

Dietary Supplementation with *Eclipta Alba* and *Polyalthia Longifolia* Foliages on Digestibility, Feeding Behaviour, Blood Profile and Carcass Characteristics of Goats

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Abstract — A feeding trial that lasted for 90 days was carried out to determine the effect of dietary supplementation of *Eclipta alba* and *Polyalthia longifolia* foliages on digestibility, feeding behaviour, blood profile and carcass characteristics of goats. A total of thirty two West African dwarf goats of about 7–8 months old were randomly assigned to four treatment diets. Each treatment was replicated four times with two goats per replicate in a completely randomized design. The four formulated treatment diets were, D₁ (90% guinea grass with 10% maize straw), D₂ (50% guinea grass with 10% maize straw and 40% *Eclipta alba* foliage), D₃ (50% guinea grass with 10% maize straw 20% *Eclipta alba* with 20% *Polyalthia longifolia* foliages) and D₄ (50% guinea grass with 10% maize straw and 40% *Polyalthia longifolia* foliage). The results indicated that goats on D₁ were significantly ($P < 0.05$) highest in eating rate, feed conversion ratio, urinary-N-output, urea and creatinine while cholesterol was greater in goats on D₂. Crude fiber and ether extract digestibility with white blood cell was significantly ($P < 0.05$) higher for goats on D₃ than other treatment diets. Feed intake, ruminating rate, live weight gain, dry matter with crude protein digestibility, nitrogen intake with retention, red blood cell, total protein, dressing weight and stomach were significantly higher ($P < 0.05$) in goats on D₄ compared with those on D₁, D₂ and D₃. Eating with ruminating time, initial weight, faecal-N-output and most of the carcass cuts with relative organs showed no significant difference ($P > 0.05$) among treatment diets. It could therefore be concluded that supplementation with *Eclipta alba* and *Polyalthia longifolia* foliages or their mixture in diets enhance digestibility, feeding behaviour, blood profile and carcass characteristics without any deleterious effect in goats.

Index Terms — *Eclipta alba*, goats, performance, *Polyalthia longifolia*.

I. INTRODUCTION

Goat rearing is increasingly playing an important role in ruminant livestock production system in the tropics. This is because of their beneficial effects in providing animal protein and income for the livelihood of vulnerable and resources-poor farmers living under extremely difficult conditions in rural areas. Regardless of these attributes, their productivity still remains low mainly due to poor feeding. Shortage supply of feedstuffs at economic prices has been the major constraint hampering goat production in Nigeria [1]. This scenario has exposed goats to severe nutritional stress most especially during the dry season when available natural forages are high in fibrous with low

nutritional values. The abundant supply of crop residues and non-conventional feed resources in Nigeria could have been a good option to put maximum and efficient use for better performance in goats. Their inefficient utilization due to their bulky roughages and relatively poor nutrient composition which are identified with low levels of intake and digestibility [2] attributes to poor performance of goats.

Notwithstanding, fodder trees are important alternative feeds as forage sources due to their highly production of edible, acceptable biomass and persistent with drought resistance. They represent enormous potential sources of protein for improving ruminants' sustainability. Many browse trees are also considered important due to their beneficial actions from their secondary metabolites as natural alternative to antibiotics in improving the health status, production and quality of ruminant products [4]. However, tree foliages as feed resources have been generally ignored in feeding systems of goats, mainly because of inadequate knowledge on various aspects of their potential use as well as initiative associated with the development of more innovative system of feeding. Thus, their potential as alternative feed resources in goat nutrition has recently increased and attracts the attention of many researchers [3], [1].

Eclipta alba and *Polyalthia longifolia* are classified as such fodder trees with high protein content (15–18% CP on average) that are ready available locally as feeds input [4] that can be referred on for feeding goats during the dry season. They grow all year round and their nutritive values do not fluctuate as much as that of grasses in different season. Perhaps, their foliages can become feed strategy of choice for increasing sustainable production of goats in many parts of the tropics. However, proper precautions need to be taken in selecting their species and level of feeding for grazing herbivores in order to make important feed strategy, improve digestion and health status. Nouala et al. [5] noted that many tree foliage secondary components have the potential to precipitate adverse effects on the productivity of ruminant livestock and enhance profitability for resources poor farmers in rural areas. Moreover, the information about supplementation of *Eclipta alba* and *Polyalthia longifolia* foliages or their combination with grasses and crop residues in the diets of growing goats is scanty. Hence, this study was designed to assess digestibility, feeding behaviour, blood profile and carcass characteristics of goats fed diets containing *Eclipta alba* and *Polyalthia longifolia* foliages.

Published on July 17, 2020.

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II. MATERIALS AND METHODS

A. Location of the Study

The study was conducted at the Small Ruminant Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Nigeria. The area is located on longitude 6.09°E and latitude 6.42°N within the humid climatic zone of southern Nigeria. The average annual rainfall and temperature of the location are about 1556mm and 31°C respectively with relative humidity of about 78%.

B. Preparation of Experimental Diets

Matured guinea grass was harvested in established pasture land within the Teaching and Research Farm and allowed to wilt overnight. Preserved dry green maize straw was also obtained within the farm, before they were manually chopped to smaller length of sizes. Fresh green matured *Eclipta alba* and *Polyalthia longifolia* leaves with branches were obtained within Ekpoma, air-dried under shade for 5 days before used as foliages. However, 90% guinea grass and 10% maize straw were used as sole basal diet for the control group with urea block salt lick as additional source of nitrogen to ensure sufficient level of protein in the diet. The ratio of the basal diet of guinea grass and maize straw to each of the foliage and their mixture as supplement in the test diets were 50:10:40 and 50:10:20:20 respectively. Hence, the four dietary treatments were; D₁ (90% guinea grass with 10% maize straw), D₂ (50% guinea grass with 10% maize straw and 40% *Eclipta alba* foliage), D₃ (50% guinea grass with 10% maize straw 20% *Eclipta alba* with 20% *Polyalthia longifolia* foliages) and D₄ (50% guinea grass with 10% maize straw and 40% *Polyalthia longifolia* foliage).

C. Animals and Management

Thirty two West African dwarf male goats sourced within Ekpoma livestock market were used for the study. They were about 7 – 8 months old with an average initial body weight of 7.00 ± 0.64kg. The goats were quarantined for two weeks, during which they were de-wormed with albendazol bolus and treated against ecto-parasites with Diazintol, following the manufacturers' recommendation.

At the end of the quarantine period, the goats were randomly selected and assigned to each of the four treatment diets based on their initial body weight. Each treatment was replicated four times with two goats per replicate in a completely randomized design. Goats were housed individually in concrete floored pens and each pen was bedded with wood shavings that changed once weekly. The feeds (grass and maize straw or grass and maize straw with foliage) were offered hanging after tying to a stick over the pens. Before preparing the feeds, the ratio of leaves plus petioles and the old stems was determined by sampling 3 times the foliage. Experimental diets were given to the goats at 5% dry matter of their body weight twice daily at about 8:00am and 4:00pm. The percentage ratio of the tree foliage to the basal diet of grass and maize straw was used to determine the proportion of plant foliage in the daily feed allowance offered to each goat. The amount of feed offered was adjusted after every week according to live weight

change. Goats had free access to drinking water in their respective pens. The experiment lasted for 90 days exclusive of the two weeks for quarantine period.

D. Feeding Behaviour and Growth Performance

Daily feed offered was recorded and leftovers were collected for individual goats in the morning of the next day to estimate voluntary feed intake. Goats were weighed at the commencement of the feeding trial and subsequently at weekly intervals to calculate the weight gains for individual goats.

Eating and ruminating time was continuously monitored visually for a 24-h period on day 10, 20, 30, 40, 50, 60 and 70 of each period using sheet scale scoring. Three individuals are instructed before recording on detection of various behaviors such as eating and ruminating. However, a specific sign is assigned for each behavior, and total chewing time was determined as the sum of total eating and ruminating times. Then eating rate and ruminating rate were calculated in accordance to the report of [6]:

Eating rate (g/min) = Total DM intake (g)/eating time (min)

Ruminating rate (g/min) = Total DM intake (g)/ruminating time (min)

E. Hematological and serum biochemical studies

Blood samples were collected from each goat on day 75 after growth trial at about 8:00am through vein puncture using hypodermic syringes before morning feeding. Approximately 5ml of the 10ml of the blood collected was drawn into ethyldiamine tetra-acetic acid (EDTA) bottle for haematological study. The other 5ml of the blood sample was deposited in anticoagulant free plastic tubes and allowed to clot at room temperature and then centrifuged at 4000xg for 20min for the separation of serum and kept at -20°C until further analyses. Packed cell volume was measured using the micro-haematocrit method. Haemoglobin concentration was measured using acid haematin [7], while red blood cell and white blood cell were measured with the aid of Neubauer counting chamber (haemocytometer) as reported by [8]. However, total protein was measured in serum for individual animal using the biuret method while albumin was obtained by bromocresol purple method [7]. Serum creatinine, urea and cholesterol were measured according to the method described by [9]. Globulin was determined as the difference between total protein and albumin.

F. Nutrient Digestion

Metabolic study of goats was carried out for 14 days. Four goats per treatment were selected and transferred into individual metabolic cages made for separate collection of faeces and urine. Treatment diets were offered to each goat daily with fresh clean water. The goats were acclimatized for the first seven days, before 7 days collection of faeces and urine voided per goat per day. The collected faecal samples for each goat was bulked, properly mixed and about 10% sub-sample was pooled and kept in plastic bags in the freezer (-20°C) for laboratory analysis. Urine sub-

samples were collected in plastic bottles with 4 drops of diluted sulphur acid (10% H₂SO₄) to prevent loss of nitrogen due to volatilization. Thus nutrient digestibility and nitrogen balance were calculated by standard procedures described by [10] for direct estimation of animal digestibility.

G. Carcass Evaluation

After the digestion trial, four goats from each treatment were selected, starved overnight and weighed to obtain slaughtered weight after stunned. Goats were bled, flayed before eviscerated using sharp knives and then washed. The head, limbs, intestinal tract and internal organs were removed and weighed before dressed carcasses were also weighed to obtained hot carcass weight [11]. Dressing percentage was then calculated as the proportion of hot carcass weight to slaughter weight. Then carcasses were divided into the primal cuts namely shoulder, neck, rack, loin, breast, and flank were weighed [12]

H. Chemical and Statistical Analyses

Sample of *Eclipta alba* and *Polyalthia longifolia* foliages with the experimental diets were dried for 48 hours at 60°C in a forced – air oven to determine the dry matter (DM) content before milled to pass through a 1mm screen in a Willey mill for proximate composition and anti-nutritional factors analyses using the procedure of [13]. The oven dried faecal and total nitrogen urine that were measured by the Kjeledehl procedures were also analysed as outline by [13].

Data obtained from feeding behavior, growth, blood profile, digestibility, nitrogen retention and carcass traits were subjected to analysis of variance (ANOVA) and significant difference between means were separated using Duncan multiple range test [14].

III. RESULTS

The proximate composition and phenolic compounds of *Eclipta alba* (EA) and *Polyalthia longifolia* (PL) foliages with experimental diets are shown in Table I. Dry matter content recorded in foliages and diets that ranged between 89.43 and 97.83% were generally high. *Polyalthia longifolia* foliage had higher crude protein and fiber values but relatively lower in ether extract, ash and nitrogen free extract than the values recorded in *Eclipta alba*. Treatment diets D₂ D₃ and D₄ registered higher values of crude protein and ether extract than the treatment diet D₁. However, crude fiber and nitrogen free extract content were found to be higher in control diet (D₁) than the test diets (D₂ D₃ and D₄) with remarkable different in their recorded values. Ash content was almost similar for all diets with no remarkable difference among the treatment diets. Tannin, saponin and phytate were higher in EA but lower in oxalate than PL. Furthermore, phenolic compounds observed in this study were generally low in control diet as compared with the values obtained the test diets.

TABLE I. PROXIMATE COMPOSITION AND PHENOLIC COMPOUNDS (%DM) OF *ECLIPTA ALBA*, *POLYALTHIA LONGIFOLIA* FOLIAGES AND EXPERIMENTAL DIETS

Parameters	EA	PL	Experimental Diets			
			D ₁	D ₂	D ₃	D ₄
Dry matter	89.43	93.29	97.83	91.89	93.87	95.64
Crude protein	15.79	17.21	8.85	11.53	11.68	11.96
Crude fibre	21.65	25.98	25.06	24.68	25.55	26.41
Ash	7.48	6.59	6.58	6.96	6.79	6.61
Ether extract	5.06	4.02	2.04	3.20	3.00	2.79
Nitrogen free extract	39.47	34.49	54.03	48.42	47.43	46.43
<i>Phenolic compounds</i>						
Tannin	0.52	0.34	0.83	1.04	1.01	0.97
Saponin	0.59	0.46	1.07	1.31	1.28	1.25
Phytate	0.33	0.29	0.78	0.92	0.91	0.90
Oxalate	0.21	0.22	1.23	1.30	1.31	1.32

EA = *Eclipta alba*, PL = *Polyalthia longifolia*.

As shown in Table II, are the mean values for feed intake, feeding behavior and live weight change for goats fed experimental diets. Remarkable variations were observed among parameters in the treatment diets, except eating time, ruminating time and initial weight gain that were not affected significantly ($P > 0.05$) by treatment diets. Test diets recorded higher significant ($P < 0.05$) values in feed intake and ruminating rate as compared with control diet. However, goats on control diet were found to be

significantly ($P < 0.05$) better in eating rate and chewing time than values obtained in diets supplemented with tree foliages. Final weight, total and daily weight gains mean data were also significantly ($P < 0.05$) influenced by diets. Goats on solely basal diet had the least values as compared with those on tree foliage supplement diets. Feed conversion ratio among the test diets were not strictly compared but significantly ($P < 0.05$) lower than the value recorded in the control diet.

TABLE II: MEAN VALUES FOR FEED INTAKE, FEEDING BEHAVIOUR AND LIVE WEIGHT GAINS OF GOATS FED BASAL DIET OF GRASS AND MAIZE STRAW SUPPLEMENTED WITH TREE FOLIAGES

Parameters	Experimental Diets				SEM ±
	D ₁	D ₂	D ₃	D ₄	
Feed intake, g/d	312.06 ^c	323.94 ^b	332.79 ^b	348.25 ^a	1.62
Eating rate, min/24hr	308.97 ^a	276.87 ^b	251.12 ^c	246.99 ^c	1.08
Ruminating rate, min/24hr	198.76 ^c	241.75 ^b	267.60 ^b	297.06 ^a	1.45
Eating time g DM/min	1.01	1.17	1.29	1.41	0.04
Ruminating time g DM/min	1.57	1.34	1.21	1.09	0.31
Chewing time g DM/min	2.58 ^a	2.51 ^b	2.51 ^b	2.50 ^b	0.46
<i>Live weight, kg</i>					
Initial	7.89	7.52	7.74	7.39	0.19
Final	10.66 ^b	10.89 ^b	11.42 ^a	11.37 ^a	0.27
Total weight gain	2.77 ^b	3.37 ^a	3.68 ^a	3.98 ^a	0.38
Live weight gain g/d	39.52 ^c	48.14 ^b	52.57 ^a	56.86 ^a	0.54
Feed conversion ratio	7.89 ^a	6.73 ^b	6.33 ^b	6.13 ^b	0.31

^{a,b,c} Means in the same row with varying superscript differ significantly ($P < 0.05$)

Variations were registered in apparent nutrient digestibility and nitrogen balance of diets for goats as presented in Table III. Digestibility of dry matter, crude protein, and nitrogen free extract were significantly ($P < 0.05$) greater in diet D₄ followed by diets D₃ and D₂ before diet D₁. Highest digestibility coefficient value of crude fiber was found in goats on diet D₃ while that of ether extract was greater in diet D₃ as compared with other treatment diets. Ash digestibility was higher in diets supplement with

foliages but relatively lower in diet with solely grass and maize straw.

Daily nitrogen intake and retention recorded higher ($P < 0.05$) values with remarkable difference in diets supplemented with tree foliages than the one containing solely basal diet. Urinary-N- output value was not strictly comparable, lower mean values were considerably more pronounced in test diets than the control diet. Notwithstanding, there was no significant ($P < 0.05$) effect among diets on faecal-N-output of goats in this study.

TABLE III: MEAN VALUES FOR NUTRIENT DIGESTIBILITY (%) AND NITROGEN BALANCE (G/D) OF GOATS FED DIETS SUPPLEMENTED WITH *ECLIPTA ALBA* AND *POLYALTHIA LONGIFOLIA* FOLIAGES

Parameters	Experimental Diets				SEM ±
	D ₁	D ₂	D ₃	D ₄	
Dry matter	68.04 ^c	71.53 ^b	73.85 ^b	75.96 ^a	1.32
Crude protein	56.13 ^c	68.97 ^b	70.32 ^a	72.48 ^a	1.01
Crude fibre	62.46 ^c	67.11 ^b	71.01 ^a	69.07 ^b	1.03
Ash	62.73 ^c	70.58 ^a	68.49 ^b	67.98 ^b	1.15
Ether extract	60.45 ^a	59.09 ^b	63.76 ^a	59.84 ^b	0.94
Nitrogen free extract	59.67 ^c	67.99 ^b	68.77 ^b	71.31 ^a	0.87
<i>Nitrogen balance g/d</i>					
Nitrogen intake	9.24 ^c	9.63 ^b	9.82 ^b	10.01 ^a	0.05
Faecal-N-output	2.50	2.34	2.32	2.30	0.04
Urinary-N-output	2.23 ^a	1.32 ^b	1.31 ^b	1.29 ^b	0.03
Nitrogen retained	4.51 ^c	5.97 ^b	6.19 ^a	6.42 ^a	0.07
Nitrogen retention (%)	48.81 ^b	61.99 ^a	63.04 ^a	64.14 ^a	0.94

^{a,b,c} Means in the same row with varying superscript differ significantly ($P < 0.05$).

Haematological and serum biological parameters of goats were generally affected by treatment diets (Table IV) in this present study. Diets with tree foliages supplementation appeared to be higher in packed cell volume, haemoglobin, red and white blood cells than the diet that contained only the grass and maize straw. However, test diets also registered higher mean values of total protein, albumin, globulin and cholesterol significantly ($P < 0.05$) but extremely lower in serum urea and creatinine as compared with levels recorded in control diet.

Presented in Table V is the carcass traits for goats fed basal diets of grass and maize straw supplemented with tree

foliages. The mean values of slaughter and dressed weights with warm dressing of goats on diets supplemented with tree foliages had significant ($P < 0.05$) better performance than the diet without tree foliage supplements. Data of carcass cut weights such as shoulder, rack, loin, breast and leg markedly increased with significant ($P < 0.05$) in test diets than the control diet. However, other carcass traits (head, neck, skin, flank and feet) of goats obtained in the study were not significantly ($P > 0.05$) differed among treatment diets.

TABLE IV: HAEMATOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF GOATS FED GRASS AND MAIZE STRAW SUPPLEMENTED WITH TREE FOLIAGES

Parameters	Experimental Diets				SEM ±
	D ₁	D ₂	D ₃	D ₄	
Packed cell volume (%)	22.98 ^c	24.19 ^b	26.38 ^a	26.52 ^a	0.56
Haemoglobin (g/dl)	7.01 ^c	8.97 ^b	9.06 ^a	9.15 ^a	0.73
Red blood cell (x10 ³ /ml)	9.58 ^b	10.16 ^a	10.45 ^a	10.68 ^a	0.62
White blood cell (x10 ³ /ml)	8.76 ^b	11.45 ^a	11.33 ^a	11.25 ^a	0.17
<i>Serum biochemical</i>					
Total protein (g/dl)	5.79 ^b	7.28 ^a	7.66 ^a	7.92 ^a	0.04
Albumin (g/dl)	2.88 ^b	3.67 ^a	3.89 ^a	3.97 ^a	0.05
Globulin (g/dl)	2.81 ^b	3.61 ^a	3.77 ^a	3.95 ^a	0.24
Cholesterol (g/dl)	55.69 ^c	61.24 ^a	60.96 ^a	58.78 ^b	0.83
Urea (mg/dl)	24.92 ^a	18.92 ^b	15.68 ^c	13.03 ^c	0.17
Creatinine (mg/dl)	1.05 ^a	0.97 ^b	0.92 ^b	0.89 ^b	0.03

^{a,b,c} Means in the same row with varying superscript differ significantly (P < 0.05)

TABLE V: CARCASS TRAITS OF GOATS FED BASAL DIETS OF GRASS AND MAIZE STRAW SUPPLEMENTED WITH TREE FOLIAGES

Parameters	Experimental Diets				SEM ±
	D ₁	D ₂	D ₃	D ₄	
Slaughter weight (kg)	9.01 ^c	9.93 ^b	10.45 ^a	10.68 ^a	0.39
Dressed weight (kg)	3.56 ^b	4.00 ^a	4.25 ^a	4.43 ^a	0.46
Warm dressing (%)	30.45 ^b	31.15 ^a	31.79 ^a	32.08 ^a	1.52
Head (%)	24.76	24.83	25.07	25.09	0.05
Neck (%)	8.62	8.60	8.67	8.78	0.03
Skin (%)	22.76	22.89	23.04	23.06	0.14
Shoulder (%)	20.87 ^c	22.83 ^b	23.29 ^a	23.74 ^a	1.36
Rack (%)	7.07 ^b	8.34 ^a	8.53 ^a	8.62 ^a	0.53
Loin (%)	5.99 ^c	6.98 ^b	7.82 ^a	7.87 ^a	0.21
Breast (%)	8.67 ^b	8.98 ^a	9.24 ^a	9.49 ^a	0.36
Legs (%)	27.84 ^c	29.97 ^b	30.16 ^a	30.24 ^a	0.74
Flank (%)	2.99	3.27	3.42	3.59	0.06
Feet (%)	9.03	9.07	8.99	8.98	0.17

^{a,b,c} Means in the same row with varying superscript differ significantly (P < 0.05).

The data presented in Table VI indicated the relative organs for goats fed diets containing tree foliage supplements. The relative contribution of various organs to the carcass traits examined in this study were similar with no significant difference (P>0.05) across the treatment

diets, except the stomach that was significantly (P<0.05) affected by diets. In numerical terms, the percentage of stomach and testes appeared to be higher in test diets as compared with control diet.

TABLE VI. RELATIVE ORGAN TRAITS OF GOATS FED DIETS SUPPLEMENTED WITH TREE FOLIAGES

Parameters	Experimental Diets				SEM ±
	D ₁	D ₂	D ₃	D ₄	
Liver (%)	4.58	4.72	4.79	4.87	0.04
Kidney (%)	1.07	1.19	1.22	1.26	0.07
Lung (%)	3.01	3.19	3.37	3.58	0.20
Spleen (%)	0.25	0.36	0.38	0.49	0.06
Heart (%)	1.37	1.39	1.43	1.44	0.05
Testes (%)	1.82 ^b	2.01 ^a	2.07 ^a	2.15 ^a	0.63
Stomach (%)	10.06 ^b	11.56 ^a	11.67 ^a	11.87 ^a	0.31
Small intestine (%)	6.60	6.89	6.63	6.76	0.04
Large intestine (%)	3.27	2.93	2.75	2.61	0.10
Caecum (%)	1.41	1.46	1.42	1.35	0.06

^{a,b,c} Means in the same row with varying superscript differ significantly (P < 0.05).

IV. DISCUSSION

Nutrient composition obtained in *Eclipta alba* (EA) and *Polyalthia longifolia* (PL) with the exception of dry matter

contents were within the values reported by [4]. However, nutrient content of the experimental diets that were varied could be linked to difference in type of tree foliage supplements. The values of crude protein content for diets

in this study were within the value of 7% crude protein for minimum requirement for small ruminants performance [15] but the control diet value was slight lower than the critical level of 8-10% crude protein requirement for ruminant production [16]. Thus, urea block lick was added to augment the protein content supplied by the diet to the goats. The anti-nutritional levels EA, PL and diets were generally low compared with the above 4% dry matter content of tannin that restrict higher feed intake and performance in ruminants [3].

The higher intake of diets supplemented with tree foliages suggest that the diets were capable of furnishing the goats with higher quality of nutrients that had positive effect in increasing breakdown and passage of digesta which are considered as important factors that increase intake of feeds in animals. It was noted by [17] that feed intake is affected by many factors such as feed nutrients, palatability, physical nature, gut fill, and rumen outflow rate or retention time that aid digestion to meet adequate balance of nutrients at the site of metabolism for ruminant requirements. However, this positive effect of diets containing tree foliages had translated to less time spent in eating rate which explaining better nutritive values of the test diets. The more time spent in chewing with less ruminating rate in goats on solely grass with maize straw further buttress the fact that they consumed diet slower than those on test diets. Rumination activity is reported [18] to be more important than eating activity in reduction of feed particle sizes and salivary secretion. The potential benefit of increased growth rate in goats on test diets was clearly an indication of the quality supplements that made available of sufficient energy to maximize the efficiency utilization of available protein intake of goats. Gatemy [15] observed that the quality of feed available has a profound effect on intake and growth performance of animals. However, the feed conversion ratio obtained in this study further attest the quality and superiority of the test diets over the control diet. Animals have been reported to grow faster on better quality diets, provided they have not reached their maturity [19].

Relative better digestibility of nutrients was encountered by goats on test diets with exception of ether extract that experienced disparity. Difference in the nature of the quality of tree foliages selected could probably be the possible reason for this divergent result. Moreover, the considerable reduction in the digestibility of most nutrients in control diet could be attributed to poor interaction between the fiber and rumen microbes. Nouala *et al.* [5] reported negative effects in apparent nutrient digestibility of diet high in fiber due to modification of rumen environment towards unfavourable condition, but supplementation with tree leaves invariable alleviate nitrogen and other nutrient deficiencies, thus increase rumen microbial activity and digestibility. Following by this improvement of digestibility observed in the study, it is noteworthy that the sufficient supply of nitrogen from the tree foliages had stimulated the intake and retention of nitrogen by goats on test diets. Other possible reasons for this increment in nitrogen retention could be the present of optimum and better protein combination among the diets that were utilized and retained

by the goats. It was established fact in literature that nitrogen retention has positive correlation with biological value of protein readily digestible and available for absorption by animals [20].

However, it is also interesting to know that the enhanced digestibility and efficiency in protein retained by goats on diets with tree foliages which translated to increased in body weight, demanded excessive quantity of oxygen that transported haemoglobin to stop the need of activeness employment of the body. This probably caused a positive reflection in increasing the total red blood cell, packed cell volume and haemoglobin as the goats grow older. This observation is in harmony with the report of [21] who stated that high level of ration protein showed significant improvement in erythrocyte cell counts in animals than poor level of protein ration. White blood cell is to fight infection, defend the body against invasion by foreign organism and to produce or at least transport antibodies in immune response. Perhaps, the result of white blood cells obtained in this study showed that feeding diets with tree foliage supplements improved health and nutrition. This was illustrated in the high values recorded in white blood cell that were within the normal range that is capable of generating anti-bodies in the process of phagocytosis and have high degree of resistance to infection [22] and enhance adaptability to local environmental and disease prevalent condition.

It is important to note that diets containing tree foliages increased serum total protein levels and its fractions (albumin and globulin) than diet without tree foliage supplements. This slight increased in their values that were within the normal range as reported by [21] might be due to tree active compounds that acted for protein building with several other reasons among which were improved crude protein digestibility, nitrogen intake and retention which reflected on the nutritional status of the goats. Cholesterol is an essential component of animal cell membrane and precursor of the steroid hormones. El-Hawy *et al.* [21] reported that there is a positive correlation between high level of serum cholesterol and cardiovascular diseases. In this current study, values of cholesterol obtained were within the range values (60-66 g/dl) reported by [23] for normal healthy goats. Serum blood urea and creatinine levels are known to reflect the state of glomerular filtration rate of kidney function in animals [9]. However, the negative relationship between total protein and urea observed in this study demonstrated that the application of urea block lick in the control group had led to positive effect in blood urea concentration and indicated inferiority of efficiency utilization of nitrogen by the goats on control group.

It is relevant to point out as well that the slaughter and dressing weights of goats were greater in foliage supplemented diets. The positive effect of valuable nutrient components of these diets were likely mechanism explaining the heavier positive turned out of dressing weights that stimulated the higher warm dressing percentage. However, these higher weights also corresponded to the carcass cut percentage of shoulder,

rack, loin, breast and leg obtained in the study. Thus, it was observed in study that slaughter weight is the main factor influencing carcass composition as shoulder and leg tissue is reasonable predictor for carcass tissue composition in goats [24]. Actually, obviously evidence had also indicated that shoulder and leg carcass cuts are known to have the highest proportion of muscle and bone ratio in goats. [25].

The percentage pertaining to testes and stomach in relative organ of goats were also observed to be greater in test diets than the control group. This difference could be connected to their active body physiological activity of the organs and their relative superiority of diets. This is in conformity with the report of [11] who noted that better utilization of feeds by animals result in greater weight and faster accretion rates of some organs in goats. Notwithstanding, similar values obtained in some of the carcass cut and relative organ traits could be traced to the age of the goats that were similar. Fadiyimu *et al.* [19] reported that some organs in ruminants maintain their integrity due to the priority of age and nutrient utilized but independently on feeds.

V. CONCLUSION

In view of the result in this current study, it could be concluded that *Eclipa alba* and *Polyalthia longifolia* foliages or their mixture could effectively served as supplement feeds in diets of goats without any adverse effect on their performance most especially in the dry season, when forages are poor in quality.

However, this effectiveness was better enhanced in goats fed on *Polyalthia longifolia* or mixture of *Eclipa alba* and *Polyalthia longifolia* foliage supplements. Thus, they were recommended for better performance in goats.

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