight, F_w). Losses were calculated as:

$$\text{Loss (\%)} = \frac{I_w - F_w}{I_w} \times 100$$

- **Drip loss:** Samples frozen at −18 ± 1 °C for 24 h.
- **Chilling loss:** Samples refrigerated at 5 ± 1 °C for 24 h.
- **Cooking loss:** Samples cooked in a water bath at 100 °C for 10 min, cooled for 5 min under running water, and blotted dry before reweighing.

Thermal Shortening

Breast muscle strips (5 cm length, I_l) were cooked at 100 °C for 10 min, cooled, blotted dry, and re-measured (F_l).

$$\text{Thermal shortening (\%)} = \frac{I_l - F_l}{I_l} \times 100$$

Statistical Analysis

The experiment followed a completely randomised design. Data were tested for normality and homogeneity of variance before analysis using the General Linear Model (GLM) procedure of SAS (SAS Institute Inc., Cary, NC, USA). Treatment means were compared using Tukey's HSD test, and statistical significance was declared at $p < 0.05$.

RESULTS

Phytochemical Composition of *Celosia argentea* (Soko) Stem

Table 1 shows that Celosia argentea used in this study contained flavonoids (27.83mg/100g), coumarin (0.23mg/100g), glycosides (0.63mg/100g), terpenoids (0.0041mg/100g), and phytic acid (0.02%).

Table 1: Composition of Experimental Diet (Kg)

	Diets	
Ingredients (%)	Starter	Finisher
Maize	50	50
Soybean meal	40	0
Full-fat soybean	0	40
Groundnut cake	3	3
Fish meal	2	2
Dicalcium phosphate	1.5	1.5
Methionine	1	1
Lysine	1	1
Salt	0.5	0.5
Premix	1	1
Total	100	100
Analysed composition		
Moisture (%)	3.58	4.40
Ash (%)	2.51	2.09
Metabolizable energy (kcal/kg)	3190.10	3257.87
Crude protein (%)	23.90	20.40
Crude fibre (%)	8.81	9.68
Ether extract (%)	3.86	3.50

Production Indices of Broilers

The production index results (Table 2) showed no significant differences ($p > 0.05$) in feed intake, weight gain, or FCR among the treatment groups. However, supplemented birds (T3) recorded the highest weight gain (2345.7g), feed intake (5088.8g), and the best FCR (2.17).

Blood Chemistry

Serum indices (Table 3) differed significantly ($p < 0.05$) for glucose, creatinine, cholesterol, high-density lipoprotein (HDL), alanine aminotransferase (ALT), alkaline phosphatase (ALP), aspartate aminotransferase (AST), low-density lipoprotein (LDL), and triglycerides.

Haematological Indices

Haematological indices (Table 4), including total mixed cells, total neutrophils, basophils, monocytes, mean corpuscular volume (MCV), mean cell haemoglobin, and platelets, differed significantly ($p < 0.05$). T4 showed significantly higher values of 6.00 (%) and 127.60 (fL) for basophils and mean corpuscular volume, respectively. White blood cell, lymphocyte, eosinophil, red blood cell, haemoglobin, haematocrit, and red blood cell width distribution showed no significant differences. However, T4 had the lowest values of 25.0 (%) and 18.2 (x103µL) in haematocrit and white blood cell, respectively.

Table 2. Production indices of broiler chickens fed diets supplemented with different additives

Parameters	T1	T2	T3	T4	SEM
Weight gain	1950.7	2170.7	2345.7	2004.0	61.47
Feed intake	4426.9	4878.7	5088.8	4427.6	84.72
Feed conversion ratio	2.29	2.25	2.17	2.23	0.07

SEM: standard error of the mean

Table 3. Serum indices of broiler chickens fed diets supplemented with different additives

PARAMETERS	T1	T2	T3	T4	SEM
Glucose Concentration (mg/dl)	31.58^{b}	35.58^{ab}	40.63^{a}	40.84^{a}	1.46
Uric Acid (mg/dl)	6.07	5.14	5.18	5.02	0.67
Albumin Conc.(g/dl)	2.70	2.36	1.76	2.07	0.39
Creatinine Conc. mg/dl)	1.67^{ab}	1.00^{b}	2.33^{a}	1.83^{ab}	0.15
Cholesterol (mg/dl)	273.35^{a}	235.33^{ab}	193.70^{bc}	142.69^{c}	10.49
HDL mg/dl	65.24^{c}	101.75^{a}	99.67^{a}	82.02^{b}	1.97
ALP (u/l)	3.88^{a}	3.87^{a}	3.10^{ab}	2.33^{b}	0.26
ALT (u/l)	14.11^{ab}	15.15^{a}	4.57^{c}	5.78^{bc}	1.54
AST u/l	61.05^{a}	64.37^{a}	20.00^{b}	17.89^{b}	1.38
TP (g/dl)	4.62	4.71	4.35	4.29	0.68
Triglycerides (mg/dl)	182.04^{b}	232.42^{a}	188.53^{b}	232.82^{a}	4.63
Globulin (g/dl)	1.71	2.00	2.48	2.08	0.35
LDL (mg/dl)	170.41^{a}	87.30^{b}	57.63^{bc}	14.11^{c}	11.10

$^{a, b, c}$ mean that different superscripts in a row differ significantly, $p < 0.05$. SEM: standard error of the mean. HDL: high-density lipoprotein. ALP: alkaline phosphatase. ALT: alanine aminotransferase. TP: total protein. AST: aspartate aminotransferase. LDL: low-density lipoprotein

Table 4. Haematological indices of broiler chickens fed diet supplemented with different additives

Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
Total White Blood Cell (X103/µL)	18.90	20.10	20.1	18.20	0.62
Total Lymphocytes (X103/µL)	13.20	12.50	13.9	12.70	0.88
Total Mixed Cells (X103/µL)	1.50^{b}	2.00^{ab}	2.60^{ab}	2.90^{a}	0.19
Total Neutrophils (X103/µL)	4.20^{ab}	5.20^{a}	3.60^{bc}	2.60^{c}	0.21
Neutrophil (%)	22.00^{ab}	25.00^{a}	18.00^{bc}	14.00^{c}	1.00
Lymphocyte (%)	70.00	62.00	69.00	70.00	1.58
Eosinophil (%	2.00	2.00	3.00	2.00	0.21
Monocyte (%)	6.00^{b}	8.00^{ab}	10.00^{a}	8.00^{ab}	0.58
Basophil (%)	6.00^{a}	3.50^{ab}	2.00^{b}	2.00^{b}	0.58
Red Blood Cell ($X10^{6}$/µL)	2.32	2.23	2.35	2.65	0.08
Haemoglobin Concentration (g/dl)	8.60	7.70	7.50	7.50	0.29
Haematocrit (%)	25.00	25.20	27.00	29.40	1.00
Mean corpuscular cell volume (fl)	125.10^{a}	116.4^{b}	122.30^{ab}	127.60^{a}	1.04
Mean cell haemoglobin (pg)	36.60^{ab}	33.2^{b}	35.00^{ab}	38.30^{a}	0.60
Mean cell haemoglobin concentration (g/dl)	29.30	24.25	29.50	29.65	1.73
Platelet (X103/µL)	49.00^{a}	51.00^{a}	48.00^{a}	33.00^{b}	1.00
Red Blood Cell distribution width - Coefficient of variation (%)	24.00	17.4	21.6	22.2	1.47

$^{a, b, c}$ means bearing different superscripts in a row differ significantly $p < 0.05$). SEM: standard error of the mean.

Carcass Characteristics

Treatments did not affect absolute carcass characteristics ($p > 0.05$) (Table 5). T3 (1750g) had the highest live weight, while T2 (1650g) recorded the lowest among treatments. The bled weight followed the same trend as live weight, with T3 highest (1700g) and T2 lowest (1575g). T3 had the highest hot carcass weight (1245g), while T1 recorded the lowest (1166g). T2 had the highest dressing percentage (74.89%), and T1 had the lowest (69.81%).

Table 5. Absolute carcass characteristics of broiler chickens fed diets supplemented with different additives

Parameters	T1	T2	T3	T4	SEM
Live weight	1675.00	1650.00	1750.00	1700.00	40.51
Bled weight	1600.00	1575.00	1700.00	1650.00	40.51
Hot carcass weight	1166.00	1233.57	1245.53	1188.14	29.37
Neck	74.15	71.59	65.92	72.58	5.73
Breast muscle	327.35	317.25	311.58	338.63	27.46
Wing	259.13	334.32	318.31	271.86	33.23
Thigh	348.13	347.14	382.13	338.80	10.09
Drumstick	157.27	163.29	165.60	166.28	11.22
Dressing percentage	69.81	74.89	71.35	69.94	3.16

SEM: standard error of mean

Meat Quality

Table 6 shows the breast meat quality characteristics of broilers fed diets supplemented with different additives. Chilling loss, cooking loss, drip loss, and thermal shortening did not differ significantly among treatments ($p > 0.05$). T4 showed the most favourable thermal shortening (20%). T1 recorded the highest chilling loss (6.17%) and drip loss (7.96%), respectively. Lightness (L*), redness (a*) and yellowness (b*) showed no significant differences ($p > 0.05$). T1 and T3 showed the highest ratings for meat lightness and yellowness, respectively.

TABLE 6: Breast meat quality of broiler chickens fed diets supplemented with different additives

Parameters	T1	T2	T3	T4	SEM
Chilling loss (%)	6.17	5.84	5.79	5.54	0.59
Cooking loss (%)	29.17	33.33	33.33	33.33	2.62
Drip loss (%)	7.96	4.71	5.63	7.50	0.84
Thermal shortening (%)	23.00	21.50	37.50	20.00	2.72
Lightness (L*)	35.59	40.17	39.25	34.76	1.48
Redness (a*)	2.89	3.63	2.47	1.70	0.17
Yellowness (b*)	2.91	1.29	5.82	5.18	0.47

SEM: standard error of the mean

DISCUSSION

Production indices demonstrated that the inclusion of *Celosia argentea* (soko) stem powder at 0.25 g/kg and 0.5 g/kg levels did enhance growth performance of broiler chickens, though not significantly ($p > 0.05$), as supplemented birds recorded the highest weight gain, feed intake and best FCR value (Table 2). These findings suggest that, at the tested inclusion levels, *C. argentea* stem powder conferred a performance-enhancing advantage comparable to other plant-based additives that improve growth without dramatically altering feed conversion. Adeyemi *et al*. (2021) similarly observed increased body weight gain in broiler chickens fed diets supplemented with onion skin and synthetic additives, while Khadem *et al*. (2014) reported improved body weight gain in birds supplemented with *Macleaya cordata* extract and oxytetracycline, supporting the view that phytogenic additives can match or approximate the efficacy of conventional growth promoters.

Serum biochemical indicators offer valuable insights into nutrient metabolism and systemic health. In this study, a significant increase in serum glucose observed in *C. argentea*-supplemented groups suggests improved energy metabolism and possibly enhanced carbohydrate utilisation efficiency in broilers. However, the glucose concentrations were lower than the range reported by Alonge *et al*. (2017) for broiler chickens fed different feed additives, underscoring

that baseline nutritional status, additive type and sampling conditions can markedly influence glycaemic values. Similar work on broilers fed dietary plant extracts has shown that such supplements can modulate glucose and other metabolites without precipitating metabolic disorders, indicating that moderate shifts in serum glucose should be interpreted in the context of overall health and performance (He *et al*., 2015; Liu *et al*., 2014).

The most pronounced effect of *C. argentea* stem powder in this study occurred in serum lipid fractions. Serum total cholesterol and LDL-cholesterol levels were significantly reduced in the T3 and T4 groups compared to the control, while HDL-cholesterol increased in supplemented birds. This hypocholesterolemic pattern agrees with Adeyemi *et al*. (2021), who reported reduced total cholesterol, triglycerides, and LDL, and increased HDL in broilers fed onionskin-based diets compared with synthetic additives. Beyond poultry, Sule *et al*. (2022) showed that methanolic leaf extract of C. argentea reduced serum total cholesterol and triglycerides and increased HDL in alloxan-induced diabetic rats, reinforcing the plant's hypolipidemic potential. These findings indicate that *C. argentea* stem powder likely contains bioactive compounds that beneficially modulate lipid metabolism and contribute to healthier meat for consumers.

Liver-related enzymes in this study further support a hepatoprotective effect. Although ALT values varied among treatments, AST concentration was markedly reduced in *C. argentea*-supplemented birds relative to the control group. Lower AST activity, in the absence of impaired growth or other signs of toxicity, generally reflects reduced hepatocellular stress or damage. Adeyemi *et al*. (2021) similarly reported reduced AST and improved liver enzyme profiles in broilers fed onionskin. In a mammalian model, Sule *et al*. (2022) showed that *C. argentea* leaf extract improved liver histology and enzyme activities in diabetic rats, further supporting a protective role on hepatic tissues. In the present experiment, total protein, albumin, globulin, uric acid and creatinine values remained within normal limits, suggesting that protein metabolism and renal function were not adversely affected by *C. argentea* supplementation.

Haematological parameters are critical for assessing systemic responses and potential toxic effects of dietary additives. In this study, red blood cell count, haemoglobin concentration, and haematocrit were within physiological ranges for broiler chickens across all treatments, and C. argentea inclusion did not result in anaemia or erythrocytosis. Mean corpuscular volume (MCV) and mean cell haemoglobin (MCH) were higher in the T4 group, suggesting improved haemoglobinisation and erythrocyte oxygen-carrying capacity. Dela Cruz *et al.* (2024) reported similar improvements in erythrocyte indices in broilers fed Angelica gigas root extract, interpreting these changes as evidence of enhanced erythropoiesis and systemic resilience. Studies on phytogenic additives and plant extracts likewise report that herbal supplements can maintain or improve haematological profiles, further supporting the safety of C. argentea at the inclusion levels used (Alonge *et al.,* 2017; Oloruntola *et al*., 2016).

White blood cell counts and leucocyte differentials were not significantly influenced by dietary *C. argentea*, indicating that the additive did not provoke leukocytosis, lymphopenia or other major shifts in immune cell distribution. Adeyemi *et al*. (2021) similarly found no significant alterations in haematological parameters in broilers fed onionskin and oxytetracycline, suggesting these plant-based and synthetic additives were not haematotoxic at the levels tested. Oloruntola *et al*. (2016) found that phytogenic feed additives in broiler diets maintained normal haematology and serum biochemistry, further supporting the non-toxic nature of plant-derived supplements when appropriately dosed. In the current study, platelet counts remained within acceptable ranges and were not associated with any adverse clinical signs, reinforcing the conclusion that *C. argentea* stem powder is haematologically safe at up to 0.5 g/kg.

Carcass traits, including live weight, hot carcass weight, dressing percentage and weights of major primal cuts, did not differ significantly among treatments. Nonetheless, birds receiving *C. argentea* tended to show numerically comparable or slightly higher live and carcass weights relative to the control, indicating that muscle deposition and nutrient partitioning were not negatively affected. Palupi *et al*. (2023) reported similar carcass outcomes in broilers fed *Lactobacillus*-fermented feed while still achieving performance improvements, suggesting that some feed additives support carcass yield mainly by maintaining health and nutrient utilisation rather than dramatically altering cut proportions. Adeyemi *et al*. (2021) also reported that onionskin-based diets maintained or improved carcass weight and dressing percentage without detrimental effects on carcass composition, which is consistent with the carcass responses observed with *C. argentea* in this study.

Breast meat quality indices such as chilling loss, cooking loss, drip loss, and thermal shortening did not differ significantly between control and supplemented birds, suggesting that water-holding capacity and

muscle structural integrity were preserved across all treatments. Adeyemi *et al*. (2021) found comparable results in broilers fed onionskin and synthetic additives, and proposed similar muscle pH among treatments as a factor underlying uniform drip and cooking losses. In the present study, colour measurements revealed higher redness (a*) values in birds fed *C. argentea* stem powder diets, while lightness and yellowness remained within acceptable ranges. Improvements in redness have also been reported in broilers fed antioxidant-rich plant materials, such as green coffee powder, and are frequently associated with better myoglobin stability and reduced oxidative discolouration in meat (Ashour *et al*., 2020). Such colour enhancement is technologically and commercially important, as consumers often associate a brighter, redder breast muscle with freshness and quality.

The production, serum biochemical, haematological, carcass and meat quality responses observed in this study indicate that *C. argentea* stem powder at up to 0.5 g/kg diet is safe and potentially beneficial as a natural feed additive for broiler chickens. Its hypocholesterolemic effects and favourable influence on AST activity are consistent with reports on onion skin, mountain celery and other phytogenic materials, which have been proposed as alternatives to antibiotic growth promoters and synthetic antioxidants in poultry nutrition (Adeyemi *et al*., 2021;

Sule *et al*., 2022). Future studies should investigate higher inclusion rates, longer feeding periods and challenge conditions (for example, heat stress or infection) to fully elucidate the immunomodulatory and antioxidant potential of *C. argentea* and to position it more clearly among other plant-based additives already evaluated in broiler diets

Animal Ethics Statement

Al-Hikmah University, Ilorin, Nigeria, approved all animal care, management, and procedures. Nigeria Animal Ethics and Use Committee.

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Conflict of Interest
Conflict of Interest: The authors declare that they have no conflicts of interest.

Authors' contributions
Bello Zainab: conceived, designed and conducted the experiment; wrote and revised the manuscript. Zubair Kadri: collected and analysed the data. Adeyemi Saheed: interpreted the data.
Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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