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Blood and carcass characteristics of two chicken strains subjected to Ocimum graticimum leaf based diet as substitute for synthetic antibiotics

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ABSTRACT

This study was designed to evaluate the effect of graded levels of scent leaf meals on blood parameters and carcass characteristics among two broiler strains. A total of 150 unsexed broilers consisting of 75 Abor Acre and 75 Cobb were randomly allotted into 5 treatments of 15 birds for each strain. Treatment one (T1) had no scent leaf meal (control); treatment two (T2), treatment three (T3), treatment four (T4) and treatment five (T5) had 0.5%, 1.0%, 1.5%, and 2.0% throughout the experimental period (56days). Blood samples and carcass characteristics were evaluated after the feeding trial and subjected to analysis of variance in a completely randomized design. Results revealed that diets and strain significantly ($P < 0.05$) affected live weight, dressed weights, and dressing percentages. T3 had the highest live and dressed weight (2091.50 ± 85.27 g and 1737.67 ± 22.16 g), while T5 recorded the lowest (1700 ± 102.47 g and1253.17 ± 68.09 g). Cobb was superior to Arbor acre for all carcass traits except for leg weight. Red Blood Cell, White Blood Cell, Mean Corpuscular Volume, Mean Corpuscular Haemoglobin and Mean Corpuscular Haemoglobin Count of the two strains were significantly ($P < 0.05$) different, while Pack Cell Volume, Haemoglobin, Neutrophils, Lymphocytes, Monocytes, Eosinphils and Basophils were not significantly different ($P > 0.05$). This study revealed no detrimental effect of the test ingredients on birds, though 1.5% inclusion rate could be tolerated, 1.0% is recommended for optimum performance, and can therefore efficiently replace synthetic antibiotic in broiler production.

Contribution/Originality: The observed deposits of chemical residues in meats due to antibiotic use have necessitated alternative sources. This study therefore contributes to existing literatures by accessing the implications of phytobiotics on blood and carcass characteristics in two common broiler strains, which are characters required for efficient and profitable broiler production.

1. INTRODUCTION

Chicken which is poultry meat is an essential component of animal protein both man and livestock. Broiler which is a fast growing meat-type bird are table ready between 8 - 10wks of age and must have reached 1.8 to 2.5 kg at 8 to 10 [1]. Broilers are over stressed due to intensification of production to meet demand leading to the proliferation of pathogenic disease infections which is a major problem facing poultry industry [2]. This has continued to threaten the poultry industry leading to reduced growth rate and high economic losses. Unfortunately, synthetic antibiotics which had hitherto been used to reduce this ugly phenomenon had continued to cause negative effects due to growth of resistance resulting from continuous and prolong use. The continuous and prolong use of synthetic antibiotics had been revealed to cause accumulated residues in poultry product, as well as exchange in antibiotic resistance between animal and man, hence, restrictions and ban have become the only alternative solution in most countries [3, 4]. Hence, the search for reasonable and cautious alternatives is beginning to gain popularity in animal nutrition. Animal scientists are currently into phytogenics in order to overcome the high economic losses resulting from diseases in animal farms [5]. Phytogenics are used mainly as growth promoters and health stabilizers in animal diet, they include saponin, Tanin, essential oils and flavonoid, extracted from medicinal plants (spices and herbs), since they fight pathogenic microorganisms and contain antioxidants [6]. Scent leaf which is a very good and important type of medicinal plant used as additive had been reported to improve growth performance in finishing broilers, improve weight gain and carcass characteristics of broilers [7, 8]. Scent leaf and other plant derived product have been certified safe to use in livestock feeding as feed additives because of its capacity to fight disease pathogens and enhance growth [9]. High addition rates of the test ingredient have also been reported to reduce inflammation and enhance growth in chickens [10]. However, there is inadequate research information on the effects of Ocimum gratissimum on the haematological and carcass attributes of broiler birds, hence the need for this study.

2. MATERIALS AND METHODS

2.1. Experimental Site and Ethical Approval

This study was executed at the Poultry Unit of the Teaching and Research Farm of Delta State University, Asaba Nigeria. The Departmental research Board approved this experiment; with reference number PhD - 0303202.

2.2. Experimental Birds and Management

A total of 150 unsexed broilers consisting of 75 Cobb and 75 Arbor Acre strains were used for the study. The birds were raised on deep - litter and fed for 56 days. All routine management practices for broiler management were followed according to Sorhue, et al. [10].

2.3. Experimental Diets and Design

One hundred and fifty (150) unsexed day-old broiler chicks were randomly allotted into five dietary treatment groups. The treatments were made up of 75 birds of each strain to give 15 birds per sub-treatment and each treatment was replicated thrice in a completely randomized block design. Birds were given routine vaccination for young chicks, while feed and water were supplied adlibitum for the entire duration of the experiment. The test ingredient/Scent Leaf Meal (SLM) was introduced in week two for treatments two (0.5%), treatment three (1.0%), treatment four (1.5%), and treatment five (2.0%), while treatment one served as the control group receiving normal medication routine for broilers. The feeds used for Treatment one to treatment five were formulated to contain between 22.12 % - 22.21 % crude protein and 2792.03 Metabolizable Energy ME Kcal/Kg, Dry Matter (DM) - 2803.43 ME Kcal/Kg DM for starter phase, and 20.19 - 20.28 ME Kcal/Kg DM and 2833.54 - 2844.94 ME Kcal/Kg DM for finisher phase as recommended by National Research Council (NRC) [11]. The proximate composition of test ingredient used for this study contained 7.47, 14.38, 6.04, 2.49, 3.75, and 65.87 percent of moisture, crude protein, crude fibre, ether extract, ash and Nitrogen free extract respectively.

2.4. Data Collection

At the end of 56days feeding trial, 6 birds were randomly collected per treatment, three per strain. The selected birds were fasted for 16 hours, weighed before euthanized by cervical dislocation. The birds were later scalded at 65°C in steaming water for 30 seconds before de-feathering. Thereafter the carcasses were disemboweled, and the different parts and organs such as legs, wings, chest and neck region, gizzard, kidneys, heart, liver and spleen were collected and weighed and the values expressed in grams (g). Blood samples for haematological evaluation were collected with the aid of a sterilized disposable syringe from under the wing veins. Just before the broilers were bled a cotton wool swab soaked in 70% ethanol was used to sterilize the skin and to dilate the vein. The blood samples were collected from the six sampled birds per treatment and transferred into a labeled sterile container with Ethylene Diamine Tetra Acetic acid (EDTAA) as an anti-coagulant and used to determine the following hematological components: Haemoglobin (Hb), Packed cell volume (PCV), Red blood cell count (RBC), White blood cell count (WBC), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC). RBC, WBC, Hb, and PCV were determined according to standard procedures as described by Sorhue, et al. [12] while MCV, MCH, and MCHC were calculated using standard expressions. Differential Leukocyte counts: Neutrophils, Lymphocytes, Monocytes, Eosinophils and Basophils were carried out on blood smear stained with Leishman stain using standard techniques.

2.5. Data Analysis

Data collected were subjected to analysis of variance using Statistical Package for Social Sciences. Significantly different means were separated using Duncan's New Multiple Range Test at 5% level of significance [13].

Table 1. Effect of dietary treatments on carcass characteristics of broilers.

Parameter (g/broiler)	T1 0.0% SLM	T2 0.5% SLM	T3 1.0% SLM	T4 1.5% SLM	T5 2.0% SLM
LWT	1893.33±18.92^{b}	1835.83±16.08^{b}	2091.50±15.27^{a}	1968.00±17.30^{ab}	1700.00±12.47^{c}
DWT	1396.50±16.09^{ab}	1421.33±12.95^{ab}	1737.67±22.16^{a}	1589.67±12.52^{ab}	1253.17±18.09^{b}
DP	73.60±0.94^{c}	76.58±2.08^{bc}	82.91±2.96^{a}	80.62±0.78^{ab}	73.89±1.49^{c}
Legs	340.33±41.23	336.50±52.90	376.17±19.93	336.33±13.45	288.17±27.21
Wings	215.33±18.50	199.50±35.93	228.17±23.25	207.67±12.21	190.67±18.29
Chest	275.83±41.51^{b}	263.17±48.92^{b}	413.67±36.84^{a}	373.50±47.92^{ab}	288.33±26.48^{ab}
Neck	77.83±12.11^{b}	77.17±10.08^{b}	89.17±3.77^{a}	65.67±7.74^{bc}	63.00±9.71^{c}
Liver	41.56±2.58^{b}	40.26±3.68^{b}	45.71±1.94^{a}	42.96±2.84^{b}	37.93±1.96^{c}
Gizzard	51.54±4.06^{ab}	49.68±5.70^{b}	55.18±4.75^{a}	43.51±4.48^{b}	41.06±2.63^{b}
Lungs	10.79±0.56^{ab}	10.46±0.95^{ab}	12.22±0.53^{a}	11.22±0.78^{ab}	9.65±0.58^{b}
Heart	8.14±0.43	7.89±0.71	8.99±0.37	8.46±0.59	7.30±0.44
Spleen	2.46±0.12	2.41±0.23	2.73±0.11	2.56±0.18	2.21±0.13
Kidney	5.49±0.29	5.33±0.48	6.06±0.25	5.71±0.39	4.94±0.29

Note: LWT - Live weight; DWT - Dressed weight; DP- Dressing percentage; a, b, c: Means values with different superscripts on the same row are significant ($P<0.05$).

3. RESULTS AND DISCUSSION

3.1. Effect of Dietary Treatment on Carcass Characteristics of Broilers

Table 1 shows the effect of dietary treatment on carcass characteristics of broiler birds fed experimental diet. The result revealed significant ($P<0.05$) differences in Average live weight, dressed weight, dressing percentage, chest weight, neck weight, liver weight, gizzard weight and lungs. T3 with 1.00% SLM had the highest live weight (2091.50±85.27g) while T5 with 2.00% SLM recorded the lowest (1700.00±102.47g). Similarly, T3 had the highest dressed weight (1737.67±22.16g) and T5 had the lowest (1253.17±68.09g). Similar trend was observed in mean values for legs, chest, neck and internal organs. However, there was no significant (P>0.05) difference in mean values for legs, wings, heart, spleen and kidney. The significant (P<0.05) differences observed in dressed weight, weights of legs and neck are in agreement with Odoemelam, et al. [7] for scent leaf supplemented diets. The range of 73.60 for T1 to 82.91 for T3 for dressing percentage in this study were above the range of 68.60% - 73.40% reported by Duncan [13] but falls within recommended range of 79-82% for chickens. The mean value of 82.91% for T3 obtained in this study is also within the range of 81.68 - 84.50% reported by Isikwenu, et al. [14] for broilers, and is slightly higher than reports by Bamgbose and Niba [15]. The significantly heavier dressed carcass weight and higher dressing percentage of birds fed 1.00% (T3) confirms that they were better and most efficient in nutrient utilization with regards to digestion, absorption and assimilation [16]. Similar results were also obtained for all cut parts expressed as percentage of live weight. The mean values for the legs, wings, heart, spleen and kidney were numerically higher for birds fed 1.00% (T3). They were however not significantly (P>0.05) different across the groups, which is similar to the report of Olumide and Akintola [17]. This implies that the Scent leaf meal had no deleterious effect on the carcass of the broiler birds since dressing percentage can be influenced by several factors including; sex, diet, castration, time spent in liarage, the actual dressing process (skinning or scalding), as well as time of collection in relation to the biological growth curve, size, weight and age of the animals.

Table 2. Effect of strain on carcass characteristics of broilers.

Parameter (G/broiler)	Arbor acre (AA)	Cobb (CB)
Live weight	1880.13±79.54^b	1915.53±81.48^a
Dressed weight	1467.95±76.89^b	1491.40±75.79^a
Dressing %	77.44±1.62	77.61±1.31
Legs	356.20±23.38^a	314.80±18.74^b
Wings	207.87±15.51	208.67±12.76
Chest	320.60±26.39	325.20±31.95
Neck	72.53±6.75^b	76.60±5.92^a
Liver	40.84±1.74^b	42.52±1.73^a
Gizzard	48.09±3.22	48.80±2.75
Lungs	10.85±0.48	10.89±0.47
Heart	8.08±0.34^b	8.23±0.35^a
Spleen	2.45±0.11	2.49±0.11
Kidneys	5.46±0.23	5.56±0.24

Note: A,B: Mean values within the same row with different letter superscript are significantly (P<0.05) different.

3.2. Effect of Strain on Carcass Characteristics of Birds Fed Experimental Diets

The result Table 2 showed that there were significant (P<0.05) differences in the two broiler strains for live weight, dressed weight, weight of legs, neck, liver and heart of broiler strain fed Scent leaf meal diet at varying levels. Cobb (CB) had higher values for most of the carcass parameters which were significant except for the weight of the legs which value was higher for the Arbor acre (AA) strain (356.20g) than Cobb (314.80g). Cobb had higher neck weight (78.60g) than Arbor acre (72.53g). Cobb had significantly higher live weight and dressed weight (1915.53g and 1491.40g) than Arbor acre (1880.13g and 1467.95g) respectively. The dressing percentage was numerically higher for Cobb (77.61%) than Arbor acre (77.44%). Cobb also had higher liver and heart weights than Arbor acre. However, there are diverse reports on the supremacy of the most familiar strains of broilers with particular reference to their carcass traits. Reports Fadare, et al. [18] indicates a significant difference in dressing yield of Cobb and Arbor acre broiler strains. It was revealed that Cobb strain produced significantly higher mean dressing percentage (77.19±3.79%) than Arbor acre strain (70.63±1.79%). The superiority of Cobb strain over Arbor acre strain in this study is also in consonance with the findings of Zaman, et al. [19] which had higher dressing percentage (though not significant) for Cobb strain than Arbor acre strain. In this present study, there were no significant (P>0.05) differences for dressing percentage, wings, chest, gizzard, lungs, spleen and kidney between the Cobb and Arbor acre strains. Non-significant differences in dressing percentage contradicted reports of Fadare, et al. [18] for broiler strains.

Table 3. Effect of dietary treatment on hematological parameters of broilers.

Parameter	T1 0.0% SLM	T2 0.5% SLM	T3 1.0% SLM	T4 1.5% SLM	T5 2.0% SLM
PCV (%)	36.00±1.29^{b}	35.50±1.67^{b}	36.33±1.56^{b}	42.00±0.73^{a}	39.83±1.60^{a}
Hb (g/dl)	11.95±0.48^{b}	12.24±0.52^{ab}	12.25±0.57^{ab}	13.58±0.41^{a}	13.12±0.52^{ab}
RBC	3.90±0.22^{c}	4.40±0.18^{b}	4.45±0.38^{b}	5.03±0.06^{a}	3.87±0.28^{c}
WBC	6100±27.08^{ab}	5566.67±33.33^{c}	5750±29.36^{bc}	6250±88.51^{a}	5933.33±13.33^{abc}
Neutrophils (%)	49.33±0.84^{b}	51.17±2.56^{b}	49.16±3.15^{b}	56.00±1.37^{a}	51.33±0.66^{a}
Lymphocyte (%)	45.33±0.72^{b}	46.33±1.91^{a}	47.00±2.11^{a}	39.00±1.53^{a}	43.67±1.20^{a}
Monocyte (%)	1.17±0.40	1.17±0.31	1.67±0.56	2.33±0.56	2.33±0.33
Eosinophil (%)	2.83±0.40a	1.83±0.65^{ab}	1.67±0.56^{b}	1.83±0.31^{ab}	1.83±0.54^{ab}
Basophils (%)	0.17±0.17	0.17±0.16	0.67±0.17	0.00±0.00	0.00±0.00
MCV (fl)	91.95±3.67^{b}	80.64±1.58^{c}	87.39±8.68^{bc}	83.22±1.88^{c}	105.09±3.27^{a}
MCH(pg)	29.97±1.03^{b}	27.19±0.45^{c}	28.81±3.06b^{c}	27.65±0.58^{c}	33.89±0.89^{a}
MCHC(g/dl)	33.35±0.01^{b}	33.49±0.07^{a}	33.41±0.05^{ab}	33.35±0.49^{b}	33.35±0.02^{b}

Note: a,b,c: Mean values within the row with different superscripts are significantly different ($P<0.05$); PAR=Parameter; Red blood cell (RBC x10^6/mm^3), White blood cell (WBC x10^3/mm^3) (MCHC)-Mean corpuscular Haemoglobin Concentration, Hb-Haemoglobin Concentration; (MCH)-Mean Corpuscular Haemoglobin, (MCV)-Mean Corpuscular Volume.

3.3. Effect of Dietary Treatment on Haematological Parameters of Broilers

The results of dietary treatment on haematological parameters of broiler birds fed Scent leaf meal are shown in Table 3. There were significant effects ($P<0.05$) of dietary treatment on almost all the haematological parameters examined except for Monocytes and Basophils. T4 had the highest PCV value (42.00±0.73) which was not significantly different from T5 (39.83±1.60). T4 and T5 are significantly different from treatments 1 to 3. Differences in RBC and WBC counts were also significant with T4 having the highest mean values of 5.03 ± 0.06 (x10^6/mm^3) and 6250.00 ± 88.51 (x10^3/mm^3) respectively. The control had the highest mean value (2.83±0.40) for eosinophil while T3 had the lowest (1.67±0.56) though not significantly different from other Scent leaf meal treated groups (T2, T4 and T5). The values of the broiler birds for MCV and MCH were significant, with T5 recording the highest mean values of 105.09±3.27 and 33.89±0.89 respectively. The mean value for PCV ranged from 35.50-42.00%, which is within the normal range of 35-55% reported by Mitruka and Rawnsley [20] for healthy birds and 24.90-45.20% reported by Oguntoye, et al. [21]. There were significant increases in the value of PCV as the level of inclusion of Scent leaf meal increased up to T4. The highest value was recorded by T4 (1.50% SLM) which was not significantly different from T5 (2.00% SLM) while T2 (0.50% SLM) had the lowest PCV value which was not significantly different from the control (0.00% SLM). This is supported by the finding of Olumide, et al. [22] which recorded a steady improvement in percentage PCV, RBC, WBC and Haemoglobin (Hb) when broiler diets were supplemented with SLM at the rate of 100g, 200g, 300g or 400g/100kg. Similarly, Olobake and Okaragu [23] who supplemented broiler diets with SLM at rate of 1%, 2% and 3% recorded higher MCH and MCV than the control (without scent leaf meal), though with no significant mean differences. In the same vein, Ogbu and Amaefule [8] and Adeleye, et al. [24] observed no significant difference ($p<0.05$) effect of Scent leaf on blood parameters of broilers. However, Chineke, et al. [25] reported a significant reduction in haemoglobin (Hb), PCV, RBC contents of the blood of broiler chicken at starter stage, but non-significant for all the haematological parameters measured at the finisher stage. The differences observed could be caused by the level of inclusion of Scent leaf in the diets, age and the breed of the birds. PCV is involved in transportation of oxygen and absorption of nutrients. It is important in the diagnosis of anaemic condition. A PCV that is lower than 35% indicates anaemic condition while increased PCV suggests better and more oxygen transportation and utilization by the cells and thus preventing anaemic condition [24]. Similarly, RBC count increased with increasing Scent leaf meal inclusion of up to T4 (1.50%). The control (T1) without Scent leaf meal had the lowest. This study corresponds with the report of Chineke, et al. [25] which revealed that PCV resulted to an increased number of RBC count.

The range of haemoglobin observed was 11.95g/dl (T1) - 13.58g/dl (T4) falls within normal range of 7-13g/dl recorded by Bounous and Stedman [26] for chickens. The result showed that there were significant differences in mean values for the white blood cell across the treatment groups. Treatment 4 (1.5% SLM diet) indicated higher significant value of 6250 ($x10^3/mm^3$) than the control (T1) 6100 ($x10^3/mm^3$). The red blood cell (RBC) increased with increasing level of Scent leaf meal inclusion up to 1.50% (T4) with a mean value of 5.03 ($x10^6/mm^3$). It also showed that the SLM inclusion could only be tolerated up to 1.50% SLM inclusion by the broiler birds with a decline at T5 which was not significantly different from T1. Haemoglobin concentration is a determinant of the oxygen carrying capacity of the blood circulatory system while the RBC is responsible for the transport of oxygen from the lungs to the tissues. The result obtained showed a significant increase in RBC with increasing level of Scent leaf meal inclusion up to 1.50%. The values ranged from 3.90±0.22 (T1, the control) – 5.03±0.06 (T4) which is higher than 2.0 ($x10^3mm^3$) reported by Thrall [27] for exotic chicken. White blood cells (WBC) are mainly recognized as a defense system of the body, and the observed significant differences in the WBC values are indications of differences in the body defense potential [28]. Hence the broiler birds that received 1.50% SLM (T4) had the highest immunity and therefore should be the least susceptible to infection and anaemia. MCV was significantly different ($P<0.05$) with a range of 80.64fl (T2)-105.09fl (T5). MCH was also significant with T5 (33.49pg) significantly ($P<0.05$) higher than T1 (29.79pg). MCV and MCH have taken a similar pattern with 2.00% (T5) SLM having significantly ($P<0.05$) higher mean values than the control (T1). Since MCH is an indication of blood carrying ability of the RBC, this could mean that 2.00% (T5) SLM is more efficient in performing respiratory function. MCHC was significantly different with T2 (33.49g/dl) showing higher mean value than T1 (33.35g/dl) which was not significantly different from T3, T4 and T5. Previous reports [23] observed that the MCV and MCH of Scent leaf meal supplemented diets were higher than control, though with no significant differences in means. Some authors [8, 29] reported no significant effect of Scent leaf on blood parameters of broilers. The result of Lymphocyte and Neutrophils show significant differences with T3 having significantly higher value than the control for lymphocytes and T4 mean value was significantly higher than control for Neutrophils. The values observed for monocytes, eosinophils, basophils and neutrophils were within the normal range of healthy birds according to Archetti, et al. [30]. The variations observed in the haematological indices of birds in this study might be due to genotype differences, age, physiological condition and nutrition [31].

Table 4. Effects of strain on haematological parameters of broilers.

Parameter	Arbor acre (AR)	Cobb (CB)
PCV (%)	37.00±1.20	38.86±0.88
Hb (g/dl)	12.49±0.39	12.77±0.32
RBC ($x10^6/mm^3$)	$3.97±0.18^b$	$4.69±0.14^a$
WBC ($x10^3/mm^3$)	$5773.33±128.91^b$	$6066.67±94.95^a$
Neutrophils (%)	50.93±1.49	51.86±1.17
Lymphocytes (%)	44.27±1.36	44.27±1.05
Monocytes (%)	1.93±0.33	1.53±0.26
Eosinophils (%)	1.93±0.34	2.07±0.25
Basophils (%)	0.20±0.11	0.00±0.00
MCV (fl)	$94.48±3.44^a$	$84.85±3.25^b$
MCH (pg)	$31.19±1.01^a$	$27.81±1.04^b$
MCHC (g/dl)	$33.44±0.04^a$	$33.34±0.01^b$

Note: A,B: Mean values with different letter superscript are significantly ($P<0.05$) different.

3.4. Effects of Strain on Haematological Parameters of Broiler

The effects of strains on haematological parameters as shown in Table 4 reveals that RBC, WBC, MCV, MCH, and MCHC of the strains were significantly different ($p<0.05$) while PCV, Hb, Neutrophils, Lymphocytes, Monocytes, Eosinophils and Basophils were not significant. The PCV, though not significantly different, falls within the normal range of 35-55% reported by Mitruka and Rawnsley [20] and 24.90-45.20% reported by Oguntoye, et al. [21]. Since MCH indicates blood conveying potentials of the red blood cell (RBC), Arbor acre having significantly higher MCH value is more efficient in performing respiratory function than the Cobb as observed by Isaac, et al. [32]. White blood cells are known to fight against disease pathogens. Cobb with higher WBC count has higher immune status than Arbor acre and therefore is capable of generating antibodies during phagocytosis and has higher resistance to diseases [32] Red blood cell functions as a carrier of haemoglobin and it is involved in movement of oxygen and carbon dioxide in and out of the body [32]. Haemoglobin is an iron-containing pigment found in the red blood cells of most animals. It illustrates the movement of oxygen and carbon dioxide in and out of the tissues for oxidation of digested food during energy production [12, 33]. A lower red blood count implies a lower oxygen and carbon dioxide that will be carried to the tissues and back to lungs respectively. This will also affect the rate of oxidation to release energy required for the various body functions.

4. CONCLUSION

Scent leaf meal in diet of broilers performs best at 1% inclusion rate; however, 1.5% inclusion could be tolerated since it tends to enhance blood health characteristics and showed no detrimental effects to carcass characteristics. Overall, the test ingredients have proven a better replacement for synthetic antibiotics considering the performance of experimental birds.

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Ethical Statement: The Ethical Committee of the Department of Animal Science, Delta State University Abraka, Nigeria, has granted approval for this study on 18 November 2022 (Ref. No. PhD-18112022).
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