

Haematological and Biochemical Indices of Finisher Broiler Chickens Fed Graded Levels of Spurge Weeds (*Euphorbia heterophylla*) Leaf Meal

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Abstract

The study aimed to investigate the Haematological and Serum Biochemical indices of finisher broiler chickens fed graded levels of *Euphorbia heterophylla* leaf meal (*EHLM*) also known as spurge weed. The birds were allotted into six dietary treatments of ten birds segregated into three replicates each. The diets formulated with *EHLM* were included at 0%, 5%, 10%, 15%, 20% and 25% levels in diets 1, 2, 3, 4, 5 and 6 respectively to replace soybean. Each treatment was replicated three times in a completely randomized design. Uncoagulated blood samples were collected from the birds at the end of the 56 days feeding trial and analysed for packed cell volume (PCV), haemoglobin concentrate (Hb), red blood cells (RBC) and white blood cells (WBC). The mean corpuscular haemoglobin volume (MCV), mean corpuscular haemoglobin (MCH), platelets, neutrophils, lymphocytes, monocytes, eosinophils, and basophils were calculated using PCV, RBC and Hb. The blood meant for serological analysis was centrifuged at 1000 G for 10 minutes, after which the serum was separated and used for determining serum total protein (Tp), Albumin, Serum glutamic oxaloacetic transaminase (SGOT) and Serum glutamic pyruvic transaminase (SGPT). The results revealed that the control group had significantly higher values of PCV, RBC, and Hb compared to other treatment groups. However, the values of MCV, MCH, lymphocytes, heterophils, and eosinophils were similar to the control. The biochemical parameters showed significant differences among treatment groups, but not significantly different from the control. The study concluded that *EHLM* may

not pose a health challenge to broiler chickens at levels of 5 - 15 percent, but improved health, immunity and performance can be achieved at the 15% inclusion level.

Keywords

Biochemical, Haematological, *Euphorbia heterophylla* Leaf, Blood Profile

1. Introduction

When considering provision of affordable animal protein especially for the low-income group, rearing poultry would readily come to mind [1]. In order to ensure fast and optimum growth of chickens, giving them a balanced ration is highly essential. The scarcity of major feed ingredients like maize and soybeans, and increase in prices of commercial finished feeds due to government policies have posed a serious challenge to the industry [2]. The search for alternative feed ingredients such as agricultural by-products [3] [4] and leaf meals [5] has been intensified recently so as to keep poultry industry from collapse. These alternative feed ingredients referred to as unconventional feedstuffs contain considerable amounts of anti-nutrients or phytochemicals which may have influence on the composition of the blood profile [1]. The evaluation of these feed ingredients on blood profile is therefore necessary to determine the use as suitable alternative that will enhance the health and performance of animals [6].

In Nigeria and many other tropical and sub-tropical countries, there abound many plants that have found widespread acceptance and utilization scientifically as a way of improving the health status and performance of animals [7] [8]. The leaves of these plants in Nigeria contain nutrients and phytochemicals that could serve as dietary supplement to enhance feed intake, body weight gain, feed conversion ratio, and disease resistance or confer healing and prophylactic advantage when used in the diet [8] [9]. Spurge weed scientifically known as *Euphorbia heterophylla* is a common herb and weed of most plants (soybean, cowpea, groundnut, cotton, maize, etc.) freely accessible and abundantly found in the tropics and sub-tropical regions of the world especially Nigeria in West Africa. It has short life span of 45 - 50 days with many reproductive cycles in a year which supports an annual turnover of about 10.5 tons/hectare [10]. The crude protein (17% - 27.1%), ether extract (9.7% DM), crude fibre (22% DM), alpha-linolenic acid (55.4%), Poly Unsaturated Fatty Acid—PUFA (71.4%), n-3 PUFA (56.0%), increase PUFA/Saturated Fatty Acid ratio (3.0%), decrease C18:2 n-6/C18:3 n-3 (0.63%) and n-6/n-3 (0.3%) ratios which results in reduction of cholesterol in *EHLM* diets makes it a good nutritious and sustainable source of feed ingredient for poultry feeding [8] [10] [11].

Owing to the dynamic nature, blood is a major indicator or reflector of the physiological, pathological and nutritional statuses of the animal body. This is because the blood is susceptible to internal and external changes/stimuli pro-

voked by nutrition, pests, diseases, metabolism, seasonal and any other stimuli or stressors to which the animal may respond [12]. Evaluation of blood profile of farm animals is, therefore, pertinent in monitoring the metabolic status of farm animals, feed quality, disease diagnosis, prophylaxis and treatment as well as evaluation of adaptation traits to various ecological/environmental factors. For fast-growing animals like broiler chickens, nutritional studies should therefore not be limited to the assessment of the biological performance traits, carcass and organ evaluation but also to the evaluation of animal's blood profile. Against this backdrop, this study, aimed to evaluate the haematological and serum biochemical indices of finisher broiler chickens fed graded levels of *Euphorbia heterophylla* leaf meal (*EHLM*).

2. Materials and Methods

2.1. Experimental Site

The experiment was conducted at Nogga Farms, located along Secretariat Road, Oju Local Government Area of Benue State, Nigeria. Oju town is located in latitude 6°51'North and longitude 8°25'East in South Guinea Savannah Zone of Nigeria. The area has an annual rainfall of 1200 mm to 1500 mm with an average minimum and maximum daily temperature of about 21°C and 35°C in the dry season and 16°C and 37°C in wet season respectively. The relative humidity ranges from 60% to 80% [13] [14].

2.2. Preparation of Experimental Materials

Euphorbia heterophylla plants were sourced from Oju metropolis and nearby communities. The plants were harvested by pulling them from the soil and the leaves detached from the stems. The leaves were washed in clean water and air dried under a shade by spreading them evenly on a mat with regular turning to avoid mould growth; they were milled in a hammer mill fitted with 2 mm sieve before being used to produce *Euphorbia heterophylla* leaf meal (*EHLM*). Prior to inclusion in the diet, the *EHLM* was sub-sampled and analyzed for proximate composition to guide in feed formulation.

2.3. Experimental House and Management

The feeding trial conducted for one hundred and eighty (180) day old chicks of Ross 308 strain consisted of six (6) experimental diets tagged: T1, T2, T3, T4, T5 and T6 containing *EHLM* which replaced soybean meal at 0%, 5%, 10%, 15%, 20% and 25% respectively in starter and finisher diets as contained in **Table 1** and **Table 2**. Each treatment was replicated three times. The feeding trial lasted 56 days (8 weeks) in a completely randomized design.

The experimental animals were raised in a conventional deep litter poultry house with concrete floor, dwarf walls and zinc coated metal roofing with wire nettings, to enhance adequate ventilation and protection. Birds were given the experimental diets and water ad-libitum. The birds were administered Newcastle

Table 1. Ingredients composition of broiler finisher diets fed graded levels of spurge weed (*Euphorbia heterophylla* leave meal (EHLM)).

Ingredients	T1	T2	T3	T4	T5	T6		
	(0% EHLM)	(5% EHLM)	(10% EHLM)	(15% EHLM)	(20% EHLM)	(25% EHLM)		
Maize	55.60	55.60	55.60	55.60	55.60	55.60		
SBM	31.00	29.45	27.90	26.35	24.80	23.25		
EHLM	-	1.55	3.10	4.65	6.20	7.75		
Brewers Dried Grain (BDG)	6.00	6.00	6.00	6.00	6.00	6.00		
Bone Meal	3.20	3.20	3.20	3.20	3.20	3.20		
Common Salt	0.25	0.25	0.25	0.25	0.25	0.25		
Premix	0.30	0.30	0.30	0.30	0.30	0.30		
Lysine	0.20	0.20	0.20	0.20	0.20	0.20		
Methionine	0.25	0.25	0.25	0.25	0.25	0.25		
Palm oil	3.20	3.20	3.20	3.20	3.20	3.20		
	100	100	100	100	100	100		
Calculated Analysis								
ME (Kcal/kg)	3035.33	3034.40	3034.35	3033.30	3032.04	3034.79		
Crude Protein (%)	20.71	20.56	20.40	20.25	20.20	20.18		
Crude Fibre (%)	3.83	4.18	4.52	4.85	5.18	5.53		
Ether Extract (%)	3.17	4.00	4.01	4.01	4.02	4.03		
Calcium (%)	1.35	1.36	1.38	1.39	1.42	1.43		
Available								
Phosphorus (%)	0.64	0.65	0.65	0.65	0.66	0.67		
Lysine (%)	1.38	1.36	1.35	1.34	1.33	1.32		
Methionine (%)	0.46	0.47	0.49	0.51	0.52	0.54		

Starter ¹Vitamin/mineral premix (Bio-mix brand) supplied per kilogramme: Vitamin A 450,000 IU, Vitamin D3 9000 IU, Vitamin E 900 IU, Vitamin K 75 mg, Vitamin B12 0.6 mg, Thiamine (B1) 60 mg, Riboflavin (B2) 180 mg, Pyridoxine (B6) 120 mg, Niacin 1200 mg, pantothenic acid 300 mg, folic acid 30 mg, Biotin 2.4 mg, Choline chloride 15 g, Antioxidant 3.75 g, Manganese 2.88 g, Zinc 1.8 g, Iron 0.72 g, Copper 0.18 g, Iodine 0.042 g, Selenium 7.2 mg, Cobalt 7.2 mg. EHLM—*Euphorbia heterophylla* leaf meal, SBM—Soya bean meal.

Table 2. Haematological indices of finisher broiler chickens (5 - 8 weeks) fed graded levels of spurge weed (*Euphorbia heterophylla*) leaf meal.

HAEMATOLOGICAL INDICES	EXPERIMENTAL DIET						S.E.M	LS
	T1	T2	T3	T4	T5	T6		
	(0% EHLM)	(5% EHLM)	(10% EHLM)	(15% EHLM)	(20% EHLM)	(25% EHLM)		
PCV (%)	45.67 ^a	33.00 ^d	41.33 ^b	40.33 ^{bc}	40.00 ^{bc}	37.33 ^c	2.01*	S
RBC × 10 ¹² /L	2.30 ^a	1.90 ^b	2.00 ^b	2.13 ^{ab}	2.13 ^{ab}	2.03 ^b	0.14*	S
WBC × 10 ¹² /L	4.40	4.80	4.73	5.27	5.27	4.93	0.63	NS
Hb (g/dL)	15.23 ^a	11.00 ^d	13.77 ^b	13.10 ^{bc}	13.30 ^{bc}	12.40 ^c	0.72*	S
MCV (fl)	182.00 ^{ab}	173.53 ^b	206.50 ^a	183.63 ^{ab}	186.17 ^{ab}	183.50 ^{ab}	15.94*	S

Continued

MCH (pg)	66.00 ^{ab}	58.07 ^c	68.67 ^a	61.33 ^{bc}	62.50 ^{bc}	60.93 ^c	2.69*	S
MCHC (g/dL)	33.33	33.30	33.27	33.33	33.27	33.20	0.11	NS
Lymphocytes (%)	46.67 ^{ab}	47.00 ^{ab}	45.67 ^b	50.67 ^a	46.33 ^b	44.33 ^b	2.26*	S
Heterophil (%)	49.33 ^{ab}	49.67 ^{ab}	50.67 ^a	45.67 ^c	47.67 ^{bc}	48.00 ^{abc}	1.67*	S
Eosinophil (%)	1.00 ^b	2.00 ^{ab}	1.33 ^b	3.00 ^{ab}	3.33 ^{ab}	4.00 ^a	1.33*	S
Basophil (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NS
Monocytes (%)	3.00	3.00	2.33	2.67	2.67	3.67	2.17	NS

^{ab*}Means with different superscripts are significantly different ($P < 0.05$). PVC = Packed Cell Volume. RBC = Red Blood Cells; WBC = White Blood Cells; Hb = Haemoglobin; MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin; MCHC = Mean Corpuscular Haemoglobin Concentration; S.E.M = Standard Error of the Mean; *EHLM* = *Euphorbia heterophylla leaf meal*; LS = Level of Significance; S = Significant; NS = Not Significant.

vaccine (lasota) at the 4th and 24th day, while Gumboro vaccine was given at the 10th and 16th day. Multivitamin, mineral and glucose were administered in drinking water on arrival. Anti-coccidial drug (Pentacox[®]) and antibiotic (Ciprofloxacin[®]) were given to the birds in drinking water in alternate week while anti-stress was administered when necessary.

2.4. Blood Collection and Analysis

Blood samples (5 mL) were collected twice between 8:30 am and 9:30 am by cutting the jugular vein of one bird per treatment replicate in sterile bottle containing about 2 mg of ethylene diamine tetra-acetic acid (EDTA) packed in ice pack to maintain cool and stable temperature and taken to laboratory to for analysis of red blood cells (RBC), White blood cells (WBC), packed cell volume (PCV), haemoglobin concentration (Hb) and mean corpuscular haemoglobin concentration (MCHC) using the standard procedures by [15]. Another 3 ml of blood sample was collected in an anticoagulants free tube and taken to laboratory for analysis of blood total protein, albumin, creatine using sigma kits. Glucose was analyzed according to [16] and cholesterol according to the procedure of [17]. Liver enzymes (AST, ALT and ALP) were analyzed as outlined by [18].

White blood cells differentials (lymphocytes, heterophils, monocytes, eosinophils and basophils) were also determined via slide reading under microscope after blood smear and staining.

2.5. Statistical Analysis

The data obtained were subjected to one-way analysis of variance (ANOVA) in a completely randomized design using the procedure outlined in [19]. Where significant difference between treatment means occurred, they were separated using the Fisher's method described in Minitab (2014). Fit Regression Model contained in [19] was used for the analysis. Formula – $Y = A + B + C + D + E + F + G$.

3. Results and Discussion

3.1. Haematological Indices of Finisher Broiler Chickens Fed Graded Levels of Spurge Weed *Euphorbia heterophylla* Leaf Meal (EHLM)

The haematological parameters of finisher broiler chicken (**Table 2**) showed packed cell volume (PCV), red blood cells (RBC), haemoglobin concentration (Hb) were significantly ($P < 0.05$) influenced by the levels of *EHLM* inclusion with the highest values in the control (PCV = 45.67%, RBC = $2.30 \times 10^{12}/L$ and Hb = 15.23 g d/L). Treatments 3, 4, 5 and 6 have similar values. The values ranged from 33.00 (T2) - 45.67% = PCV; 1.90 (T2) - 2.30 ($10^{12}/L$) = RBC and 11.00 (T2) - 15.23 g/dL = Hb. Mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) were statistically similar with those of T1 (182.00 fl = MCV and 66.00 pg = MCH) which were also similar with the values of T4, T5, and T6. The values ranged from 173.53 (T2) - 206.50 fl for MCV and 58.07 (T2) - 68.67 pg for MCH. Lymphocytes, heterophils, and eosinophils varied significantly ($P < 0.05$) with range values of 44.33% - 50.67%, 45.67% - 50.67% and 1.00% - 4.00% respectively which were similar with the control. The white blood cell count (WBC), mean corpuscular haemoglobin concentration (MCH), monocytes and basophils did not show significant difference ($P < 0.05$).

Haematology is available in assessing the physiological responses of chicken [2] [20]. PCV and Hb are two parameters of high significance in determining health status of broiler chickens. The parameters were affected by levels of *EHLM* inclusion but both values were within the normal range (PCV = 35.9% - 41.0%; 25.20% - 45.20% and 11.60 - 13.68 g/dL; 10.02 - 15.1 g/dL) described for healthy birds by [21]-[23] respectively. The PCV and Hb values in the present study are similar with values of 25% - 45% and 10.25 - 15.87 g/dL reported by [24] [25] for broiler in Nigeria and commercial Ross 308 strain respectively. The value of RBC is within the normal ranges of 1.58 - 3.8 ($\times 10^{12}/L$) as reported by [22] which was also in agreement with the value of 2.00 - 3.00 ($\times 10^{12}/L$) described by [26] [27] for broiler chicken in Nigeria. The similarity in the values of RBC in T1, T4 and T5, suggested that 15% and 20% of *EHLM* levels had no adverse effect on the blood profile. The increase in PCV in this study correlated with increase in RBC hence the diets with highest RBC values (T1, T4 and T5) had high PCV while the T2 and T6 had the lowest RBC and PCV. This agreed with [28] who reported that PCV rose while RBC increased. The high value of PCV in T3 (41.33%) with low RBC - 2.0 ($\times 10^{12}/L$) was a chance effect. The significantly ($P < 0.05$) higher levels of PCV, RBC and Hb in T1 could be attributed to the higher level of protein in the diet and level of protein intake by the birds. This observation was consistent with the findings of [22] [29]. Significantly ($P < 0.05$) higher Hb value in T1 may be attributed to adequacy of critical nutrients such as iron, copper, vitamins and amino acids [41]. Though, there were significant ($P < 0.05$) effect in the values of PCV, RBC and Hb, with the highest value in the control, the values across the treatment groups fell within the normal

range suggesting that feeding *EHLM* did not result in disturbances to erythrocyte indices that could adversely impact the health of broiler birds.

Though, the mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) values showed significant ($P < 0.05$) effect, the value obtained in this study were similar with control except in T3 which also had the highest values (206.50 fl) of MCV and 88.67 pg of MCH). This high value of MCV and MCH in T3 which has low RBC $2.0 (\times 10^{12}/L)$ could be attributed to mild haemolytic effect of saponin in the blood of the birds though the RBC level was within the normal level ($1.58 - 3.80 (\times 10^{12}/L)$) reported by [22]. However, since the MCV and MCH in 15%, 20% and 25% *EHLM* were statistically similar to the control (0% *EHLM*), the higher value in T3 (10% *EHLM*) could not be as a result of the effect of diet *but strain effect*. This suggests that the significant variation in MCV and MCH does not have negative impact on chickens. This agreed with the findings [25] who observed significant ($P < 0.05$) high values of MCV and MCH in Ross 308 broiler strain which was also used for this study but reported no negative impact on the chickens. The researcher reported a lower and upper limit values of 77.00 - 88.40 fl and 159.98 - 187.50 fl for MCV and 26.00 - 28.83 pg and 54.36 - 63.13 pg for MCH as normal values for Ross 308 broiler strain. More so, the value of MCV and MCH in this study is in agreement with normal reference range of 89 - 203 fl and 39 - 61 pg reported by [30] for MCV and MCH respectively and similar to the values of 175.30 fl and 55.80 pg observed for MCV and MCH by [31] who fed broiler chickens with graded levels of *Artenia urmanica* powder. The report of [25] who observed that the variation in the values of MCV and MCH could be the consequence of the effect of the parameters such as age, sex, weight, type of diet, strain and climate on chickens, suggested that the significant ($P < 0.05$) difference in the value of MCV and MCH in this study may not negatively affect the birds as RBC, WBC, PVC, Hb and MCHC values were normal. The blood parameters with greater values observed in this study could also be a consequence of wide range of ambient temperature. This is consistent with the findings of [27]. Mean corpuscular haemoglobin concentration (MCHC) values were not affected ($P < 0.05$) by the diets. Values were within the normal range of 32.41 - 33 - 37 g/dL reported by [21]. The normal values of MCV, MCH and MCHC in this study indicated an intact immune system. This agreed with the report of [32]. The higher WBC values with increasing *EHLM* inclusion levels were reflected in significantly ($P < 0.05$) higher lymphocytes, heterophils and eosinophils differentials which suggested the potential of *EHLM* to stimulate immune response. This agreed with [10] who reported that immune-modulatory properties of quercetin (flavonoid) saponin and terpenes have effect on hormonal and cellular immunity. White blood cells (RBC) also called leucocytes are important medications of immune response in living organisms, and high WBC count have generally been regarded as efficient immune response [33]. According to [34], increase in WBC differentials in the blood indicated enhanced immunological well-being of the body. The WBC count in T2, T3, T4, T5 and T6 which were similar with the control which had the lowest

value suggested that the test ingredient has the potential to stimulate immune production to protect birds against diseases. The values obtained for WBC, lymphocytes, heterophils and eosinophil were within the normal ranges of 2.2 - 7.5 ($\times 10^3$ g/L) and 1.0 - 9.5 ($\times 10^3$ u/L), 45% - 70%; 20% - 50% and 1% - 4% reported by [22]. The monocytes and basophils values showed no diet effect. The values agreed with the normal reference levels of 2% - 8% and 0% reported by [21] for broiler chickens in Nigeria.

3.2. Serum Biochemical Indices of Finisher Broiler Chickens Fed Graded Levels of Spurge Weed *Euphorbia heterophylla* Leaf Meal (EHLM)

The serum biochemical indices of finisher broiler chickens (Table 3) showed significant ($P < 0.05$) difference for serum total protein, Albumin and glucose. Serum total protein and albumin values were highest in T5 (7.63 g/dL) and T6 (2.30 g/dL) respectively. The values across the treatment groups were similar with the control apart from T5 that had the highest value. Serum protein had values range from 5.20 - 7.63 g/dL and 2.30 - 3.80 g/dL for albumin. Though the value of glucose was significantly ($P < 0.05$) affected by EHLM inclusion levels, the values across treatment groups were similar with the control (169.73 g/dL) apart from T6 (231.33 g/dL) and T5 (215.60 g/dL) and T2 (110.07 g/dL) which had the highest and least values respectively. Aspartate amino transferase (AST), Alanine amino transferase (ALT) and Alkaline phosphatase (ALP) showed significant ($P < 0.05$) diet effect on the birds. However, the values of 103.83 (T3) - 119.37 u/L (T4) = AST; 39.97 (T6) - 43.40 u/L (T4) for ALT and 46.23 (T2) - 61.30 u/L (T4) for ALP. Globulin, Albumin/globulin ratio, serum cholesterol and creatinine were not affected by the diet. However, cholesterol value decreased with increasing EHLM inclusion levels.

The use of biochemical indices as a pointer to conditions that may not be readily noticed by performance indices cannot be over-emphasized. Plane of nutrition is known to affect these values [35]. The observed significantly ($P < 0.05$) higher values of total serum protein (TSP) in this study which were similar to the control could be attributed to the significantly ($P < 0.05$) higher liver size and weight which results in the increased activities of the liver. This was activated by the effect of increased concentration of n-3 PUFA such as alpha-linolenic acids, eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA) in the liver of chickens fed EHLM. This resulted in increased activity of the liver, thus, the liver increased synthesis of serum protein (TSP) concentration in the blood. Furthermore, the intensity of the building of proteins into the tissues may significantly influence the concentration of proteins in the blood as well as their compositions as reported by [8] [36]. The values of serum protein in this study (5.20 - 7.63 g/dL) were higher than the normal reference values (3.0 - 4.9 g/dL and 3.55 - 4.96 g/dL) established by [22] [37] respectively but similar to the value of 4.96 - 6.40 g/dL and 5.49 - 6.25 g/dL reported by [38] [39] for Ross 308 broiler strain respectively. The high serum protein values in this study

Table 3. Serum biochemical indices of broilers finisher chickens (5 - 8 weeks) fed graded levels of spurge weed (*Euphorbia heterophylla*) leaf meal.

BIOCHEMICAL INDICES	EXPERIMENTAL DIETS						S.E.M	LS
	T1 (0% <i>EHLM</i>)	T2 (5% <i>EHLM</i>)	T3 (10% <i>EHLM</i>)	T4 (15% <i>EHLM</i>)	T5 (20% <i>EHLM</i>)	T6 (25% <i>EHLM</i>)		
Total Protein (g/dL)	5.20 ^b	6.23 ^{ab}	5.53 ^{ab}	6.67 ^{ab}	7.63 ^a	6.22 ^{ab}	1.21*	S
Albumin (g/dL)	2.80 ^b	2.73 ^b	3.13 ^{ab}	2.97 ^{ab}	3.80 ^a	2.30 ^b	0.50*	S
Globulin (g/dL)	2.40	3.50	2.40	3.70	3.83	3.42	1.33	NS
Albumin/Globulin Ratio	1.17	0.78	1.30	0.80	0.99	0.82	0.61	NS
Glucose (mg/dL)	169.73 ^b	110.07 ^c	200.97 ^{ab}	163.73 ^b	215.60 ^a	231.33 ^a	21.12*	S
Cholesterol (mg/dL)	110.57	105.87	105.83	106.63	105.87	102.73	10.57	NS
AST (U/L)	107.13 ^b	109.40 ^b	103.83 ^b	119.37 ^a	119.00 ^a	109.03 ^b	4.97*	S
ALT (U/L)	41.37 ^{ab}	40.70 ^{ab}	40.20 ^b	43.40 ^a	42.77 ^{ab}	39.97 ^b	1.65*	S
Creatinine (mg/dL)	0.73	0.70	0.57	0.87	1.17	0.77	0.38	NS
ALP (U/L)	51.70 ^{ab}	46.23 ^b	57.03 ^{ab}	61.30 ^a	57.47 ^{ab}	58.17 ^a	6.32*	S

^{abc*}Means with different superscripts are significantly different ($P < 0.05$). AST = Aspartate Amino Transferase; ALT = Alanine Amino Transferase; ALP = Alkaline Phosphatase; S.E.M = Standard Error of the Mean; *EHLM* = *Euphorbia heterophylla* leaf meal; LS = Level of Significance; S = Significant; NS = Not Significant.

agreed with [40] who reported that high serum protein was an indication of healthy liver because severe liver damage or prolonged protein deficiency usually leads to reduced plasma protein synthesis. The similarity in the values of serum protein among the dietary treatments with the control inferred that the high serum protein could be attributed to high protein and lipid profiles of *EHLM* and not any abnormality. The higher level of albumin correlated with the high value of serum protein which indicated higher clotting ability of the blood and enhance prevention of haemorrhages and this agreed with [35]. The non-significant ($P < 0.05$) variation in the globulin and albumin/globulin ratio could be due to the adequate protein in all the treatment diets. The globulin level was higher in T2, T4, T5 and T6 than in the control (2.40 g/dL) while the albumin/globulin ratio was higher in the control (1.70 g/dL) compared to other dietary treatments which inferred that *EHLM* has the greater ability to stimulate immunity to fight infection. This is in agreement with the findings of [35] [41] who reported that high levels of globulin and low albumin/globulin ratio was indicative of high immune production and ability to fight infections by birds. The values of albumin, globulin and albumin/globulin ratio were within the normal range of 2.43 - 3.86 g/dL; 2.0 - 3.5 g/dL and 0.75 - 1.53 g/dL established by [21]. The glucose values (110.07 - 231.33 mg/dL) in this study is similar to the normal reference value of 174 - 239 mg/dL reported by [37] [42] but lower than the values of 200 - 500 mg/dL established by [38] [43] except in treatments 6, 5 and 3. The low level of glucose obtained in this study especially in T2 (110.07 g/dL) could be attributed to low level of metabolizable energy in SBM (2420 (Kcal/kg) and *EHLM*

(2339.79 (Kcal/kg) and low amount of fat and oil in *EHLM*. The serum cholesterol in this study was suppressed as the dietary *EHLM* increased. This is advantageous in the production of lean broiler carcass since fat is distasteful to the consumers of poultry meat because of incidence of cholesterol-related diseases [12] [44]. The cholesterol lowering effect of increasing CF as *EHLM* levels increased in the diets could be linked to the binding action of soluble fibre and lignin with the bile acids for excretion [12]. The reduction in cholesterol in this study is principally attributed to increased proportion of total polyunsaturated fatty acids (PUFA), n-3 PUFA, PUFA/SFA ratio and robust decrease in C18:2 n-6/C18:3 n-3 and n-6/n-3 ratios which regulates cholesterol levels in the muscles, plasma and adipose tissues of birds fed *EHLM* diets. This observation was consistent with the findings of [45]. Values (102.73 - 110.57 mg/dL) of the present study are within the normal range of 87 - 192 mg/dL reported by [37] but lower than the values of 179.50 - 181.50 mg/dL reported by [38] for Ross 308 broiler strain. This agrees with [46] who reported significant reduction of 18% in egg York cholesterol of laying hen fed *E. heterophylla* diet. The lowering effect of cholesterol in chickens is advantageous in improving heart and general health of the birds which can be attributed to production of lean broiler carcass. This agrees with the findings of [8] [10] [11] [44] who reported that the lowering effects of cholesterol are positively correlated with low fat deposition in adipose tissues, visceral organs and joints resulting in improved carcass and bone development and growth; production of lean carcass and improved meat quality of chickens.

Alteration in the activities of serum enzymes, such as Aspartate aminotransferase (AST), Alanine aminotransferase (ALT) and Alkaline phosphatase (ALP) are often utilized as markers of toxicity for the assessment of biochemical and physiological health of vital organs and tissues, such as liver and heart [47]. It is established that damage to cellular membrane in tissues where these enzymes are normally localized results in their leakage into bloodstream giving an index of cellular integrity [47] the results of this study showed that *EHLM* diets have significant ($P < 0.05$) effect on the levels of AST, ALT and ALP. The values are similar with the control (0% *EHLM*) which fall within the normal reference range of 70 - 220 (u/L); 7 - 56 (u/L) and 40 - 130 (u/L) reported by [37] respectively. The values of the liver enzymes in this study may be positively influenced by the anti-inflammatory activities of the phytochemicals, flavonoids and terpenes in *EHLM* which maintained the integrity and improved the oxidative status of the liver. This observation was consistent with the findings of [48] who reported flavonoids and terpenoids suppressed the metabolism of inflammatory prostaglandins. Flavonoids and terpenes act by over expressing anti-oxidant enzymes which regulated the inflammatory process, hence prevented damages to the liver and regulating its functional activities [49]. Creatinine values were not significantly ($P > 0.05$) affected by the *EHLM* diets which indicated that there was no obvious muscular wastage because of the protein adequacy of the diets. This

trend supported the report of [41]. Values from this study (0.59 - 1.17 mg/dL) are within the normal reference range of 0.5 - 1.20 mg/dL reported by [37]. The normal values of creatinine in this study might be influenced by the inhibitory activity of saponin in *EHLM* on microbial urease enzymes which resulted in decreased production of intestinal ammonia, enhanced the health, integrity and function of kidney. Intestinal ammonia is considered as an important health stress to the kidney [45].

3.3. Growth Performance

The result of the growth performance of starter and finisher broiler chickens fed graded levels of spurge weed (*Euphorbia heterophylla*) Leaf Meal (*EHLM*) indicated that the experimental diets improved significantly ($P < 0.05$) the growth of broiler chickens. The average weight gain (AWG) = 32.04 g (T2) to 34.06 g (T3) for starter chick which compared with the control 33.94 g) was affected ($P < 0.05$) by the diets. However, the AWG for finisher broiler chickens with values ranging from 45.13 g (T5) - 48.28 g (T2) which are similar with control (46.73 g) had diet effect ($P > 0.05$). The similarity in the values among treatment groups infers that *EHLM* supported the AWG of broiler chicken. This suggests that feeding *EHLM* to broiler at graded levels improved performance which is in agreement with [8].

4. Conclusion

It could be concluded from the result that *Euphorbia heterophylla* leaf meal (*EHLM*) is a potential feed resource and inclusion levels at 15% in the diet of broiler chickens as replacement of soybean meal (SBM) has no debilitating effect on their growth performance and blood profiles.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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