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HAEMATOLOGY AND SERUM BIOCHEMICAL PROFILE OF BROILER CHICKENS FED DIETS WITH VARIOUS INCLUSION LEVELS OF ATILI (*Canarium schweinfurthii*) LEAF MEAL

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ABSTRACT

This study was carried out to assess the health status of broiler chickens fed *Canarium schweinfurthii* leaf meal in a completely randomized design. A total of 150 two weeks old broiler chicks were used randomly distributed into five dietary treatments comprising 0% (control), 2.0%, 4.0%, 6.0% and 8.0% (Treatment 1 to 5, respectively) of Canarium *schweinfurthii* leaf meal (CSLM) inclusion. Each treatment contains thirty birds three replicates of ten birds. The haematological profile of the birds showed that pack cell volume (PCV) was significantly different ($p< 0.05$) across treatments, birds in T5 having the highest value (32.50). The haemoglobin (Hb) values were significantly different ($p<0.05$) across all treatments, treatment T5 having the highest value. The values for Red Blood Cell showed significant difference ($p< 0.05$) across treatment with the highest observed in T5 which was significantly different from T2 and T3. The serum albumin content was also significantly ($p< 0.05$) higher in birds fed 2.0%, followed by birds fed control diet, 8.0%, 6.0% and 4.0%. Total protein contents were significantly different ($p< 0.05$) across all treatments with birds in 2.0% showing the highest value. The aspartate transaminase and alanine transaminase were similar across all treatments, no significant difference was observed. Cholesterol, Triglycerides, LDL, HDL were significantly ($p<0.05$) increased from control (0%) to T4 (6.0%). It could be concluded that *Canarium schweinfurthii* leaf meal, can be incorporated into diets of broiler chickens up to 8.0% inclusion level.

Keywords: Haematology, serum indices, broiler chickens, Atili leaves

INTRODUCTION

Haematological parameters in animal sciences are important indices in physiological state of the animal (Maidala *et al*., 2014). Blood in animal body serves as a medium of transporting nutrients absorbed

from the digestive system or released from storage in adipose tissues or in liver. The haematological parameters which are of significant diagnostic values include the packed cell volume (PCV), haemoglobin (Hb), total protein (TP) and Serum globulin (SG) are known to affect health, production and adaptability to environmental conditions in livestock (Medugu *et al*., 2010; Adekola *et al*., 2011). Benerjee (2008) reported normal blood values for domestic fowl has PCV 25-45%, RBC 2-4 x 106, Hb 7-13g/dl, WBC 931x 103, and total serum protein 5-7%. Poultry birds especially broilers play a significant role in the provision of animal protein required by man to meet his daily protein intake (Maidala & Istifanus, 2012). They have high growth rate, high feed conversion ratio, short generation interval (5-6 months), short intestinal feed transit of 2-3 hours and traits that respond to feeding and nutritional manipulations within days (Atteh, 2003).

The poultry industry in the developing countries is facing some challenges, one of which is increase in the cost of feed because of high prices of protein and energy sources (Abbas, 2013). Livestock feed costs in developing countries are a continuing challenge. The high and increasing prices for animal feeds have compelled researchers to direct their attention to non-conventional feed sources, with particular emphasis on protein substitutes. The use of leguminous multipurpose trees and shrubs has been suggested to be a viable alternative source of proteins, vitamins and minerals for poultry feeding. Plant leaves are commonly processed into leaf meals for use as poultry feed. Examples of the leaf meals which have been widely used in feeding non-ruminant animals include *Leucaena leucocephala*, *Gliricidia sepium*, *Sesbania sesban* and *Manihot esculenta* (Gadzirayi *et al*., 2012). *Canarium schweinfurthii* is one of those plants usually used by indigenous people for its nutritional value; it belongs to the family Burseraceae. A perennial plant found in Africa referred to as black olive, African olive, black elemi etc. In English, it is commonly known as purple canary tree, bush candle amongst others. Nyam (2011) reported that the tree is common in some parts of states like Bauchi, Plateau, Niger, Southern Kaduna and Oyo state Nigeria.

Haematology has been defined as the study of blood; an important part of clinical pathology as well as diagnostic process (Lutz & Przytulski, 2008). Haematology includes not only the examination of the cellular and fluid portions of blood, but also includes a study of the tissues that form, store and circulate blood cells. However, the serum is the component that is neither a blood cell nor a clotting factor. It is the part of blood that is like water and that contains substances (called antibodies) that fight disease. Serum includes all proteins not used in blood clotting and all the electrolytes, antibodies, antigens, hormones, and any exogenous substances (Martin, 2007) The result of haematology and serum analysis

is usually used to assess the health status of an animal. Haematological and serum parameters have been observed as good indicators of the physiological status of animal and their changes are important in assessing the response of such animal to various physiological situations (Khan & Zafar, 2005).

MATERIALS AND METHODS

Experimental site

This study was carried out at the Poultry section of the Teaching and Research farm, Federal College of Animal Health and Production Technology, National Veterinary Research Institute, Vom, Jos South Local Government Area of Plateau State, Nigeria. It is located between latitude 9° 30' to 10° N and longitude 8° 30' E. It is situated in the southern part of Plateau State with its headquarters at Bukuru Express, which is about 15km from the state capital Jos, with four (4) districts; namely Du, Gyel, Kuru and Vwang districts. The local government area has a total land area of about 1,037 Km^2 with a population of 306, 716 according to the National Population Commission (NPC, 2006). It has a cool climatic condition due to its position on a high altitude. The coldest period is between November and February with an average mean daily temperature of 18°C, while the month of March, April and May are warm. The mean annual rainfall varies between 1347.5 and 1460mm per annum (WikiVet, 2013).

Experimental design

A total of 150 unsexed two weeks old broiler chicks was used for the study. The chicks were randomly distributed into five dietary treatments comprising 0.0% (control), 2.0%, 4.0%, 6.0% and 8.0% (Treatments 1 to 5, respectively) of *Canarium schweinfurthii* leaf meal (CSLM) in a completely randomised design, with each treatment containing thirty birds each and three replicates. The feed was presented in mash form, water was provided *ad libitum*. The feed was formulated to meet the nutrient requirement for broiler chickens. The birds were raised on deep litter system with standard management and hygiene maintained, the recommended vaccines for broilers were administered accordingly. The duration of the study was six weeks.

Experimental diets

Leaves of *Canarium Schweinfurthii* were sourced within the premises of National Veterinary is Institute, Vom and neighbouring Community of Jos South Local Government Area of Plateau State, Nigeria. Five starter and finisher diets (Tables 1 and 2 below) were formulated for the study. *Canarium schweinfurthii* leaf meal (CSLM) was added to the diets at 0.0, 2.0, 4.0, 6.0 and 8.0% inclusion levels. The diets were isonitrogenous and isocaloric.

Blood sample/data collection

Two birds each were randomly selected from each replicate and blood samples were collected from each of them through the jugular vein, 5ml of blood samples was collected from each bird into a labelled Ethylene Diamine Tetra Acetic Acid (EDTA) specimen bottle for determination of haematological profiles. Then the second set of 5ml of blood samples were also collected from the same birds into heparinised tubes for serum chemical indices. Data collected for haematological parameters were packed cell volume (PCV), red blood cell count (RBC), white blood cell (WBC), haemoglobin, mean corpuscular haemoglobin (MCH), Mean corpuscular concentration (MCHC) while data collected for serum biochemistry were (Albumin (g/dl), Total protein (g/dl), Glucose (g/dl), Alanine transaminase (U/L), Aspartate transaminase (U/L), Triglyceride (g/dl), cholesterol (g/dl), HDL (g/dl), LDL (g/dl).

Data analysis

All data collected were subjected to analysis of variance while differences in means were separated using Duncan Multiple Range Test.

Chemical analyses

The chemical composition of *Canarium schweinfurthii* was determined using the analytical procedures of the Association of Official Analytical Chemists (AOAC, 1990).

Table 1: Proximate composition of *Canarium schweinfurthii* leaf meal

Parameters	Composition
Crude protein	18%
Energy	2720.54 Kcal
Calcium	0.99
Phosphorus	0.68
Lysine	1.06
Methionine	0.55
Crude fibre	3.00

Table 2: Phytochemical screening result of *Canarium schweinfurthii* leaf meal

Phytochemical(s)	Result
Tannins	++
Phlobatannins	-

Flavonoids	+++
Phenols	+
Carbohydrate	+++
Steroids	+
Anthraquinones	-
Alkaloids	+++
Saponins	+++

Table 3: Percentage composition of broiler starter diets

Ingredients	**0.0%**	**2.0%**	**4.0%**	**6.0%**	**8.0%**
Maize	50.00	50.00	50.00	50.00	50.00
Wheat offal	9.10	8.10	6.10	6.10	5.10
Soybean meal	18.00	17.00	17.00	17.00	17.00
Groundnut cake	18.00	18.00	18.00	18.00	18.00
Fish meal	1.00	1.00	1.00	1.00	1.00
CSLM	0.00	2.00	4.00	6.00	8.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Starter Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

CSLM= *Canarium schweinfurthii* leaf meal

Table 4: Percentage composition of broiler Finisher diets

Ingredient	**0.0%**	**2.0%**	**4.0%**	**6.0%**	**8.0%**
Maize	47.00	47.00	45.00	45.00	45.00
Wheat offal	15.15	17.05	18.05	16.05	14.05
Soybean meal	17.00	15.00	14.00	14.00	14.00
Groundnut cake	17.00	15.00	15.00	15.00	15.00
Fish meal	0.00	0.00	0.00	0.00	0.00
Atili leaf meal	0.00	2.00	4.00	6.00	8.00
Limestone	1.00	1.00	1,00	1,00	1.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Finisher premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00

RESULTS

Figure 1 shows the effect of *Canarium schweinfurthii* leaf meal on some hematology indices of broiler chickens. The results show a consistent increase in packed cell volume (PCV) across the treatments,

rising from 26.00% in T1 to 32.50% in T5. Similarly, haemoglobin (Hb) concentration increased steadily from 8.75 g/L in T1 to 11.09 g/L in T5. The red blood cell (RBC) count also exhibited an overall increasing trend. Although a slight decrease was observed in T2 (2.05×10^6 mm³) compared with T1 (2.56×10^6 mm³), the values subsequently increased to 2.44×10^6 mm³ (T3), 2.84×10^6 mm³ (T4), and reached the highest value of 3.17×10^6 mm³ in T5.

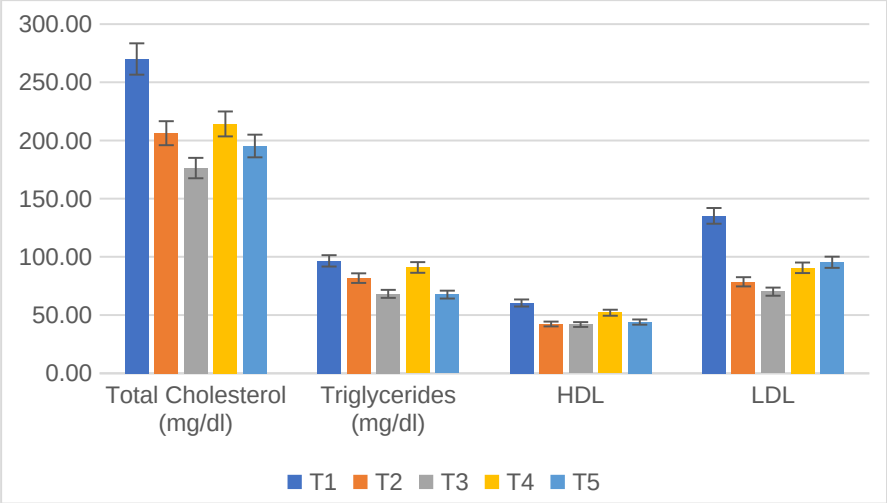


Figure 1: Effect of *Canarium schweinfurthii* leaf meal on some hematology indices of broiler chickens

Table 5 shows the effect of *Canarium schweinfurthii* leave meal on some hematology indices of broiler chickens. The inclusion of *Canarium schweinfurthii* leaf meal significantly ($P < 0.05$) influenced several haematological indices of broiler chickens, while lymphocyte counts remained unaffected ($P > 0.05$).

Heterophil (%) values ranged from 38.50% in T2 to 55.50% in T5. Birds fed T5 recorded the highest heterophil count, which was significantly ($P < 0.05$) higher than those in T2 but comparable to T4. Lymphocyte (%) values varied between 43.50% and 55.00%, with no significant differences ($P > 0.05$) among treatments. Monocyte (%) values were significantly ($P < 0.05$) reduced as dietary inclusion increased. The highest values were observed in T1 (5.50%), T2 (4.00%), and T3 (4.75%), while T4 (1.00%) and T5 (0.75%) recorded the lowest values. Eosinophil (%) counts also differed significantly ($P < 0.05$) among treatments. Birds on T1 (7.00%) and T3 (5.00%) had significantly higher eosinophil counts than those on T2 (2.50%), T4 (2.00%), and T5 (1.00%). Mean Corpuscular Volume (MCV) was significantly ($P < 0.05$) affected by dietary treatment, ranging from 102.53 fL in T5 to 131.91 fL in T2. Birds fed T2 exhibited the highest MCV, while T1, T4, and T5 had similar lower values. Similarly, Mean

Corpuscular Haemoglobin (MCH) differed significantly (P < 0.05), with the highest value recorded in T2 (4.39 pg/cell), followed by T3 (3.89 pg/cell). Birds fed T1, T4, and T5 had significantly lower but comparable values. Mean Corpuscular Haemoglobin Concentration (MCHC) also showed significant (P < 0.05) differences. The highest concentration was observed in T5 (34.12 g/dL), followed by T1 (33.70 g/dL) and T4 (33.67 g/dL), whereas T3 (33.01 g/dL) recorded the lowest value.

Table 5: Effect of *Canarium schweinfurthii* leave meal on some hematology indices of broiler chickens

Parameters	T1	T2	T3	T4	T5	SEM
Heterophils (%)	44.00^{bc}	38.50^{c}	41.75^{bc}	50.00^{ab}	55.50^{a}	2.17
Lymphocytes (%)	44.50	55.00	49.25	47.00	43.50	1.72
Monocyte (%)	5.50^{a}	4.00^{a}	4.75^{a}	1.00^{b}	0.75^{b}	0.65
Eosinophils (%)	7.00^{a}	2.50^{b}	5.00^{a}	2.00^{b}	1.00^{b}	0.64
Mean corpuscular volume (FL)	103.06^{c}	131.91^{a}	117.32^{b}	105.63^{c}	102.53^{c}	3.20
Mean corpuscular haemoglobin (pg/cell)	3.47^{c}	4.39^{a}	3.89^{b}	3.56^{c}	3.50^{c}	0.10
Mean corpuscular haemoglobin concentration (g/dl)	33.70^{b}	33.33^{c}	33.01^{d}	33.67^{b}	34.12^{a}	0.11

$^{a, b, c:}$ Mean values in the same horizontal row with different superscripts are significantly different to the (P<0.05) SEM = Standard Error Mean

The effect of dietary inclusion of *Canarium schweinfurthii* leaf meal on selected serum biochemical indices of broiler chickens is presented in Table 6. The results indicate that dietary treatment had no significant effect (P > 0.05) on serum alanine transaminase (ALT) and aspartate transaminase (AST) activities but significantly (P < 0.05) affected total protein and albumin concentrations.

Alanine transaminase (ALT) values ranged from 20.00 U/L in T4 to 25.00 U/L in T1. Although there was a gradual numerical decline in ALT activity with increasing dietary inclusion of *C. schweinfurthii* leaf meal, the differences among treatments were not statistically significant (P > 0.05). Similarly, Aspartate transaminase (AST) values ranged from 29.80 U/L in T4 to 33.00 U/L in T3, with no significant differences (P > 0.05) among treatments. Total protein concentration was significantly (P < 0.05) influenced by dietary treatment. Birds fed T2 (59.15 g/dL) recorded the highest total protein concentration, which was significantly higher than those of T3 and T4 but comparable to T1. The lowest values were observed in T3 (39.98 g/dL) and T4 (40.60 g/dL), while T5 (42.30 g/dL) was intermediate.

A similar trend was observed for albumin concentration, which also differed significantly ($P < 0.05$) among treatments. The highest albumin concentration was obtained in T2 (36.40 g/dL), followed by T1 (32.35 g/dL), whereas T3 (22.35 g/dL) and T4 (23.25 g/dL) recorded the lowest values. Birds fed T5 (25.70 g/dL) had intermediate albumin concentrations.

Table 6: Effect of *Canarium schweinfurthii* leaf meal on some serum indices of broiler chickens

Parameters	T1	T2	T3	T4	T5	SEM
Alanine transaminase (U/L)	25.00	24.90	22.03	20.00	20.80	0.94
Aspartate transaminase (U/L)	32.05	31.55	33.00	29.80	30.83	0.70
Total protein (g/dl)	52.25^{ab}	59.15^{a}	39.98^{c}	40.60^{c}	42.30^{bc}	2.39
Albumin	32.35^{ab}	36.40^{a}	22.35^{c}	23.25^{c}	25.70^{bc}	1.78

[a, b, c:] Mean values in the same horizontal row with different superscripts are significantly different ($P<0.05$) SEM = Standard Error Mean

Figure 2 illustrates the effect of dietary inclusion of Canarium schweinfurthii leaf meal on the lipid profile of broiler chickens, including total cholesterol, triglycerides, high-density lipoprotein (HDL), and low-density lipoprotein (LDL). The results show that total cholesterol decreased markedly with dietary supplementation compared to the control. Birds in T1 (control) recorded the highest cholesterol concentration (approximately 270 mg/dL), whereas birds fed the leaf meal exhibited lower values. The lowest cholesterol level was observed in T3 (approximately 175 mg/dL), followed by T5 (approximately 195 mg/dL) and T2 (approximately 205 mg/dL). Although T4 showed a slight increase compared with T2 and T3, its cholesterol concentration remained lower than that of the control. A similar trend was observed for triglycerides. The highest triglyceride concentration was recorded in T1 (approximately 95 mg/dL), while birds receiving the dietary treatments had generally lower values. The lowest triglyceride concentration was observed in T5 (approximately 67 mg/dL), followed by T3 (approximately 70 mg/dL) and T2 (approximately 82 mg/dL). Although T4 showed a moderate increase (approximately 90 mg/dL), it remained slightly lower than the control. For high-density lipoprotein (HDL), values were generally lower in the treated groups than in the control. The control group (T1) recorded the highest HDL concentration (approximately 60 mg/dL), whereas T3 and T2 had the lowest values (approximately 41–43 mg/dL). Birds in T4 and T5 showed intermediate HDL concentrations. The low-density lipoprotein

(LDL) concentration showed a substantial reduction following dietary supplementation. Birds in T1 recorded the highest LDL concentration (approximately 135 mg/dL), while T3 had the lowest value (approximately 70 mg/dL). Intermediate values were observed in T2 (approximately 80 mg/dL), T4 (approximately 90 mg/dL), and T5 (approximately 95 mg/dL).

$$\text{Organism per litre} = \frac{\text{Organism per ml of concentration}}{\text{Litres of filtered concentration}} \times 1000$$

Figure 2: Effect of *Canarium schweinfurthii* leaf meal on t=lipid profile of broiler chickens

DISCUSSION

Result obtained in figure 1 showed that Pack Cell Volume showed significant difference ($p < 0.05$) across treatment with birds in T5 (CSLM 8.0%) having the highest value (32.50). Though significant difference ($p < 0.05$) among treatment groups exists, yet the range is within the PCV range of (28.75 - 49.33%), (26.0 - 45.20%) and (32 - 35%) is within the normal values reported by Fayeye *et al*. (2005). PCV when too high is an indicator of toxic factors which could have adverse effect on the formation of blood. The haemoglobin (Hb) values were significantly different ($p > 0.05$) across all treatments, with treatment T5 (8.0% inclusion of CSLM) the highest. Values for Red Blood Cell showed significant difference ($p < 0.05$) across treatment with the highest observed in T5 which was significantly different from T2 and T3. Range values for RBC was 2.05 - 3.17 x 10^6. This shows that birds fed CSLM 8.0% had more red blood cells, which could imply that CSLM have some innate quality to stimulate the production of red blood cells through vitamin synthesis. With PCV, Hb and RBC been within normal range, could be an indicator of the bride marrow of the birds functioning normally thereby stimulating RBC formation. In Table 5, the Heterophils were significantly ($p < 0.05$) higher in birds fed 8.0% CSLM, followed by 6.0% CSLM, Control diet, 4.0% CSLM and lastly 2.0% CSLM. No significant difference was observed in Lymphocytes parameter across all treatments. Mean cell volume (MCV) also showed significant difference at ($p < 0.05$). Range of value were 103.06 fl - 131.91 fl. Mean corpuscular haemoglobin MCH

also showed significance difference $p<0.05$ with value of T1 having 3.47 pg as the least while T2 with 4.39 pg as the highest. Mean corpuscular haemoglobin concentration showed significant variation at $p < 0.05$. Highest level recorded was at T5 (8.0% CSLM) 34.12 g/dl which varied with T4 (CSLM 6.0%) 33.67 pg/dl, T3 (CSLM 4.0%) 33.01 pg/dl, T2 (CSLM 2.0%) 33.33 pg/dl and T1 33.70 g/dl (control). Range of values (35.25 g/dl and 36.18 g/d1) is like the normal range reported by Mitruka and Rawnsley (1977). Data on the serum biochemical indices are shown in Table 6 and figure 2 respectively. The serum albumin content was significantly ($p < 0.05$) high in birds fed 2.0% CSLM, followed by birds fed control diet, 8.0% CSLM, 6.0% CSLM and 4.0% CSLM. Here significant value was found, Albumin is influenced by environment, breed, age, physiological state, and antigen exposure. When protein intake exceeds the amount required for growth and maintenance serum albumin is also increase. Albumin is an important protein in blood. Storage of protein in the white material of egg is also a type of albumin (Farrugia, 2010). It helps to repair body tissue, builds enzymes and hormones and assists in clotting blood. By the consumption of more amount of protein increases the amount of albumin levels. Serum albumin produced from liver and forms a proportion of plasma protein. Albumin is very essential indications to blood protein. Serum total protein contents were significantly different ($p < 0.05$) across all treatment groups with birds 2.0% CSLM showing the highest figures. Value range obtained for total protein and albumin though significantly different ($p > 0.05$) yet values are within range reported by Mitruka and Rawnsley (1977) for healthy chicks. This implies that chick's immunity was not compromised at all levels of inclusion. The aspartate transaminase and alanine transaminase were similar across all treatment groups, no significant difference was observed. Cholesterol, Triglycerides, LDL, HDL were significantly ($p<0.05$) increased from the control (0%) to T4 (6.0%) CSLM inclusion group.

CONCLUSION

Generally, haematological parameters and its knowledge can be used to assess the health as well as the physiological status of farm animals under consideration. The hematological indices and serum biochemistry of birds administered CSLM at various level of inclusion were significantly ($p < 0.05$) different to those of the control implying better utilization of the experimental materials by the birds. Since all the birds used in this experiment showed adequate normal range of values in all parameters analyzed, it could be concluded that with respect to the administration of *Canarium schweinfurthii* leaf meal, it can be incorporated into diets of broiler chickens up to 8.0% inclusion level and still attain optimum hematological and serum performance.

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