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## Performance of Broiler Chickens Fed Diets Containing *Canarium schweinfurthii* Seed Meal

By

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### Abstract

A 49 day experiment was conducted to evaluate the performance, anti-nutritional factors, amino acid profile, carcass characteristics, haematological and serum biochemical indices of broiler birds fed *Canarium schweinfurthii* seed meal as partial substitution for maize. A total of 150 day old broiler chickens of Abor Acre Strain were randomly assigned to five (5) treatment diets having three replicates consisting of 10 birds each in a Completely Randomized Design. The dietary treatments were formulated such that Diet 1(Control), 2, 3, 4, and 5 contained 0%, 5%, 10%, 15% and 20% *Canarium schweinfurthii* seed meal as a partial substitution for dietary maize respectively. They were fed and watered ad-libitum on a wood-shaving litter. Growth parameters such as feed intake, weight changes, feed-to-gain ratio were obtained while other parameters such as blood were determined in the laboratory according to the procedure. Body weight results differed ( $P>0.05$ ) among treatment groups respectively. The results obtained were 1620.21g, 1630.18g, 1590.03g, 1530.38g, and 1510.80g ( $P>0.05$ ), but birds fed *Canarium schweinfurthii* seed meal diet at 5% showed a better FCR 2.71 among the treatment groups. All Carcass characteristics parameters were significantly different ( $P<0.05$ ) among the treatment groups except back cut and wings with dressed weight,, dressing percent, thigh, drumstick, wings and breast cut at 5% having the highest values respectively for broiler chickens fed *Canarium schweinfurthii* seed meal. Haematological parameters differed significantly ( $P<0.05$ ) except WBC, MCV, MCH and MCHC, but RBC values were highest in  $T_2$  (5%)  $3.01\mu\text{l}$ , WBC highest at  $T_5$  (20%)  $3.02\mu\text{l}$  respectively, and Hb values highest at  $T_2$  (5%)  $11.78\text{g/dl}$  and PCV values were highest at the same  $T_2$  35.16% at 10% of broilers fed *Canarium schweinfurthii* seed meal diets. Some Serum biochemistry parameters differed ( $P>0.05$ ) among treatment groups except glucose, globulin, creatinine, urea and bilirubin. Therefore, the findings demonstrate that 5–10% dietary inclusion of processed *Canarium schweinfurthii* seed meal is the optimum level for maintaining normal metabolic status while sustaining good growth performance and carcass quality in broiler chickens without deleterious effect

**Keywords:** Broilers, *Canarium schweinfurthii*, Seed meal, Carcass Characteristics, Haematology, Serum biochemistry.

**Target Audience:** Poultry Farmers, Animal Nutritionists

## INTRODUCTION

Poultry production is one of the fastest-growing agricultural enterprises worldwide and remains an important source of high-quality animal protein for the increasing human population. Broiler chickens are particularly valued because of their rapid growth rate, efficient feed conversion, short production cycle, and high meat yield. In Nigeria, the poultry industry contributes substantially to food security,

employment generation, and household income. However, the continuous increase in the prices of conventional feed ingredients, particularly maize and soybean meal, has significantly increased the cost of broiler production. Feed accounts for about 70–80% of the total production cost, making the identification of alternative feed resources a major focus of poultry nutrition research (FAO, 2024).

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The increasing competition between humans and livestock for conventional feed ingredients has encouraged the search for unconventional plant feed resources that are inexpensive, readily available, and nutritionally valuable. The use of indigenous plant materials as alternative feed ingredients has the potential to reduce feed costs, improve resource utilization, and promote sustainable poultry production. Consequently, researchers have continued to investigate underutilized tree seeds and agro-forestry products for their suitability in poultry feeding (Garba and Soli, 2024).

*Canarium schweinfurthii* Engl., commonly known as African elemi or African black olive and known as Ube Mgba in South Eastern part of Nigeria is a tropical tree belonging to the family Burseraceae and is widely distributed across West and Central Africa. The fruits are consumed by humans after roasting or boiling, whereas the seeds are usually discarded despite their nutritional potential. Recent investigations have shown that processed *Canarium schweinfurthii* seed meal can serve as a promising unconventional feed ingredient for broiler chickens because of its appreciable nutrient composition and availability in many parts of Nigeria.

The nutritional value of any feed ingredient depends not only on its proximate composition but also on its amino acid profile. Amino acids are essential for protein synthesis, tissue development, enzyme production, immune function, and growth in poultry. Essential amino acids such as lysine, methionine, threonine, leucine, valine, and arginine must be supplied in adequate quantities because poultry cannot synthesize them in sufficient amounts. A recent study on defatted *Canarium schweinfurthii* residue reported appreciable levels of lysine, valine, arginine, and other essential amino acids, indicating that the material possesses considerable potential as an alternative protein source for poultry diets. However, sulphur-containing amino acids, particularly methionine, were relatively low, suggesting that dietary supplementation may be necessary when the seed meal is incorporated into broiler diets.

Despite its nutritional potential, *Canarium schweinfurthii* seed meal contains anti-nutritional compounds such as phytates, tannins, oxalates, and saponins. These compounds can reduce nutrient digestibility, interfere with mineral absorption, and lower feed efficiency when present in high concentrations. Appropriate processing techniques, including drying and heat treatment, have been shown to significantly reduce the levels of these anti-nutritional factors, thereby improving the nutritional quality and safety of the seed meal for poultry feeding.

Growth performance is one of the most reliable indicators for evaluating the feeding value of alternative feed ingredients. Parameters such as body weight gain, feed intake, feed conversion ratio, protein efficiency ratio, and mortality provide useful information on the ability of broiler chickens to utilize nutrients supplied by experimental diets. Recent feeding trials involving *Canarium schweinfurthii* seed meal demonstrated that dietary inclusion of processed seed meal, particularly when supplemented with phytase enzyme,

supported satisfactory growth performance and improved selected serum biochemical indices without adverse effects on bird health.

Carcass characteristics are equally important because they determine the economic value of broiler production. Measurements such as dressing percentage, breast muscle yield, drumstick, thigh, wing, and organ weights are commonly used to assess meat quality and nutrient utilization. Adelowo *et al.* (2024) reported that the inclusion of oven-dried *Canarium schweinfurthii* seed meal up to 7.5% had no detrimental effect on carcass yield or organ development of broiler chickens, indicating that the ingredient can be safely incorporated into broiler diets at appropriate inclusion levels.

Haematological indices are widely used to evaluate the physiological and health status of poultry receiving experimental diets. Parameters including packed cell volume, haemoglobin concentration, red blood cell count, white blood cell count, mean corpuscular volume, mean corpuscular haemoglobin, and mean corpuscular haemoglobin concentration provide valuable information on nutrient utilization, immune competence, and possible toxic effects of feed ingredients. Maintaining normal haematological values following dietary inclusion of unconventional feed ingredients is an indication that such ingredients are safe for poultry consumption.

Although recent studies have demonstrated the potential of *Canarium schweinfurthii* seed meal in broiler nutrition, comprehensive information on its amino acid profile, anti-nutritional factors, growth performance, carcass characteristics, and haematological responses remains limited. Therefore, this study was designed to evaluate the performance, amino acid profile, anti-nutritional factors, carcass characteristics, and haematological indices of broiler chickens fed graded levels of processed *Canarium schweinfurthii* seed meal. The findings will contribute to the development of cost-effective broiler diets based on locally available feed resources and promote sustainable poultry production.

### Statement of the Problem

The high cost of conventional feed ingredients has continued to reduce the profitability of broiler production in Nigeria. This has increased the need to explore alternative feed resources that are affordable, locally available, and nutritionally adequate (FAO, 2024).

Although *Canarium schweinfurthii* seed meal has shown potential as an alternative feed ingredient, information on its amino acid profile, anti-nutritional factors, carcass characteristics, and haematological effects in broiler chickens is still limited. Therefore, this study was undertaken to evaluate its nutritional value and determine the appropriate dietary inclusion level for broiler chickens (Adelowo *et al.*, 2024).

### Justification of the Study

This study will provide information on the nutritional quality of *Canarium schweinfurthii* seed meal and its suitability as an

alternative feed ingredient for broiler chickens. The findings will help determine its optimum inclusion level, reduce dependence on expensive conventional feed ingredients, lower feed costs, and promote sustainable poultry production (Adelowo *et al.*, 2024).

#### Objectives

- To evaluate the nutritional composition of *Canarium schweinfurthii* seed meal.
- Anti-nutritional composition of *Canarium schweinfurthii* seed meal
- Amino acid profile of *Canarium schweinfurthii* seed meal
- To determine its optimal inclusion level in broiler diets.
- To assess its effects on growth performance and health of broilers.
- To assess carcass characteristics of broilers. Fed *Canarium schweinfurthii* seed meal
- Haematological and Serum Biochemical Indices of broilers fed *Canarium schweinfurthii* seed meal

## MATERIALS AND METHODS

#### Experimental site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The area falls within the tropical rain forest zone with an annual rainfall of 2177mm, temperature range between 20-30° C, with relative humidity of 50-59%, depending on season (NRCRI, 2025).

#### Source of *Canarium schweinfurthii* Seed Meal

Ripe fruits of *Canarium schweinfurthii* (African elemi) used for this study were purchased from local fruit markets within Umuhia, Abia State, Nigeria. The fruits were transported to the Animal Nutrition and Biochemistry Laboratory, Department of Animal Nutrition and Forage Science, Michael Okpara University of Agriculture, Umudike, for processing. The plant material was identified and authenticated before use to ensure the correct botanical identity of the experimental feed ingredient (Adelowo *et al.*, 2024).

#### Processing of *Canarium schweinfurthii* Seed Meal

The harvested fruits were first washed with clean water to remove soil particles and other foreign materials. They were then soaked briefly in warm water to soften the pulp, after which the pulp was manually separated from the seeds. The recovered seeds were thoroughly washed and allowed to air-dry for 24 hours. Thereafter, the hard seed coat was cracked manually to obtain the kernels. The kernels were cut into

smaller pieces to facilitate rapid drying and were oven-dried at 60–65°C until a constant weight was achieved. After drying, the kernels were ground into a fine meal using a hammer mill and sieved to obtain a uniform particle size. The processed *Canarium schweinfurthii* seed meal was packaged in clean airtight polyethylene bags and stored in a cool, dry place until it was incorporated into the experimental diets.

Heat processing was adopted because it has been reported to reduce the concentration of naturally occurring anti-nutritional compounds, including tannins, phytates, oxalates, and saponins, which may limit nutrient utilization in poultry. Processing also improves nutrient availability, enhances digestibility, and increases the suitability of the seed meal for inclusion in broiler diets (Adelowo *et al.*, 2024). Furthermore, proper drying minimizes microbial contamination and extends the shelf life of the processed meal without adversely affecting its nutritional quality (Alagawany *et al.*, 2021).

The milled *Canarium schweinfurthii* seed was used for the anti-nutrient analysis and also proximate composition was carried out according to the method of A.O.A.C (2012). During the analysis, values were obtained on dry mater, moisture, crude protein, crude fiber, ether extract and ash used for nitrogen free extract and metabolizable energy calculation.

#### Experimental birds and management

A total of 150 day-old Abor Acre broiler were procured from Amo Byng® farms for the experiment. The initial weight of the birds were taken and randomly divided into 5 treatment groups with 10 birds per replicate, comprising 30 birds in each group, and the birds were brooded together with a 60W bulb. Each group was raised in floor pens with wood shavings as litter materials, feeders and drinkers were respectively provided for the supply of ad libitum feed and water for a duration of seven weeks. The birds were vaccinated against Gumboro disease at 10th and 18th days of life while Newcastle vaccine was administered at the 28th day. Coccidiostat was administered in drinking water within the second week and third week of the experiment.

#### Experimental diets

Five (5) experimental broiler diets were formulated for the experiment such that the control diet (T<sub>1</sub>) did not contain *Canarium schweinfurthii* seed meal seed meal, while Diets T<sub>2</sub>-T<sub>5</sub> contained *Canarium schweinfurthii* seed meal at 0%, 5%, 10%, 15% and 20% across board. The composition of broiler chickens diets and calculated analysis are shown in table 1.

**Table 1: Dietary Composition of Straight Broiler Diets showing percent substitution of *Canarium schweinfurthii* seed meal in broiler chicken diets**

| Ingredients (%)                    | T <sub>1</sub> (0%) | T <sub>2</sub> (5%) | T <sub>3</sub> (10%) | T <sub>4</sub> (15%) | T <sub>5</sub> (20%) |
|------------------------------------|---------------------|---------------------|----------------------|----------------------|----------------------|
| Maize                              | 55.00               | 52.25               | 49.50                | 46.75                | 44.00                |
| <i>C. schweinfurthii</i> seed meal | 0.00                | 2.75                | 5.50                 | 8.25                 | 11.00                |
| Wheat Offal                        | 4.50                | 4.50                | 4.50                 | 4.50                 | 4.50                 |
| Soyabean Meal                      | 24.00               | 24.00               | 24.00                | 24.00                | 24.00                |
| Groundnut Cake                     | 8.00                | 8.00                | 8.00                 | 8.00                 | 8.00                 |
| Fish Meal (Local)                  | 2.00                | 2.00                | 2.00                 | 2.00                 | 5.00                 |
| Palm Kernel Meal                   | 4.00                | 4.00                | 4.00                 | 4.00                 | 4.00                 |
| Bone Meal                          | 1.50                | 1.50                | 1.50                 | 1.50                 | 1.50                 |
| Premix                             | 0.25                | 0.25                | 0.25                 | 0.25                 | 0.25                 |
| Salt                               | 0.30                | 0.30                | 0.30                 | 0.30                 | 0.30                 |
| Methionine DL                      | 0.20                | 0.20                | 0.20                 | 0.20                 | 0.20                 |
| Lysine                             | 0.15                | 0.15                | 0.15                 | 0.15                 | 0.15                 |
| <b>Total</b>                       | <b>100.00</b>       | <b>100.00</b>       | <b>100.00</b>        | <b>100.00</b>        | <b>100.00</b>        |
| <b>Calculated Analysis</b>         |                     |                     |                      |                      |                      |
| Crude protein %                    | 22.60               | 22.55               | 22.48                | 22.42                | 22.35                |
| ME Kcal/Kg                         | 3045.00             | 3028.00             | 3012.00              | 2995.00              | 2978.00              |
| <b>Analyzed composition</b>        |                     |                     |                      |                      |                      |
| Dry matter %                       | 89.10               | 89.30               | 89.50                | 89.70                | 89.90                |
| Crude protein %                    | 22.35               | 22.28               | 22.20                | 22.12                | 22.05                |
| Crude fibre %                      | 4.28                | 4.61                | 4.95                 | 5.30                 | 5.66                 |
| Ether extract %                    | 4.62                | 5.08                | 5.55                 | 6.02                 | 6.48                 |
| Moisture %                         | 10.90               | 10.70               | 10.50                | 10.30                | 10.10                |
| NFE %                              | 52.23               | 51.68               | 51.11                | 50.53                | 49.95                |
| Ash                                | 5.62                | 5.65                | 5.69                 | 5.73                 | 5.76                 |
| ME Kcal/kg                         | 3040.00             | 3025.00             | 3010.00              | 2992.00              | 2975.00              |

Vitamin-mineral premix supplied the following: Vitamin A 8,000,000 iu, Vitamin D<sub>3</sub> 2,000,000, Vitamin E 5,000mg, Vitamin K<sub>3</sub> 2,000mg,

Folic acid 500mg, Niacin 15,000mg, Vitamin B<sub>2</sub> 8,000mg, Vitamin B<sub>12</sub> 10,000mg, Vitamin B<sub>1</sub> 1,500mg, B6 1,500mg, Biotin 20mg, Calpan 5,000mg.

**Table 2: Determined Proximate composition of *Canarium schweinfurthii***

| Parameters                     | % Composition |
|--------------------------------|---------------|
| Dry matter                     | 91.20         |
| Crude protein                  | 18.84         |
| Crude fat (Ether extract)      | 24.70         |
| Crude fibre                    | 10.42         |
| Ash                            | 3.85          |
| Moisture                       | 8.80          |
| Nitrogen free extract          | 42.19         |
| Metabolizable energy (Kcal/kg) | 3.420 kcal/kg |

The processed *Canarium schweinfurthii* seed meal contained 91.20% dry matter, indicating that the material was adequately dried and therefore possesses good storage stability with reduced susceptibility to microbial spoilage (AOAC, 2019). The crude protein content (18.84%) suggests that the seed meal can serve as a moderate source of plant protein for poultry diets, while the relatively high ether extract (24.70%) reflects its oil-rich nature and contributes substantially to its energy value, making it a potential alternative energy feed ingredient for broiler chickens (Jabar *et al.*, 2017; Adelowo *et al.*, 2024).

The crude fibre content (10.42%) was moderate and may necessitate controlled dietary inclusion to avoid adverse effects on nutrient digestibility in monogastric animals. The ash content (3.85%) indicates the presence of essential minerals, whereas the nitrogen-free extract (42.19%) demonstrates that the seed meal also supplies digestible carbohydrates for energy metabolism. Based on its overall nutrient composition, the metabolizable energy was estimated at approximately 3,420 kcal/kg, suggesting that processed *Canarium schweinfurthii* seed meal can partially replace conventional energy sources such as maize in broiler diets when properly processed and incorporated at appropriate inclusion levels (NRC, 1994; Adelowo *et al.*, 2024).

**Table 3: Determined anti-nutritional factors of *Canarium schweinfurthii***

| Parameters       | % Composition |
|------------------|---------------|
| Saponin (mg/g)   | 0.46          |
| Tannins (mg/g)   | 0.64          |
| Oxalate (mg/g)   | 0.67          |
| Alkaloids (mg/g) | 0.77          |
| Phytate (mg/g)   | 0.61          |

The processed *Canarium schweinfurthii* seed meal contained relatively low concentrations of anti-nutritional factors, indicating that the processing method adopted effectively reduced these compounds to levels that are unlikely to adversely affect broiler performance (Anyalogbu and Ezeiofor, 2018). The phytate content (0.61 mg/g) was low and therefore is not expected to significantly reduce the bioavailability of minerals such as calcium, phosphorus, iron and zinc in poultry diets (Ravindran *et al.*, 2017).

The tannin concentration (0.64 mg/g) was also low, suggesting minimal interference with protein digestibility, enzyme activity and feed palatability. This agrees with reports that moderate processing markedly decreases tannin levels in unconventional feed ingredients, thereby improving nutrient utilization (Anyalogbu & Ezeiofor, 2018). Similarly, the oxalate content (0.67 mg/g) was below the level considered harmful to poultry and is unlikely to impair calcium absorption or increase the risk of mineral deficiencies (Ehirim *et al.*, 2015).

Furthermore, the saponin (0.46 mg/g) and alkaloid (0.77 mg/g) contents were relatively low, indicating that the processed seed meal is safe for incorporation into broiler diets at moderate inclusion levels. Low concentrations of these anti-nutritional compounds have been associated with improved nutrient digestibility, feed intake and growth performance in broiler chickens fed processed non-conventional feed resources (Adelowo *et al.*, 2024). Overall, the anti-nutritional profile of the processed *Canarium schweinfurthii* seed meal suggests that it can be utilized as an alternative feed ingredient for broiler chickens without causing detrimental effects when properly processed and included at recommended dietary levels (NRC, 1994).

**Table 4: Determined Amino Acid Profile of Processed *Canarium schweinfurthii* seed (g/100g P Crude Protein)**

| Amino Acid | % Value |
|------------|---------|
| Lysine     | 4.62    |
| Methionine | 1.58    |
| Cystine    | 1.43    |
| Threonine  | 3.71    |
| Arginine   | 6.84    |
| Leucine    | 7.18    |

|               |       |
|---------------|-------|
| Isoleucine    | 3.82  |
| Valine        | 4.32  |
| Phenylalanine | 4.51  |
| Histidine     | 2.30  |
| Tryptophan    | 1.11  |
| Serine        | 3.67  |
| Alanine       | 4.28  |
| Aspartic acid | 8.91  |
| Glutamic acid | 13.52 |
| Proline       | 3.86  |
| Glycine       | 4.12  |

The amino acid profile of processed *Canarium schweinfurthii* seed meal revealed that glutamic acid (13.52 g/100 g crude protein) and aspartic acid (8.91 g/100 g crude protein) were the predominant amino acids, indicating that the seed meal is rich in non-essential amino acids that play important roles in protein metabolism and nitrogen transport (Jabar *et al.*, 2017). Among the essential amino acids, leucine (7.18 g/100 g crude protein) and arginine (6.84 g/100 g crude protein) were present in relatively high concentrations, suggesting that the seed meal can contribute to muscle development, tissue growth and immune function in broiler chickens (FAO, 2013). The concentrations of lysine (4.62 g/100 g crude protein) and threonine (3.71 g/100 g crude protein) were moderate and can support protein synthesis and feather development when the ingredient is incorporated into balanced poultry diets. However, the relatively low levels of the sulphur-containing amino acids, methionine (1.58 g/100 g crude protein) and cystine (1.43 g/100 g crude protein), indicate that dietary supplementation with synthetic methionine may be required to satisfy the nutritional requirements of fast-growing broiler chickens (NRC, 1994; Ravindran *et al.*, 2017).

Overall, the amino acid composition demonstrates that processed *Canarium schweinfurthii* seed meal possesses a favourable amino acid balance and can serve as a useful unconventional feed ingredient in broiler nutrition when appropriately processed and included at moderate dietary levels (Jabar *et al.*, 2017; Adelowo *et al.*, 2024).

## Data Collection

### Growth performance

Data on performance characteristics such as average initial weight, average weight, average feed intake, were collected while average weight gain, feed conversion ratio, daily protein intake and protein efficiency ratio calculated.

### Carcass evaluation

At the end of the experiment, two (2) birds of similar body weight were selected from the treatment groups, fasted, weighed and slaughtered by severing the jugular vein. They were thoroughly bled and scalded by dipping in hot water of 60°C and defeathered. The carcass values from head, shank,

neck and visceral were removed in order to determine the dressed weight as described by Ojewola and Longe (1999).

$$\text{Dressing \%} = \frac{\text{Dressed weight}}{\text{Live weight}} \times 100$$

$$\text{Organs} = \frac{\text{Heart/liver/kidney/intestine/proventriculus}}{\text{Live weight}} \times 100$$

#### Haematological indices

Blood samples (10mls) were taken from the jugular vein of each of the birds under each of the treatment diets at the end of the experiments using sterile needle and syringe to withdraw the blood; from which 5mls each were kept in a sample containing Ethylene Diamine Tetra Acetic Acid (EDTA) (Alcorn, 2002) an anti-coagulant to prevent blood clotting. Each of the blood samples collected were put into properly labelled and sterilized tube and taken to the laboratory for haematological assessment. The following were determined; Packed Cell Volume (PCV), Red Blood Cells (RBC)- was determined using the methods as described by Sood, (2006). White Blood Cells (RBC), Haemoglobin (Hb), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) Baker and Silverton (1985).

#### Mean Corpuscular Haemoglobin (MCH)

$$\text{Hb} \times 10$$

RBC

#### Mean Corpuscular Volume (MCV)

$$\frac{\text{PCV} \times 10}{\text{RBC}}$$

#### Mean Corpuscular Haemoglobin Concentration (MCHC)

$$\frac{\text{Hb} \times 100}{\text{PCV}}$$

#### Serum Biochemical Indices

**Total Protein** = Biuret Method

**Glucose** = Glucose Oxidase Method

$$\text{Albumin (g/dL)} = \frac{A_{\text{sample}}}{A_{\text{standard}}} \times \text{Albumin Standard}$$

$$\text{Creatine (mg/dL)} = \frac{A_{\text{sample}}}{A_{\text{standard}}} \times \text{Creatinine Standard}$$

$$\text{Cholesterol (mg/dL)} = \frac{A_{\text{sample}}}{A_{\text{standard}}} \times 200$$

$$\text{Urea (mg/dL)} = \frac{A_{\text{sample}}}{A_{\text{standard}}} \times \text{Urea Standard}$$

$$\text{Total Bilirubin (mg/dL)} = \frac{A_{\text{sample}}}{A_{\text{standard}}} \times \text{Bilirubin Standard}$$

$$\text{Globulin (g/dL)} = \text{Total Protein} - \text{Albumin}$$

\*Where

$A_{\text{sample}}$  = Absorbance(optical density) of the sample

$A_{\text{standard}}$  = Absorbance of the standard

**Table 5: Growth Performance of broiler chickens fed diets containing *Canarium schweinfurthii* seed meal in broiler chicken diets**

| Parameter (g) | T <sub>1</sub> (0%)  | T <sub>2</sub> (5%)  | T <sub>3</sub> (10%)  | T <sub>4</sub> (15%) | T <sub>5</sub> (20%) | SEM   |
|---------------|----------------------|----------------------|-----------------------|----------------------|----------------------|-------|
| Initial W     | 41.00                | 40.21                | 41.37                 | 41.00                | 42.13                | 0.39  |
| Final W       | 1661.21 <sup>a</sup> | 1670.39 <sup>a</sup> | 1631.40 <sup>ab</sup> | 1571.38 <sup>b</sup> | 1552.93 <sup>b</sup> | 22.14 |
| Total W       | 1620.21 <sup>a</sup> | 1630.18 <sup>a</sup> | 1590.03 <sup>ab</sup> | 1530.38 <sup>b</sup> | 1510.80 <sup>b</sup> | 21.98 |
| ADW           | 33.07 <sup>a</sup>   | 33.27 <sup>a</sup>   | 32.45 <sup>ab</sup>   | 31.23 <sup>b</sup>   | 30.83 <sup>b</sup>   | 0.45  |
| TFI           | 4460.30              | 4418.60              | 4382.50               | 4350.20              | 4320.80              | 36.81 |
| ADFI          | 91.03                | 90.18                | 89.44                 | 88.78                | 88.18                | 0.75  |
| FCR           | 2.75 <sup>a</sup>    | 2.71 <sup>a</sup>    | 2.76 <sup>a</sup>     | 2.84 <sup>b</sup>    | 2.86 <sup>b</sup>    | 0.03  |
| DPI           | 20.57                | 20.34                | 20.11                 | 19.90                | 19.71                | 0.18  |
| PER           | 1.67 <sup>a</sup>    | 1.69 <sup>a</sup>    | 1.65 <sup>a</sup>     | 1.56 <sup>b</sup>    | 1.54 <sup>b</sup>    | 0.03  |

<sup>a,b,c</sup>. Means within the rows with different superscripts are significantly different (P<0.05); SEM=Standard error of mean. FW:Final Weight; TW: Total Weight ; ADW: Average Daily Weight; ADFI: Average Daily

#### Discussion of Growth Performance of Broiler Chickens Fed Graded Levels of *Canarium schweinfurthii* Seed Meal

The results of the growth performance trial showed that dietary inclusion of processed *Canarium schweinfurthii* seed meal significantly (P < 0.05) influenced the growth performance of broiler chickens. Birds fed the control diet (0%) and those receiving 5% and 10% inclusion levels

recorded comparable final body weight, total weight gain and daily weight gain, whereas birds fed 15% and 20% inclusion levels exhibited significantly lower values. This finding suggests that the processed seed meal was efficiently utilized at inclusion levels up to 10% without compromising growth performance. The slight improvement observed at the 5% inclusion level may be attributed to the additional dietary energy supplied by the oil-rich seed meal and the adequate nutrient balance of the diets (Adelowo *et al.*, 2024; Ravindran *et al.*, 2021).

The comparable performance observed in broilers fed 5% and 10% *Canarium schweinfurthii* seed meal indicates that

processing effectively reduced the anti-nutritional factors to levels that did not impair nutrient digestion or feed utilization. Similar observations have been reported for other processed unconventional feed ingredients where moderate inclusion levels supported satisfactory growth and nutrient utilization in broiler chickens (Onunkwo *et al.*, 2022; Adeyemi *et al.*, 2023). This implies that processed *Canarium schweinfurthii* seed meal can safely replace a proportion of conventional energy ingredients such as maize without adverse effects on broiler productivity.

The reduction in final body weight and weight gain at the 15% and 20% dietary inclusion levels may be associated with the gradual increase in dietary fibre and residual anti-nutritional compounds as the level of *Canarium schweinfurthii* seed meal increased. Higher fibre concentrations are known to reduce nutrient digestibility, increase digesta passage time and decrease the efficiency of energy utilization in broilers, ultimately resulting in poorer growth performance (Ravindran and Abdollahi, 2021). Although the seed meal was processed before incorporation into the diets, increasing inclusion levels may still have supplied sufficient residual phytate, tannins and fibre to slightly reduce nutrient availability.

Total feed intake and average daily feed intake showed only slight reductions as dietary inclusion of *Canarium schweinfurthii* seed meal increased. The absence of marked differences in feed intake indicates that the processed seed meal did not adversely affect diet palatability. This agrees with reports that properly processed unconventional feed resources are generally well accepted by broiler chickens when included at moderate dietary levels (Afolabi *et al.*, 2022). The slight decline in feed consumption at higher inclusion levels could be attributed to the higher oil and fibre contents of the seed meal, which may have promoted earlier satiety and reduced voluntary feed intake.

Feed conversion ratio was significantly improved in birds fed 5% and 10% inclusion levels compared with those fed 15% and 20% diets. Lower feed conversion ratio values indicate more efficient conversion of feed into body weight gain. The superior feed efficiency observed at moderate inclusion levels suggests that broilers effectively utilized the nutrients supplied by the processed seed meal. However, the deterioration in feed conversion ratio at 15% and 20% inclusion levels indicates reduced nutrient utilization, probably due to increasing fibre content and reduced digestibility of nutrients at higher dietary concentrations (Ravindran *et al.*, 2021; Adeyemi *et al.*, 2023).

Daily protein intake declined slightly across treatments because of the gradual reduction in feed intake and the small decline in dietary crude protein concentration. Nevertheless, the differences were minimal and therefore unlikely to be biologically important. The higher protein efficiency ratio obtained in the control, 5% and 10% inclusion levels demonstrates that birds converted dietary protein into body tissue more efficiently than those fed the 15% and 20% diets. Reduced protein efficiency at higher inclusion levels may

reflect lower protein digestibility associated with increased dietary fibre and residual anti-nutritional factors, particularly phytate and tannins, which are known to reduce amino acid availability in poultry (Cowieson and Bedford, 2022).

Overall, the findings indicate that processed *Canarium schweinfurthii* seed meal can be included successfully in broiler diets at levels up to 10% without compromising growth performance. Inclusion beyond this level resulted in depressed weight gain and poorer feed efficiency, suggesting that excessive dietary incorporation may limit nutrient utilization despite processing. Therefore, 5–10% dietary inclusion appears to be the optimum range for achieving satisfactory growth performance while partially replacing conventional feed ingredients in broiler production.

**Table 6: Carcass Characteristics of Broiler Chickens fed *Canarium schweinfurthii* seed meal diets.**

| Parameters (%)           | T <sub>1</sub> (0%)  | T <sub>2</sub> (5%)  | T <sub>3</sub> (10%)  | T <sub>4</sub> (15%) | T <sub>5</sub> (20%) | SEM   |
|--------------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|-------|
| Live Weight (g/b)        | 1661.21 <sup>a</sup> | 1670.39 <sup>a</sup> | 1631.40 <sup>ab</sup> | 1571.38 <sup>b</sup> | 1552.93 <sup>b</sup> | 22.14 |
| Defeathered Weight (g/b) | 1565.40 <sup>a</sup> | 1576.82 <sup>a</sup> | 1537.90 <sup>ab</sup> | 1478.62 <sup>b</sup> | 1461.18 <sup>b</sup> | 20.46 |
| Dressed Weight (g/b)     | 1218.55 <sup>a</sup> | 1233.96 <sup>a</sup> | 1200.74 <sup>ab</sup> | 1140.30 <sup>b</sup> | 1120.12 <sup>b</sup> | 17.62 |
| Dressing %               | 73.35 <sup>a</sup>   | 73.87 <sup>a</sup>   | 73.60 <sup>a</sup>    | 72.56 <sup>b</sup>   | 72.13 <sup>b</sup>   | 0.41  |
| Back cut                 | 16.40                | 16.52                | 16.30                 | 16.05 <sup>c</sup>   | 15.92                | 0.18  |
| Thigh                    | 13.82 <sup>a</sup>   | 13.95 <sup>a</sup>   | 13.76 <sup>a</sup>    | 13.20 <sup>b</sup>   | 13.06 <sup>b</sup>   | 0.14  |
| Drumstick                | 12.34 <sup>a</sup>   | 12.48 <sup>a</sup>   | 12.30 <sup>a</sup>    | 11.86 <sup>b</sup>   | 11.70 <sup>b</sup>   | 0.12  |
| Wings                    | 10.56                | 10.64                | 10.58                 | 10.43                | 10.31                | 0.10  |
| Breast                   | 22.81 <sup>a</sup>   | 23.10 <sup>a</sup>   | 22.95 <sup>a</sup>    | 21.96 <sup>b</sup>   | 21.72 <sup>b</sup>   | 0.25  |

<sup>a,b</sup>, Means within the rows with different superscripts are significantly different ( $P < 0.05$ ); SEM-Standard Error of mean.

#### Discussion of Carcass Characteristics of Broiler Chickens Fed Graded Levels of *Canarium schweinfurthii* Seed Meal

The carcass characteristics of broiler chickens were significantly ( $P < 0.05$ ) influenced by the dietary inclusion of processed *Canarium schweinfurthii* seed meal. Birds fed the control diet (0%) and diets containing 5% and 10% *Canarium schweinfurthii* seed meal produced comparable live weight, defeathered weight and dressed weight, whereas birds fed 15% and 20% inclusion levels recorded significantly lower values. This trend is consistent with the growth performance results, where birds on the lower inclusion levels exhibited superior weight gain and feed efficiency. The findings indicate that processing of the seed meal improved its feeding value and allowed its utilization up to 10% dietary inclusion without adversely affecting carcass yield (Adelowo *et al.*, 2024; Ravindran and Abdollahi, 2021).

The significantly higher live weight observed in birds fed the control, 5% and 10% diets suggests that these inclusion levels supplied sufficient digestible nutrients and metabolizable energy to support efficient muscle deposition. Since live weight is closely associated with carcass yield, the higher carcass weights obtained in these treatments were expected. Similar observations have been reported for broilers fed properly processed unconventional feed ingredients, where moderate dietary inclusion maintained carcass yield comparable with conventional maize-based diets (Onunkwo *et*

al., 2022; Adeyemi et al., 2023). This implies that processed *Canarium schweinfurthii* seed meal can successfully replace part of conventional energy sources without compromising carcass production when included at appropriate levels.

Defeathered weight and dressed weight followed the same pattern as live weight, with birds receiving 15% and 20% dietary inclusion recording lower values. The reduction observed at these higher inclusion levels may be attributed to the gradual increase in dietary fibre and the residual anti-nutritional compounds present in the seed meal. Higher fibre concentrations are known to reduce nutrient digestibility and metabolizable energy utilization, thereby limiting muscle growth and carcass development in broiler chickens (Cowieson and Bedford, 2022). Consequently, although the seed meal was processed before incorporation into the diets, increasing its dietary proportion beyond 10% may have reduced nutrient availability sufficiently to affect carcass development.

Dressing percentage was significantly ( $P < 0.05$ ) higher in birds fed the 0%, 5% and 10% diets than those receiving 15% and 20% inclusion levels. Dressing percentage is an important indicator of meat yield and reflects the efficiency with which birds convert body tissues into edible carcass. The superior dressing percentage recorded at the lower inclusion levels indicates that nutrient partitioning towards lean tissue deposition remained efficient when processed *Canarium schweinfurthii* seed meal was incorporated up to 10% of the diet. Conversely, the slight reduction observed at higher inclusion levels suggests that increasing dietary fibre may have reduced nutrient utilization and muscle accretion (Ravindran et al., 2021).

Among the commercial carcass cuts, thigh, drumstick and breast weights were significantly higher in birds fed the 0%, 5% and 10% diets than those receiving 15% and 20%

inclusion levels. The breast muscle represents the largest and most economically valuable portion of the broiler carcass because of its high lean meat content. Therefore, the higher breast yield observed at moderate inclusion levels indicates that processed *Canarium schweinfurthii* seed meal adequately supported protein deposition and muscle growth. The decline in breast, thigh and drumstick yields at 15% and 20% inclusion levels may have resulted from reduced digestibility of dietary protein and amino acids associated with increased fibre and residual phytate concentrations, thereby limiting muscle protein synthesis (Cowieson and Bedford, 2022; Adeyemi et al., 2023).

In contrast, back cut and wing percentages were not significantly ( $P > 0.05$ ) influenced by dietary treatment. The similarity observed among treatments suggests that these carcass components are relatively less sensitive to moderate changes in dietary nutrient composition than the major muscle portions. Similar findings have been reported in broiler studies evaluating alternative feed ingredients, where dietary treatments affected economically important cuts such as the breast and thighs more than structural components like the back and wings (Onunkwo et al., 2022).

Overall, the carcass evaluation demonstrates that processed *Canarium schweinfurthii* seed meal can be included in broiler diets up to 10% without adverse effects on carcass yield or the development of valuable meat cuts. However, increasing the dietary inclusion level to 15% and 20% reduced carcass performance, indicating that excessive inclusion may compromise nutrient utilization and muscle deposition despite prior processing. Therefore, based on the carcass characteristics obtained in this study, 5–10% inclusion of processed *Canarium schweinfurthii* seed meal is recommended for optimum carcass yield and meat production in broiler chickens.

**Table 7: Haematological indices of Broiler Chickens Fed Graded Levels of *Canarium schweinfurthii* Seed Meal**

| Parameters                        | T <sub>1</sub> (0%) | T <sub>2</sub> (5%) | T <sub>3</sub> (10%) | T <sub>4</sub> (15%) | T <sub>5</sub> (20%) | SEM  |
|-----------------------------------|---------------------|---------------------|----------------------|----------------------|----------------------|------|
| RBC ( $\times 10^6/\mu\text{l}$ ) | 2.96 <sup>a</sup>   | 3.01 <sup>a</sup>   | 2.93 <sup>a</sup>    | 2.72 <sup>b</sup>    | 2.66 <sup>b</sup>    | 0.04 |
| WBC ( $\times 10^3/\mu\text{l}$ ) | 2.86                | 2.91                | 2.88                 | 2.96                 | 3.02                 | 0.05 |
| Hb (g/dl)                         | 11.63 <sup>a</sup>  | 11.78 <sup>a</sup>  | 11.54 <sup>a</sup>   | 10.92 <sup>b</sup>   | 10.74 <sup>b</sup>   | 0.15 |
| MCV (fl)                          | 117.64              | 116.81              | 118.12               | 120.74               | 121.43               | 1.14 |
| MCH (pg)                          | 39.29               | 39.14               | 39.39                | 40.15                | 40.38                | 0.33 |
| MCHC (g/dl)                       | 33.40               | 33.50               | 33.35                | 33.27                | 33.25                | 0.18 |
| PCV (%)                           | 34.82 <sup>a</sup>  | 35.16 <sup>a</sup>  | 34.61 <sup>a</sup>   | 32.84 <sup>b</sup>   | 31.90 <sup>b</sup>   | 0.42 |

<sup>a,b</sup> Means within the rows with different superscripts are significantly different ( $P < 0.05$ ); SEM-Standard Error of the mean. PCV: Packed Cell Volume; Hb: Haemoglobin; RBC: Red Blood Cell; WBC: White Blood Cell; MCV: Mean Cell Volume; MCH: Mean Cell Haemoglobin; MCHC: Mean Cellular Haemoglobin Concentration.

#### Discussion of Haematological Indices of Broiler Chickens Fed Graded Levels of *Canarium schweinfurthii* Seed Meal

The haematological profile of broiler chickens is a reliable indicator of their physiological status, health, immune competence and the nutritional adequacy of experimental diets. In the present study, dietary inclusion of processed *Canarium schweinfurthii* seed meal significantly ( $P < 0.05$ ) affected some erythrocytic parameters, whereas most leucocytic indices remained unaffected. Overall, the values obtained were within the normal physiological ranges reported for healthy broiler chickens, indicating that the processed seed meal did not induce any pathological or toxic

effects irrespective of the inclusion level (Campbell and Grant, 2022; Oloruntola *et al.*, 2023).

Packed cell volume (PCV) was significantly ( $P < 0.05$ ) higher in birds fed the 0%, 5% and 10% diets 34.82%, 35.16% and 34.61% than in those fed 15% and 20% *Canarium schweinfurthii* seed meal which was similar to the reports of Isaac *et al.* (2026) when melon seed meal was used in broiler chicken diets. PCV is an important indicator of the oxygen-carrying capacity of blood and reflects the adequacy of erythropoiesis. The higher PCV values recorded at the lower inclusion levels suggest that nutrient availability, particularly protein, iron and vitamins required for red blood cell formation, was adequate. The slight decline observed at the 15% and 20% inclusion levels may have resulted from increased dietary fibre and residual anti-nutritional factors, which could reduce nutrient digestibility and mineral utilization. Nevertheless, the values remained within the normal physiological range for broiler chickens, indicating that the birds were not anaemic (Adeyemi *et al.*, 2023; Campbell and Grant, 2022).

Haemoglobin (Hb) concentration followed a trend similar to that of PCV, with significantly higher values of 11.63g/dl, 11.78g/dl, 11.54g/dl observed in birds fed 0%, 5% and 10% inclusion levels. Haemoglobin is responsible for oxygen transport to body tissues and is therefore closely associated with growth performance. The higher haemoglobin concentrations observed in these treatments agree with the superior body weight gain and feed conversion ratio recorded earlier, suggesting efficient nutrient utilization and satisfactory health status. The slight reduction in Hb at the 15% and 20% inclusion levels may indicate a minor reduction in erythrocyte synthesis due to increasing dietary fibre; however, the values remained within the accepted physiological limits and therefore do not suggest any clinical disorder (Ravindran and Abdollahi, 2021; Oloruntola *et al.*, 2023).

Red blood cell (RBC) count also differed significantly ( $P < 0.05$ ), with birds fed 0–10% processed *Canarium schweinfurthii* seed meal recording higher values than those fed 15% and 20% inclusion levels. Red blood cells are directly involved in oxygen transport and tissue metabolism; therefore, higher RBC values generally reflect improved metabolic activity and growth. The slight reduction observed at higher dietary inclusion levels may be attributed to reduced nutrient utilization associated with increased fibre and residual phytate concentrations. Despite these reductions, the RBC values remained within the normal range reported for broiler chickens, indicating that the processed seed meal did not adversely affect erythropoiesis (Adeyemi *et al.*, 2023; Campbell and Grant, 2022).

White blood cell (WBC) counts were not significantly ( $P > 0.05$ ) influenced by dietary treatment, although a slight numerical increase was observed with increasing dietary inclusion of *Canarium schweinfurthii* seed meal. White blood cells are responsible for immune defence against pathogens. The absence of significant differences among treatments

suggests that the experimental diets did not induce infection, inflammation or physiological stress. The slight increase observed at higher inclusion levels may represent a normal adaptive immune response rather than evidence of disease (Oloruntola *et al.*, 2023). This finding further confirms that the processed seed meal was safe for broiler chickens.

Similarly, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were not significantly affected by dietary treatment. These erythrocyte indices provide information on the size of red blood cells and the amount of haemoglobin contained within them. Their stability across all treatments indicates that the processed *Canarium schweinfurthii* seed meal did not interfere with normal erythrocyte morphology or haemoglobin synthesis. This observation suggests that the diets supplied sufficient nutrients to maintain normal blood cell development despite increasing dietary inclusion levels (Campbell and Grant, 2022).

**Table 8: Serum biochemical indices of Broiler Chickens Fed Graded Levels of *Canarium schweinfurthii* Seed Meal**

| Parameters   | T <sub>1</sub> (0%) | T <sub>2</sub> (5%) | T <sub>3</sub> (10%) | T <sub>4</sub> (15%) | T <sub>5</sub> (20%) | SEM  |
|--------------|---------------------|---------------------|----------------------|----------------------|----------------------|------|
| Pro (g/dl)   | 4.61 <sup>a</sup>   | 4.69 <sup>a</sup>   | 4.56 <sup>a</sup>    | 4.28 <sup>b</sup>    | 4.19 <sup>b</sup>    | 0.08 |
| Glu (mg/dl)  | 228.64              | 225.81              | 223.47               | 219.36               | 216.82               | 2.63 |
| Alb (g/dl)   | 2.41 <sup>a</sup>   | 2.45 <sup>a</sup>   | 2.39 <sup>a</sup>    | 2.23 <sup>b</sup>    | 2.18 <sup>b</sup>    | 0.04 |
| Glo (g/dl)   | 2.20                | 2.24 <sup>c</sup>   | 2.17                 | 2.05                 | 2.01                 | 0.05 |
| Cre (mg/dl)  | 0.61                | 0.60                | 0.62                 | 0.65                 | 0.66                 | 0.01 |
| Chol (mg/dl) | 135.24 <sup>a</sup> | 132.40 <sup>a</sup> | 129.82 <sup>ab</sup> | 123.58 <sup>b</sup>  | 121.43 <sup>b</sup>  | 2.12 |
| Ur (mg/dl)   | 5.81                | 5.69                | 5.74                 | 5.96                 | 6.08                 | 0.09 |
| Bil (mg/dl)  | 0.29                | 0.28                | 0.29                 | 0.31                 | 0.32                 | 0.01 |

<sup>a,b</sup> Means within the rows with different superscripts are significantly different ( $P < 0.05$ ); SEM-Standard Error of the mean. Pro=Protein, Glu=Glucose, Alb=Albumin; Glo=Globulin; Cre=Creatinine; Chol=Cholesterol; Ur=Urea, Bil=Bilirubin

#### Discussion of Serum Biochemical Indices of Broiler Chickens Fed Graded Levels of *Canarium schweinfurthii* Seed Meal

The serum biochemical indices obtained in this study demonstrated that dietary inclusion of processed *Canarium schweinfurthii* seed meal influenced some blood metabolites without causing adverse physiological effects. Serum biochemical parameters are useful indicators of protein metabolism, energy utilization, liver function and kidney integrity in poultry. The values obtained across all treatments were within the normal physiological ranges reported for healthy broiler chickens, indicating that the experimental diets adequately supported normal metabolic functions (Campbell and Grant, 2022; Weiss and Wardrop, 2024).

Serum total protein differed significantly ( $P < 0.05$ ) among the treatments. Birds fed the 0% (4.61 g/dL), 5% (4.69 g/dL) and 10% (4.56 g/dL) inclusion levels recorded significantly higher total protein concentrations than those fed the 15%

(4.28 g/dL) and 20% (4.19 g/dL) diets. Total protein reflects the efficiency of dietary protein digestion, absorption and utilization. The higher values recorded at the lower inclusion levels indicate that protein supplied by the processed *Canarium schweinfurthii* seed meal was efficiently utilized when included up to 10% of the diet. The decline observed at 15% and 20% inclusion levels may be attributed to the increased dietary fibre and residual anti-nutritional compounds, which could reduce protein digestibility and amino acid availability. Nevertheless, the values remained within normal physiological limits, suggesting that protein metabolism was not adversely impaired (Oloruntola *et al.*, 2023; Adeyemi *et al.*, 2023).

A similar trend was observed for albumin, where birds fed the 0% (2.41 g/dL), 5% (2.45 g/dL) and 10% (2.39 g/dL) diets had significantly ( $P < 0.05$ ) higher albumin concentrations than those fed the 15% (2.23 g/dL) and 20% (2.18 g/dL) diets. Albumin is synthesized primarily in the liver and serves as an important indicator of liver function and protein nutritional status. The relatively higher albumin values at the lower inclusion levels suggest that liver protein synthesis was not compromised and that dietary amino acids were adequately utilized. The slight reduction observed at higher inclusion levels may reflect reduced protein utilization associated with increased dietary fibre rather than liver dysfunction, since the values remained within the normal range (Campbell and Grant, 2022).

Serum globulin concentration was not significantly ( $P > 0.05$ ) affected by dietary treatment, although a slight numerical decrease was observed with increasing inclusion of *Canarium schweinfurthii* seed meal. Birds fed 0%, 5%, 10%, 15% and 20% inclusion levels recorded globulin values of 2.20, 2.24, 2.17, 2.05 and 2.01 g/dL, respectively. Globulin is closely associated with antibody production and immune competence. The absence of significant differences among treatments indicates that dietary inclusion of processed *Canarium schweinfurthii* seed meal did not compromise the immune status of the broiler chickens. This observation corroborates the normal white blood cell counts obtained in the haematological evaluation (Oloruntola *et al.*, 2023).

Serum glucose concentrations were also not significantly ( $P > 0.05$ ) affected by dietary treatment. Birds fed 0%, 5%, 10%, 15% and 20% inclusion levels recorded glucose concentrations of 228.64, 225.81, 223.47, 219.36 and 216.82 mg/dL, respectively. Although there was a gradual numerical decline as the dietary inclusion level increased, all values remained within the normal physiological range for broiler chickens. The slight reduction may be attributed to the increased dietary fibre, which can moderate glucose absorption from the gastrointestinal tract. However, the absence of significant differences indicates that energy metabolism remained normal irrespective of dietary treatment (Ravindran and Abdollahi, 2021).

Serum cholesterol was significantly ( $P < 0.05$ ) reduced as the inclusion level of *Canarium schweinfurthii* seed meal increased. Birds fed the 0% (135.24 mg/dL), 5% (132.40

mg/dL) and 10% (129.82 mg/dL) diets recorded significantly higher cholesterol concentrations than birds fed the 15% (123.58 mg/dL) and 20% (121.43 mg/dL) diets. The reduction in serum cholesterol at higher dietary inclusion levels may be attributed to the presence of dietary fibre and bioactive phytochemicals in *Canarium schweinfurthii* seed meal, which may interfere with cholesterol absorption and lipid metabolism. Lower serum cholesterol is generally considered beneficial because it reflects improved lipid metabolism without negatively affecting bird health (Adeyemi *et al.*, 2023; Oloruntola *et al.*, 2023). This finding suggests an additional nutritional advantage of incorporating moderate levels of the processed seed meal into broiler diets.

Serum urea was not significantly ( $P > 0.05$ ) influenced by dietary treatment. Birds fed 0%, 5%, 10%, 15% and 20% inclusion levels recorded values of 5.81, 5.69, 5.74, 5.96 and 6.08 mg/dL, respectively. Urea concentration is commonly used to assess protein metabolism and renal function. The similarity observed among treatments indicates that dietary protein was adequately metabolized and that the kidneys efficiently eliminated nitrogenous waste products. The slight increase observed at 15% and 20% inclusion levels may simply reflect marginally lower protein utilization rather than impaired kidney function (Campbell and Grant, 2022).

Likewise, creatinine concentration was not significantly affected by dietary treatment, with values ranging from 0.60 to 0.66 mg/dL across the treatments. Creatinine is a sensitive indicator of kidney function and muscle metabolism. The maintenance of normal creatinine concentrations across all dietary inclusion levels demonstrates that processed *Canarium schweinfurthii* seed meal did not exert any nephrotoxic effect on the broiler chickens (Weiss and Wardrop, 2024).

Serum total bilirubin also showed no significant ( $P > 0.05$ ) differences among treatments, with values ranging from 0.28 to 0.32 mg/dL. Bilirubin is an important biochemical indicator of liver integrity and red blood cell breakdown. The similarity observed across all dietary treatments indicates that liver function was not adversely affected by dietary inclusion of processed *Canarium schweinfurthii* seed meal. This finding agrees with the normal albumin concentrations and the absence of clinical signs of toxicity throughout the experiment (Campbell and Grant, 2022).

## CONCLUSION

Overall, from the performance, carcass, haematological and the serum biochemical results indicated that dietary inclusion of processed *Canarium schweinfurthii* seed meal up to 10% supported growth, normal protein metabolism, energy utilization and liver and kidney function in broiler chickens. Although birds fed 15% and 20% inclusion levels showed slight reductions in some performance, carcass, haematological and the serum biochemical parameters. Therefore, the findings demonstrate that 5–10% dietary inclusion of processed *Canarium schweinfurthii* seed meal is the optimum level for maintaining normal metabolic status while sustaining good growth performance and carcass quality in broiler chickens without deleterious effects.

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