Performance characteristics and blood profile of rams fed mixture of bamboo (*Bambusa vulgaris*) leaves and neem *(Azadirachta indica)* seed cake

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Abstract

The study was carried out to assess the performance characteristics and blood profile of growing rams fed mixture of bamboo leaves and neem seed cake. Eighteen West African dwarf rams with an average weight of 8.00± 0.20kg and aged between 8 – 9 months were randomly allotted to three dietary treatments with six animals per treatment group in a completely randomized design. The diets compared were TD_1 (70% Guinea grass with 30% concentrate diet which was the control group), TD_2 (mixture of 50% bamboo leaves with 20% neem seed cake and 30% concentrate diet) and TD_3 (combination of 45% bamboo leaves with 25% neem seed cake and 30% concentrate diet). The results obtained indicated that average total feed intake (11.13kg), average daily feed intake (132.50g), mean corpuscular haemoglobin concentration (33.35g/dL), glucose (59.01mg/dL), cholesterol (42.89mg/dL), creatinine (1.01mg/dL) and urea (13.73mg/dL) were significantly ($P<0.05$) better with animals on TD_1. Animals on TD_2 had the highest values in terms of finial body weight (11.33kg), average total weight gain (3.27kg), average daily weight gain (38.93g), total digestible nutrient (68.97%), packed cell volume (30.06%), haemoglobin (10.68g/dl), red blood cell (9.42×10^6/.ml), mean corpuscular haemoglobin (11.70Pg), total protein (8.09g/dL), albumin (3.03g/dL), and globulin (5.06g/dL). Feed conversion ratio (4.27), mean corpuscular volume (30.95fl) and white blood cell (2.56×10^3/mL) were significantly highest for animals on TD_3. No significant ($P>0.05$) difference existed between the experimental rams with regards to initial body weight, lymphocyte, neutrophile. It was concluded that combination of 50% bamboo leaves with 20% of neem seed cake and 30% concentrate diet improved performance, haematological and serum biochemical indices for growing rams.

Keywords: bamboo leaves, neem seed cake, performance, blood, ram

Introduction

The tremendous increase in human population coupled with the high standard of living has placed considerably pressure on the existing conventional livestock feed resources. The competition between man and livestock for these conventional feed resources as well as scarcity of forage grasses in the dry season has been a major constraint militating against the increase in production of animal protein from ruminants. The potential of ruminant production in alleviating the low animal protein intake in Nigeria and other developing countries especially those in the tropics need no emphasis (Ahamefule and Udo, 2010). Attempts to alleviate this problem by searching for potential feed resources, have led to urgent need to source for alternative feedstuff within the localities for incorporation into the diet of ruminant animals at a least cost. However, Agiang *et* *al.* (2004) suggested that such alternative feedstuff should not be in great demand as human food or industrial use. Besides, they should be readily available and not be subjected to the dictates of season.

In recent years, there has been a growing interest in many tropical countries to identify potentially important feed sources among non-conventional feeds and lesser-known types and grasses for inclusion in the ruminant diet to provide rations that are sufficient in energy and protein to supplement or replace the available low nutrient forages during the off season. Bamboo *(Bambusa vulgaris*) leaves and neem (*Azadirachta indica*) seed cake have been recognised as some of the most lesser-known feed ingredients to improve animal performance in smallholder ruminant livestock production. Bamboo is a grass with a woody stem that belongs to the family of poaceae. It is a major non-timber forest product which if properly harnessed should provide rural people with sufficient food and fodder for their livestock and generate income (ITTO, 2009). Bamboo leaves are rich in energy, protein, phosphorus and vitamin A, which are the principal components that may be limiting in other grasses on rangelands. The major limiting factor in using bamboo leaves as forage is the inherent content of the leaves that is affected by leaf age, plant age and the position of the leaf. Though, there are few documented evidences on the use of bamboo leaves as fodder in ruminant nutrition, literature (Antwi-Boasiako *et al*.,2011) reported that bamboo leaves are rich in nitrogenous material and excellent source of vitamin A which are valuable feed for cattle and horses if combined with other relatively known feedstuff such as neem seed cake. Neem seed cake obtained from need seed oil industry is a non-conventional feedstuff for livestock. Need plant is native to India with only species in the genus Azardirachta, which belongs to the family of meliceae. Its medicinal properties are well documented making it a desirable tree plant (Adjorlolo *et al.,* 2016). Neem seed has great potentials for livestock production, thus it has been reported to be relative balanced in protein and rich in mineral profiles (Aruwayo *et al.,* 2011). The major limiting factors of need seed as livestock feed ingredient include neem oil, bitterness and toxic triterpenoids which are mainly nimbin, nimbidin, azadirachtin and salanin (Bawa *et al.,* 2005). Thus, processing that require oil extraction and detoxification to reduce the oil and anti-nutritional factors are important to obtain neem seed cake. The need therefore arises to investigate the use of bamboo leaves with neem seed cake as replacement for guinea grass with a view to provide information which could be employed for ruminant livestock nutrition in developing countries where livestock feeds security is not certain. Thus, the study was therefore designed to assess the performance characteristics and blood profile of growing rams fed *bamboo* **(*Bambusa vulgaris*)** *leaves with neem seed cake*.

Materials and Methods

Site location

This research was conducted at the Teaching and Research Farm of Ambrose Alli University, Ekpoma, Nigeria. The site was located on longitude 6.09^{0}E and Latitude 6.42^{0}N and with a temperature range of between 26^{0}C and 34^{0}C. The mean annual rainfall was about 1556mm.

Experimental diets and animals

Guinea grass (*Panicum maximum) and bamboo* ***(Bambusa vulgaris)*** *leaves* were harvested within the livestock farm. The neem seed were collected in batches during fruiting season. Neem fruits were soaked in water for five days and de-pulped using a de-pulper machine. The seeds and pulp were then washed and sundried for ten days. The dried seeds were decorticated using a winnowing machine. Thereafter, the neem seed kernels were crushed before steamed and the oil was expelled using expeller machine. The concentrate supplement that comprised 80% wheat offal, 18% brewer dried grain, 0.75% oyster shell, 0.5% bone meal, 0.05% salt and 0.25% vitamin premix was purchased at a feedmill in Benin City. The diets consist of basal and concentrate supplement which were offered at the rate of 5% of their body weight in a ratio of 70:30 respectively. Guinea grass and bamboo leaves with neem seed cake constituted the basal diets. Dietary treatments comprised; TD_1 (solely on 70% *guinea grass as basal diet, which* was the control group), TD_2 (combination of 50% bamboo leaves with 20% neem seed cake as basal diet) and TD_3 (consisted of 45% bamboo leaves with 25% neem seed cake as basal diet). Concentrate supplement of 30% was added to all the three dietary treatments respectively. Eighty healthy West African dwarf growing rams purchased from local livestock market at Ekpoma were used in this study. The ram-lambs were between 8-9 months old with an average weight of 8.00 ± 0.20kg. They were randomly allotted to the three dietary treatment groups (T_1, T_2 and T_3) with replicates of six animals per treatment group in a completely randomized design.

Management and feeding

Prior to the commencement of this experiment, pens were cleaned and disinfected; animals were vaccinated against the common viral diseases and dewormed against the helminthes. Animals were housed individually in dwarf wall pens with concrete floors and roofed with asbestos sheets. Experimental diets were offered once daily at about 8.00am to the animals. The animals equally had free access to water and mineral salt lick. Feeds offered and leftovers were measured daily in the morning prior to feeding and watering to determine daily feed intake. Animals were weighed at the commencement of the study before administering the experimental diets. Subsequently, live weight measurement were carried out on weekly basis to determine weight changes. Feed conversion ratio was calculated as the ratio of feed intake over the body weight gain. The experiment lasted for 84 days.

Digestibility

At the end of the growth study, total digestible nutrient (TDN) was carried out on the sheep. The sheep were kept off-feeds for 12 hours but with water supplied constantly; this was to evacuate their gut of the residual feeds eaten. Fresh feeds of known weight were then given to the sheep. The quantity of feeds offered which represented the fraction of feeds given to each sheep per day and the leftover which represented the one that was not consumed were weighed daily. The weight difference between them was recorded and taken as the feed intake. Faecal samples were also collected and weighed daily. However, the process of samples collection lasted for 7 days. Thereafter, sub-samples of each replicate faecal sample were bulked together before they were stored separately in airtight container and frozen until required for analysis.

Thus, total digestible nutrient (TDN) was calculated using this formula;

TDN = Digestible crude protein + Digestible crude fibre + 2.25 X digestible ether extract + Digestible nitrogen free extract.

Blood collection

On the last day of the feeding trial period, experimental animals were fasted over night and blood was collected in the morning. Two sets of blood samples were collected from all the experimental animals from the jugular vein using sterile disposable 10mL needles of 20 gauge and syringes. A set of the blood samples (5mL) was collected and transferred immediately into plastic tubes containing the anti-coagulant ethylene diamine tetra acetic acid for haematological study. Another set of the blood samples (5mL) was collected into sterile anti-coagulant free plastic tubes and centrifuged at 3000 rpm for 15 minutes to separate the plasma. The separated plasma was then transferred into previously numbered plastic vials with the help of automatic micro-lit pipette capped and preserved at -20^{0}C for further analysis. For serum separation, the supernatant serum was carefully aspirated, placed in a clean labelled plastic vial and stored in deep freezer for further assay to determine serum biochemical indices.

Laboratory and statistical analyses

The proximate compositions of the basal diets and concentrate supplement offered to the animals and faecal samples were determined according to the procedures of AOAC (1990). The haematological parameters determined were packed cell volume (PCV) and haemoglobin (Hb) concentration following the procedures outlined by Schalm *et al.* (1975). Red blood cell (RBC) and white blood cell (WBC) with their differential counts were determined by using the haemocytometer. Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were calculated according to standard formulae (Jain, 1986). Biochemical components of the Serum samples estimated were total protein, albumin, globulin, glucose, cholesterol, creatinine and Urea using the methods described by other researchers (Ogunsanmi *et al.,* 1984; Ikhimioya and Imasuen, 2007).

Data generated from growth, total digestible nutrient (TDN), haematological and serum biochemical parameters were subjected to analysis of variance (ANOVA) and significant differences between means were separated using the Duncan's Multiple Range Test (SAS, 1999).

Results and Discussion

Table 1 presents proximate composition of Guinea grass (GG), bamboo leaves (BL), neem seed cake (NSC) and concentrate supplement (CS) of the experimental diets. Dry matter values were generally high except for Guinea grass that was slightly above average value. The stage at which the GG was harvested could probably affect the dry matter content. The crude protein value for GG was low but high in crude fibre. Thus, the need to combine with concentrate supplement in the diets was necessary to supply fermentable carbohydrate and protein to balance the supplied nutrient from the GG and encourage rumen degradation as well as to promote production (Yousuf and Adeloye, 2011). Ether extract values that ranged between 1.06 and 7.54% were highest in NSC and lowest in CS. The NSC had the lowest value of crude fibre, hence it was combined with bamboo leaves to increase the fibre content in the test diets. The highest value of ash obtained in BL indicated that bamboo leaves were highest in mineral supply in the treatment diets than other feed ingredients. Nitrogen free extract obtained in the feedstuffs varied from 31.85 to 57.16% with CS recorded that highest and BL the lowest. The proximate compositions of NSC recorded in this study were consistent with the report of Bawa *et al*. (2007). The BL proximate composition of the study was lower than the values reported by Zehui (2007).

Table 1: Proximate Composition (%DM basis) of guinea grass, test feeds and concentrate supplement offered to the experimental growing rams.

Nutrient	Feeds			
	GG	BL	NSC	CS
Dry Matter	68.99	89.66	96.65	84.42
Crude protein	7.95	18.40	23.88	20.78
Ether extract	4.00	1.52	7.54	1.06
Crude fibre	31.00	27.06	5.44	13.00
Ash	8.90	10.83	5.69	8.00
Nitrogen free extract	48.15	31.85	44.55	57.16

GG = Guinea grass, BL = Bamboo leaves, NSC = Neem seed cake, CS = Concentrate Supplement

Growth indices of growing rams as influenced by treatment diets is shown in Table 2. Final body weight values of 10.94, 11.33 and 10.81kg recorded for growing rams on TD_1, TD_2 and TD_3 respectively were statistically differed ($P < 0.05$) between treatment diets. Higher numerical values were obtained in rams on TD_2 compared with TD_1 and TD_3. This could be an indication of a good nutritive value of the test diet (bamboo leaves and neem seed cake) and their combination ratios that were optimally utilized by the rams. This lends support from the report of Odunsi *et al.* (2009) that the diet that is optimally utilized by animals has a positive effect on the final body weight of the animals. Average total weight gain for rams on treatment diets TD_1 (2.71kg) and TD_3 (2.50kg) were not significantly ($P > 0.05$) different from one another but TD_2 (3.27kg) was significantly higher ($P < 0.05$) than the two treatment diets. However, the numerical increased values in average total weight gain for rams with corresponding increase in inclusion level of bamboo leaves and decrease level of neem seed cake in the diet (TD_2) might ascribed to the nutrient density and availability that was efficiently utilized which eventually translated to the improvement in growth rate. This fact support the findings of some workers (Ogbuewu *et al.,* 2011; Adjorlolo *et al.,* 2016) who reported that when diets of ruminant animals consist of a mixed forage and lesser neem seed cake regime, higher weight gain is obtained than when diets consist of neem seed cake alone. Average daily weight gain of rams were significantly ($P < 0.05$) affected by dietary treatments. Rams fed increased level of neem seed cake with decreased inclusion level of bamboo leaves diet (TD_3, 29.76g) had a significant ($P < 0.05$) depressed daily weight gain compared to those on diets TD_1(32.26g) and TD_2(38.93g). The depressed weight gain observed in rams on TD_3 could be attributed to the residual anti-nutritional factors of the neem seed cake and high level of bitter principles inherent in the diet which did not prevent tissue depletion in rams. Authors (Ghimeray *et al.,* 2009; Bawa *et al.,* 2007; Odunsi *et al.,* 2009), had reported that several feeding trials with higher levels of neem seed cake (above 30%) have revealed poor palatability and adverse effect on growth performance among different categories of livestock and poultry with ruminants tolerating reasonably levels of the neem seed cake than the monogastrics.

Table 2: Growth indices and total digestible nutrients of growing rams fed experimental diets

Parameters	Treatments			SEM ±
	TD_1	TD_2	TD_3	
Initial body weight (kg)	8.23	8.06	8.31	0.03
Finial body weight (kg)	10.94^b	11.33^a	10.81^b	0.07
Av. total weight gain (kg)	2.71^b	3.27^a	2.50^b	0.01
Av. daily weight gain (g)	32.26^b	38.93^a	29.76^c	0.12
Av. Total feed intake (kg)	11.13^a	10.89^b	10.67^b	0.13
Av. daily feed intake (g)	132.50^a	129.64^b	127.02^c	0.10
Feed conversion ratio (FCR)	4.11^a	3.33^b	4.27^a	0.04
Total digestible nutrient (%)	63.99^b	68.97^a	65.97^b	0.20

AV= Average

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

SEM± = Standard error of mean

Average total feed intake of growing rams fed experimental diets had significant ($P < 0.05$) differences across dietary treatments. Rams fed treatment diets TD_2 (10.89kg) and TD_3 (10.67kg) had the least total feed intake compared to those fed on TD_1 (11.13kg) which was the control group. This could probably due to the neem seed pungent smell and poor palatability, which depressed feed consumption and adversely affected daily feed intake. This observation corroborates the report of Gowda and Sastry (2000) that neem seed cake is toxic and bitter to taste due to triterpenoids, which restricts its safe inclusion in livestock diets. In the same vein, they further reported that lower feed intake, nutrient digestibility and growth were observed in rabbits fed 20% raw neem seed meal. The average daily feed intake that ranged between 127.02 and 132.50g decreased with increased in inclusion levels of neem seed cake in the diet. The significant ($P < 0.05$) decline in feed intake registered in rams on TD_3 could be linked with poor presentation of the neem seed cake due to its blackish colour in addition to its bitter taste which hitherto affected on the filling on the gastro intestinal tract at faster rate. This is in consonance with the study conducted by Chandrawathani *et al.* (2006) who reported that physical presentation of feed and its poor biological value contribute to less feed consumption and lesser weight gain in livestock.

Feed conversion ratio of rams fed TD_1 (4.11) and TD_3 (4.27) showed no significant ($P > 0.05$) difference compared to those fed on TD_2 (3.33). The low feed conversion ratio of rams maintained on TD_2 could be ascribed to the quality of nutrient which was capable of increasing feed efficiency and growth rate. Thus rams on TD_2 efficiently utilized their feed better than those treatment diets TD_1 and TD_3. This further attest the comparable growth performance observed in rams on TD_2. However, the variation observed in respect to total digestible nutrient (TDN) that ranged between 63.99 and 68.98% were significantly ($P<0.05$) different among treatment diets. This disparity might be due to the degree of digestibility of nutrient in the diets. Nevertheless, the higher values obtained in all the dietary treatments was an evidence that the diets were acceptable to the rams without detrimental effect.

Table 3: Haematological parameters of growing rams fed mixture of bamboo leaves and neem seed cake as replacement for forage grass.

Parameters	Treatments			SEM$\pm$
	TD$_1$	TD$_2$	TD$_3$	
Packed cell volume (%)	26.08^b	30.06^a	27.93^c	0.09
Haemoglobin (g/dL)	10.21^a	10.68^b	9.59^b	0.07
Red blood cell (x10^6/mL)	9.07^a	9.42^a	8.23^b	0.01
MCV (fl)	28.03^b	26.98^c	30.95^a	0.04
MCH (pg)	11.49^a	11.70^a	10.61^b	0.04
MCHC (g/dL)	33.35^a	33.04^a	31.65^b	0.03
White blood cell (x10^3/mL)	7.99^b	9.78^a	10.01^a	1.58
Lymphocytes (%)	94.36	94.88	95.06	0.05
Neutrophils (%)	4.28	4.03	4.75	0.07

MCV = mean corpuscular volume, MCH = Mean corpuscular haemoglobin, MCHC = mean corpuscular haemoglobin concentration

$^{a, b, c,}$ Means within the same row with different superscripts differ significantly (P<0.05); SEM = Standard error of mean

Presented in Table 3 is the haematological parameter of growing rams fed mixture of bamboo leaves and neem seed cake as replacement for forage grass. It was noted in literature that significant changes in the haemetological parameters are good indicator for the assessment of the pathological and nutritional status of farm animals. The inclusion of bamboo leaves and neem seed cake as test diets in rams dietary treatments significantly (P<0.05) influenced the haematological parameters of rams except lymphocyte and nuetrophile that were not significant (P > 0.05). The numerical values obtained for packed cell volume (PCV) in rams were significantly (P < 0.05) higher in test diet TD$_2$ (30.06%) compared to test diet TD$_3$ (27.93%) and the control diet TD$_1$ (26.08%). The PCV values were within the normal levels (26–36%) earlier reported for healthy sheep by Pampori (2003). This indicated that at the levels of bamboo leaves and neem seed cake inclusion in the test diets did not have any adverse effect on the functions of the cells. It could also be said that ram maintained on these diets had better nutritional qualities; hence they had low susceptibility to infections and nutritional stress. Rams fed treatment diets TD$_1$(10.21g/dL) and TD$_2$(10.68g/dL) had significant (P<0.05) higher haemoglobin (Hb) compared to the rams on diet TD$_3$(9.59g/dL). The slight significant reduction in rams on TD$_3$ might perhaps be consequent upon the effect of some anti-quality components acting together in the bamboo leaves and neem seed cake to induce haematopoiesis inhibition. The significant (P < 0.05) higher variation that exist in red blood cell (RBC) of rams on treatment diets TD$_1$ (9.07 x 10^6/mL) and TD$_2$ (9.42 x 10^6/mL) compared with TD$_3$ (8.23 x 10^6/mL) could suggest their superiority in terms of their capability of supporting high oxygen carrying capacity in the blood and absence of anemia related diseases which might be due to iron deficiency. However, the slight low values observed in red blood cell of rams fed diet TD$_3$, further attest the improper utilization of the diet for the formation of Hb that had greater affinity for iron by making them unavailable which reduces effective oxygen transpiration in the blood. Notwithstanding, the mean values of Hb and RBC recorded in this study were within the normal range of values for Hb(8.07 to 11.70g/dL) and RBC(5.00 to

11.00x 10^6/mL) as indicated by several studies (Pampori, 2003; Taiwo and Ogunsanmi, 2003) for sheep. Mean corpuscular volume (MCV) that had no particular trend in variation was significantly ($P < 0.05$) highest in TD_3 (30.95fl) and lowest in TD_2 (26.98fl). MCV is an important trait that determines the cell size of red blood cell and the ability of animal to survive in low oxygen conditions. Thus, the higher MCV observed in rams fed diet TD_3 indicated that they could able to withstand prolonged oxygen starvation (Aruwayo *et al.,* 2011*)*. Mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were significantly ($P < 0.05$) improved in diets TD_1 (11.49Pg & 33.35g/dL) and TD_2 (11.70Pg & 33.04g/dL) than diet TD_3 (10.61 & 31.65g/dL). These numerical depressed values for MCH and MCHC in diet TD_3 corroborate the reduced RBC value observed in the same diet TD_3. This further elucidated the inferiority of the diet to test diet TD_2. The reduction in the white blood cell (WBC) of rams on diet TD_1(7.99 x 10^3/mL) reflects a decline in the production of defensive mechanism which naturally predisposes the rams to various physiological stresses due to disease and poor growth. Besides, the increase in the WBC of rams maintained on TD_2 and TD_3 showed an immunological response of the rams to foreign challenged. The similarity in high values of lymphocyte in this study is in line with the report of Opara *et al.* (2010) that high lymphocytes and WBC values are associated with the ability of animals to perform well under a very stressful condition. The non-significant ($P > 0.05$) reduction in values of neutrophile among diets possibly explained the inclusion levels of the test diets that were tolerant and did not have inverse effect in the blood quality of the rams.

Table 4: Serum biochemical parameters of growing of rams fed experimental diets.

Parameters	Treatment			SEM±
	TD_1	TD_2	TD_3	
Total protein (g/dL)	5.37^b	8.09^a	7.01^b	0.05
Albumin (g/dL)	2.34^b	3.03^a	2.95^b	0.01
Globulin (g/dL)	3.03^b	5.06^a	4.05^b	0.03
Glucose (mg/dL)	59.01^a	51.82^b	53.97^b	0.12
Cholesterol (mg/dL)	42.89^a	35.64^b	31.98^c	0.09
Creatinine (mg/dL)	1.08^a	0.79^b	0.91^b	0.04
Urea (mg/dL)	13.73^a	7.01^c	9.85^b	0.06

[a, b, c,] Means within the same row with different superscripts differ significantly ($P<0.05$);
SEM= Standard error of mean

Table 4, shows the serum biochemical parameters of growing rams fed experimental diets. Blood contains myriad metabolites and other constituents, which provide a valuable medium for clinical investigation and assessment of nutritional status of animals. According to Waziri *et al.* (2010), serum biochemistry helps to investigate indications of gastro intestinal problems, immune suppression, productive organ problems and blood abnormalities. Parameters obtained for serum biochemistry were all significantly ($P<0.05$) affected by treatment diets. The mean values of total protein followed a particular trend with respect to mixture of bamboo leaves and neem seed cake content of the diets. However, total protein was influenced by increased in bamboo leaves with decreased in neem seed cake inclusion levels in the test diets which resulted in increased of total protein values by rams fed diet TD_2(8.09g/dL) compared to those on diets TD_1(5.37g/dL) and TD_3(7.10g/dL). This suggests that the protein content of bamboo leaves and the combination with neem seed cake in TD_2 positively influenced the protein utilization in rams which could probably responsible for the concomitant increased in the total protein values. Albumen and globulin were significantly ($P < 0.05$) lower in diets TD_1 (2.34 & 3.03g/dL) and TD_3 (2.96 & 4.05g/dL) compared with TD_2 (3.03 & 5.06g/dL) which was the highest. The reduction in total protein, albumin and globulin values observed in rams placed on diets TD_1 and TD_3 indicated abnormal alteration in systemic protein utilization which could be attributed on interference in protein synthesis. Furthermore, the higher levels of albumin and globulin observed in diet TD_2 could be related to the nutritional adequacy and safety of the test diet which agrees with the report of Odunsi *et al.* (2009), that albumin synthesis in animals, is related to the amount of available protein present in the diets. Glucose values that did not follow any particular pattern of variation with respect to bamboo leaves inclusion in the test diets were significantly ($P < 0.05$) highest among rams fed on treatment diet TD_1 with a mean value of 59.01mg/dL followed by comparable values of 53.97mg/dL and 51.82mg/dL recorded among rams maintained on diets TD_3 and TD_2 respectively. The elevation in the level of glucose in TD_1 might perhaps be ascribed to the influence of guinea grass utilization in the diet which could probably increase the energy content and subsequently improved glucose level in the rams. Several researchers (Daramola *et al.,* 2005; Ogbuewu *et al.,* 2011) reported that concentration of serum glucose is directly associated with energy utilization and metabolism in animal's body. Serum cholesterol values of 42.89, 35.64 and 31.98mg/dL were recorded among rams on diets TD_1, TD_2 and TD_3 respectively. The cholesterol levels declined progressively with increased levels of neem seed cake inclusion in the diets. This implies that serum cholesterol synthesis, metabolism and utilization were directly affected by the test diets although values observed were still within the range values (30.15 – 82.08mg/dL) reported by Waziri *et al.* (2010). In addition, this observation agree with the similar findings of Ogbuewu *et al.* (2011) who noted that administration of the mature neem leaf extract concentration decreased serum cholesterol significantly without changing serum protein, blood urea and uric acid levels in rats.

Creatinine is formed when feed is changed into energy through the process called metabolism and it is muscle mass dependent. Its increase is an indication of the damage that might have been done to the kidney, hence, it is noted that high level of creatinine could lead to tissue wastage. The significant highest ($P < 0.05$) value of creatinine was recorded in rams on TD_1 (1.08mg/dL) compared to rams on TD_2 (0.79mg/dL) and TD_3 (0.91mg/dL). Notwithstanding, the creatinine values in this study did not exceed the normal range values of 0.6 to 2.5mg/dL as reported by Taiwo and Ogunsanmi (2003). This implied that the test diets used in this study had no tendency to damage the nephron which could result into nephropathy. Serum urea was significantly ($P < 0.05$) influenced by treatment diets with rams on TD_1 (13.73mg/dL) recorded the highest values followed by those on TD_3 (9.86mg/dL) before TD_2 (7.01mg/dL). The increase in serum urea level in rams placed on diet TD_1 might perhaps be ascribed to the effect of some endogenous anti-quality components which could probably reduces protein utilization owing to increase amino acid catabolism which were subsequently degraded into urea. This is in conformity with the report of Omoikhoje *et al.* (2003) that urea is an indirect measure of protein utilization in animals.

Conclusion

The study showed that feeding bamboo leaves with need seed cake to rams has potential of meeting the nutritional needs to rams in terms of basal diet. The response in terms of improved body weight gain and blood characteristics by growing rams indicated that mixture of 50% bamboo leaves with 20% neem seed cake can serve as the best sustainable feeds for rams most especially during the dry season.

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