INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

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CHEMICAL COMPOSITION, MINERAL PROFILE AND PHYTOCHEMICAL PROPERTIES OF COMMON FEED RESOURCES USED FOR SMALL RUMINANT ANIMAL PRODUCTION IN SOUTH-WEST, NIGERIA

[1]Lamidi, A.A. & [2]Ogunkunle, T.
[1]Department of Animal Science, Faculty of Agriculture, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria.
[2]Agricultural Biotechnology and Bio-resources Development Unit, National Biotechnology Development Agency, South West BIODEC, Zonal Centre Owode Yewa, Ogun state, Nigeria
*Correspondent author's email: akeem.lamidi@uniport.edu.ng

ABSTRACT
Chemical composition, mineral profile and phytochemical properties of common feed resources used for small ruminant animal production in South-west, Nigeria were analysed. Thirty (30) farmers were randomly visited in 15 villages, 5 in each 3 Local Government Areas in Ogun and Lagos State South west, Nigeria the identified common feedstuffs were used for sheep and goat production through interview and observational methods. *Panicum maximum*, *Gliricidia sepium*, *Gmelina arborea*, cassava peel, wheat offal and Ruminant mineral premix. Results shows that there is a significant ($P<0.05$) variation in the dry matter (DM) of the feed materials, CP content is significantly ($P<0.05$) higher in *Gliricidia sepium* (GLS) (15.68%) followed by *Gmelina arborea* (GMA), wheat offal (WTO) and *Panicum maximum* (PAM), while cassava peel (CAP) had the lowest (5.32%) CP. Cassava peel had the least significant value of NDF and ADF while the ADF value recorded were similar ($P>0.05$) for PAM, GLS, GMA and WTO. Ash contents varied across the feedstuffs with PAM having the highest significant ($P<0.05$) contents. Ruminant Mineral Premix (RMP) was significantly higher ($P<0.05$) in all the minerals than other feedstuffs except K. phytate content of the feedstuffs varied while PAM and GLS phytate contents were significantly ($P<0.05$) higher than other feedstuffs. The hydrocyanic acid (HCN) was detected only in CAP and WTO while there was no trace in other feedstuffs. Alkaloid value was significantly higher in PAM, GLS and CAP respectively. The least of alkaloid concentration was observed in WTO. Conclusively, all the feedstuffs analysed has a great potential for supporting ruminant production in the region and Nigeria at large.

KEY WORDS: Chemical composition, minerals, phytochemicals, feedstuffs and small ruminant.

INTRODUCTION

Small ruminant animal were referred to sheep and goat, these animals play a crucial roles in socio-economic development of the nation, and their production were basically traditional which is characterised with low production and poor products in terms of quantity and quality. Sheep and goat production in the tropics were reared basically on natural pasture that were not adequate in nutrients to meet the nutrients requirement of the animals, prolong dry season make the natural pasture not available and pose a serious challenge to the production of this animal. Majority of the farmers supplemented the feed with available feed resources such as crop residues, browse plants and agro-industrial by products (AIBP). *Gmelina arborea*, *Leuceana leucocephala*, and *Gliricidia sepium*, have been reported to remain green to larger part of dry season and have been fed to ruminants with appreciable results (Lamidi *et al*., 2009). *Gmelina arborea* Roxb (family verbenanceae) is a fast growing deciduous tree reaching up to 40 m tall and 140cm in diameter, but usually smaller than this (Jensen, 1995). Previous records (Ahamefule *et al*., 2006; Adu *et al*., 1996) have shown that the leaves contained as much as 10.01-38.4 % crude protein and 3.10-30.46 % crude fibre. Agro industrial by products (AIBPs) are waste products arising from the processing of crop or animal products usually by an agricultural firm. (Alhassan *et al.*, 1985). The use of these by-products for supplementary livestock feeding is justified when the forage supply is inadequate for animal needs either in terms of quantity or quality, (Aina, 2012). However, most of these material has been in used through trial and error, much has not been done in the area of chemical and phytochemical assessment of these important and common feedstuffs such as crop residue (Cassava peel), AIBP (Wheat offal), grass (*Panicum maximum*), browse (*Gmelina arborea*), legume browse (*Gliricidia sepium*) and ruminant mineral premix for effective small ruminant animal production. There is need for continuous screening of both the forages and crop residues to identify those with good potentials as feed resources which could serve as alternatives or to complement to those feedstuffs which have already being tested and trusted. Mtengeti and Mhelela (2006) reported that any method used to screen potential browse species must take into consideration both the preference of browsing animals and laboratory analyses to verify the nutritional quality of the browse plants. D'Mello (1992) stated that results of proximate analyses are extensively employed in research and industry for quick estimation of nutrient potentials of feedstuffs; although such results may not give a true indication of the

nutritive value of a feed, they supply clues in research to plants of potential value for further *in vitro* or *in vivo* studies. Buttressing this assertion, Okoli *et al.* (2003) stated that proximate analysis is specifically useful in screening the array of tropical browse plants. In lieu of this, the present study intends to establish the chemical composition, mineral profile and phytochemical properties of common feed resources used for small ruminant animal production in South-west, Nigeria. So as to improve their utilization for effective and efficient production of sheep and goat in the area and country at large.

MATERIALS & METHODS

Study area: Thirty (30) farmers were randomly visited in 15 towns/villages, 5 in each 3 Local Government Areas in Ogun State (Sagamu, Yewa South and Odeda) and Lagos State (Badagry, Ojo and Ikorodu) South west, Nigeria to identify the common feedstuffs used for sheep and goat production through interview and observational methods.

Samples collection: Samples of cassava peel were collected from cottage cassava processing firm in Lusada Area, Ado-Odo/Ota Local Government Area, Ogun State, sundried for 4-6 days. *Panicum maximum*, *Gliricidia sepium*, *Gmelina arborea* were harvested within the campus of Adeniran Ogunsanya College of Education, Otto/Ijankin, Lagos State, sundried for 3-4 days. Wheat offal was purchased from the feed mill. Ruminant minerals premix was formulated as 20% salt, 40% bone meal and 40% egg shell. Samples were replicated.

Chemical Analysis: Samples of the *Panicum maximum*, **Gmelina arborea**, *Gliricidia sepium*, cassava peels, wheat offal were prepare for chemical analysis. Proximate analysis was carried out using the methods recommended (AOAC, 1990). The following parameters were determined; dry matter, crude protein, crude fiber, ether extract and total ash. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed as recommended (Goering and Van Soest, 1970). Mineral elements were determined by atomic absorption spectrophotometer (AAS) model 490 Gallenkamp, London

Phytochemical Analysis: The following anti-nutritional factors were determined; tannin, phytate, oxalate and saponin. Quantitative estimation of tannins in the samples was carried out using vanillin-HCl methanol (Price and Buttler, 1977). A standard curve of tannic acid was prepared (AOAC, 1990) for measurement of the concentration of tannins in the samples. Phytic acid was determined according to the method (Wheeler and Ferrel, 1971). Oxalate was determined by acid digestion, using 15uH2SO followed by filtration using a Whatman No.1 filter paper. The filtrate was titrated hot (80-90^{o}C) against an O./NKMnO solution to a faint pink colour that persists for 30 seconds. Saponin was determined by extraction in 50% aqueous methanol followed by transfer to a test tube with constant vigorous agitation. Formation of persistent foam at the surface was taken as an indication of the presence of saponin.

Statistical Analysis

Data collected were subjected to One way Analysis of Variance and significant differences among means were compared using Duncan multiple Range test (SAS, 1990).

RESULTS

The proximate composition of the common feed materials used for small ruminant farmers in south west of Nigeria is shown in Table 1. There is a significant (P<0.05) variation in the dry matter (DM) of the feed materials. Wheat offal (WTO) had highest value of 89.88% followed by cassava peel (CAP) (89.82%), *Gmelina arborea* (GMA) (89.26%), *Panicum maximum* (PAM) (89.67%) least DM is recorded in *Gliricidia sepium* (GLS) (89.26%). The CP content is significantly (P<0.05) higher in GLS (15.68%) followed by GMA, WTO and PAM, while CAP had the lowest (5.32%) CP.

Cassava peel had the highest (P<0.05) value of ether extract (EE) followed by WTO, PAM and GMA with GLS indicating the least (P<0.05) value. The WTO has the highest (17.96%) content of CF followed by PAM, GLS, CAP and GMA with 17.89, 16.92, 16.84 and 13.49 %DM respectively. Cassava peel had the least significant value of NDF and ADF while the ADF value recorded were similar for PAM, GLS, GMA and WTO. The gross energy of CAP, WTO and PAM were similar (P>0.05). Ash contents varied across the experimental feedstuffs with PAM having the highest significant (P<0.05) contents followed by GMA, GLS, WTO and CAP, in that other.

TABLE 1: Proximate composition (%DM) of the common feed for small ruminant production in south west Nigeria

	Feedstuff					
Parameters	*Panicum maximum**	*Gliricidia sepium**	*Gmelina arborea**	Cassava peel*	Wheat offal**	±SEM
Dry matter	89.67^{b}	89.26^{c}	89.82^{b}	89.82^{b}	89.88^{a}	0.31
Crude protein	12.26^{c}	15.68^{a}	14.51^{b}	5.32^{d}	12.38^{c}	1.21
Ether extract	1.87^{c}	1.14^{e}	1.62^{d}	4.12^{a}	3.04^{b}	1.83
Crude fibre	17.89^{b}	16.92^{c}	13.49^{e}	16.84^{d}	17.96^{a}	1.66
Ash	13.09^{a}	11.97^{c}	12.89^{b}	8.94^{e}	11.92^{d}	0.01
NFE	54.89^{c}	54.29^{c}	57.49^{b}	64.78^{a}	54.72^{c}	1.21
NDF	69.87^{a}	64.89^{c}	65.86^{b}	47.84^{e}	64.28^{c}	0.24
ADF	41.36^{a}	41.37^{a}	42.38^{a}	21.32^{b}	43.37^{a}	0.07
Gross energy (Kcal/g)	3.15^{a}	3.01^{c}	2.98^{c}	3.07^{ab}	3.10^{ab}	0.00

a, b, c, d, e means with different superscript on the same row are significantly different (P < 0.05) *Sundried samples were used for analysis; ** Analyzed as purchased from the feed supplier; NFE= Nitrogen free extract; NDF= Neutral Detergent Fiber; ADF= Acid Detergent Fiber; SEM= Standard Error of Mean

Table 2 depicts the mineral profile of the feedstuffs used for the experiment. Ruminant Mineral Premix (RMP) was significantly higher (RMP) was significantly higher (P<0.05) in Ca than other feedstuffs. Similar contents were recorded for GMA and WTO, GMA and PAM, PAM and GLS, GLS and CAP. The phosphorus (P) was higher (P<0.05) in RMP than in other feedstuffs. Similar values were recorded in WOT and GMA, GLS and PAM. The least P content was noticed in CAP.

T ABLE 2: Mineral profile of common feedstuffs for small ruminant animal production in South west Nigeria

	Feedstuffs						
Minerals	*Panicum maximum**	*Gliricidia sepium**	*Gmelina arborea**	Cassava peel*	Wheat offal**	Ruminant Mineral Premix***	±SEM
Ca (%)	0.24^{cd}	0.22^{de}	0.28^{bc}	0.17^{e}	0.33^{b}	35.89^{a}	0.02
P (%)	0.38^{c}	0.35^{c}	0.42^{bc}	0.08^{d}	0.49^{b}	17.03^{a}	0.03
K (%)	0.17^{b}	0.16^{bc}	0.13^{c}	0.03^{d}	0.21^{a}	0.14^{bc}	0.06
Na (%)	0.12^{cd}	0.09^{de}	0.15^{cd}	0.05^{e}	0.22^{b}	0.53^{a}	0.02
Mg (%)	0.30^{b}	0.29^{b}	0.23^{c}	0.12^{d}	0.34^{b}	0.66^{a}	0.02
Zn (ppm)	760^{b}	790^{b}	680^{b}	340^{c}	850^{b}	940^{a}	1.67
Fe (ppm)	330^{b}	250^{bc}	230^{bc}	130^{c}	630^{b}	860^{a}	1,24

a, b, c, d, e means with different superscript on the same row are significantly different (P < 0.05) *Sundried samples were used for analysis; ** Analyzed as purchased from the feed supplier; ***Mixture of 20% Salt + 40% Bone meal + 40% Egg shell meal; SEM= Standard Error of Mean

The potassium (K) content was significantly (P<0.05) higher in WOT than others followed by PAM. Similar contents were recorded for PAM, GLS and RMP. Ruminant mineral premix, GLS, and GMA were also similar in K contents. CAP had the least (P<0.05) K contents. Ruminant minerals premix had the highest (P<0.05) content of sodium (Na) followed by WOT. Similar Na level was noticed in GMA and PAM, GLS and GMA, and GLS and CAP. Magnesium (Mg) was higher (P<0.05) in RMP compared to other experimental feedstuffs. PAM, GLS and WTO had similar contents of Mg while Mg was significantly lower in CAP. Zinc was significantly (P<0.05) higher in RMP, while the lowest (P<0.05) value was recorded in CAP. Iron was also (P<0.05) higher in RMP than in other feedstuffs this is followed by WTO and PAM, GLS and GMA with similar values, while CAP had the lowest content of iron. The antinutritional factors (ANF) of the experimental feedstuffs are shown in Table 3. The phytate content of the feedstuffs varied while PAM and GLS phytate contents were significantly (P<0.05) higher than other feedstuffs. These were followed by GMA and WTO. The least value of phytate was recorded in CAP. The oxalate was higher (P<0.05) in GMA compared with others, followed by PAM, GLS respectively. Wheat offal and CAP had the least values. Tannin content was higher (P<0.05) in PAM and GMA, followed by GLS, WTO and CAP. Hydro cyanide was detected only in CAP and WTO while there were no traces in other feedstuffs. Alkaloid value was significantly higher in PAM, GLS and CAP respectively. The least of alkaloid concentration was observed in WTO.

TABLE 3: Antinutritional factors of common feedstuffs for small ruminant animal production in South west Nigeria

	Feedstuffs					
ANF	Panicum maximum*	Gliricidia sepium*	Gmelina arborea*	Cassava pel*	Wheat offal**	± SEM
Phytate (mg/g)	1.78^{a}	1.74^{a}	1.32^{b}	1.01^{d}	1.18^{c}	0.34
Oxalate (%DM)	0.72^{b}	0.71^{b}	0.85^{a}	0.49^{c}	0.51^{c}	0.15
Tannin (%DM)	0.62^{a}	0.47^{b}	0.61^{a}	0.21^{d}	0.25^{c}	0.03
Saponin (%DM)	0.57^{a}	0.42^{c}	0.49^{b}	0.26^{d}	0.27^{a}	0.14
HCN (mg/kg)	0.00	0.00	0.00	38.62^{a}	13.28^{b}	0.62
Alkaloid (%DM)	0.24^{a}	0.12c	0.21^{b}	0.08^{d}	0.05^{e}	0.82

a, b, c, d, e means with different superscript on the same row are significantly different (P < 0.05) *Sundried samples were used for analysis; ** Analyzed as purchased from the feed supplier

DISCUSSION

The chemical composition recorded for *Panicum maximum* in the present study different from what was reported by Hamzat *et al.* (2003) who reported DM (26.04), CP (13.13), CF (20.50), and EE (2.50) this might be attributed to the fact that samples used for this experiment were sundried before the laboratory analysis. The CP (12.26) recorded in the present study for *Panicum maximum* was higher than the value 9.74% reported by Bamikole and Ikhatua (2006), favourably compared with those reported in preserved elephant grass by Sowande, (2004). Aina and Onwukwe (1997) reported DM, CP, CF, ash and EE contents of 15.2%, 12.2%, 28.5%, 11.9% and 1.4% respectively for *Panicum maximum* which are close values to the present study. The nutrient values for *Gliricidia sepium* were similar to those reported by Aye (2002) except the CP with slight difference (19.72 vs. 15.68). The 15.68% CP recorded in the present study was in agreement with the value of 15.60% CP reported by Smith (1995) for dried *G sepium*, also higher than CP (10.94%) reported by Ifut and Inyang (2007). The *Gmelina arborea* proximate composition used in the present study was still within the

range reported by Ojo (2005), while the chemical composition reported for wheat offal in the present varied slightly from that reported by Maigandu and Hadeija (2003). Cassava peel used in the present study can be compared favorably with the report of Osei *et al.* (1990), and Baah *et al*. (1999). The higher DM value recorded in the wheat offal against the other experimental feedstuffs could have resulted from the mechanical processing undergone during the production of the wheat offal. The highest CP recorded in the *Gliricidia sepium* in present study indicated that the forage is rich in crude protein been leguminous plant as observed by Aye (2002) and Carew (1983). All the experimental feedstuff shows appreciable content of protein for ruminant nutrition except cassava peel which needs a supplementation with other sources of nitrogen as recommended by Adeloye *et al.* (1993). Gatenby (2002) indicated 10–12% CP as moderate level for ruminant production. The ash content of the forages was higher compared to crop residues. These findings are in line with those of Animashahun *et al.* (2006) who observed higher values of Ash for the forage compared to the value of concentrate fed to rabbits. The high level of ash content is an indicative of high mineral content inherent in forages, which are essential in the formation and function of blood and bones. (Animashahun *et al.*, 2006). Ruminant Mineral Premix (RMP) had the higher value of all the minerals analysed except K. This shows that RMP is a source of minerals which can be enhanced for better performance of the animals in the area. In respect of the value obtained in the present study, *Panicum maximum* Ca 0.24, P 0.38, Mg 0.30, K 0.17, slightly varied from the value reported by Ogunbosoye *et al*. (2006) who reported Ca 0.24, Mg 0.36, K 0.26, P 0.27 for the same plant. Aye *et al*. (2006) reported Ca 0.44, Na 0.70, P 0.60, and Mg 0.83 for *Gliricidia sepium* which slightly varied from what obtained in the present study Ca 0.22, Na 0.09, P 0.42, Mg 0.29 for the same plant. The variation observed in the two studies might be due to the age, soil and time as factors affecting the nutrients and minerals of forages (Lamidi, 2004). The mineral profile of the majority feedstuffs was within the recommendation of (NRC, 1980). The phytate (mg/g) contents reported in the present study (1.01 to 1.78mg/g) were lower than those recorded by Aletor and Omodara (1994) (5.007 to 82.28mg/g), Ologhobo (1989) (89.2 to 316.4mg/g), Ogungbesan *et al*. (2005) (2.29 to 3.68mg/g). The oxalate contents (%DM) of the experimental feedstuffs (0.49 to 0.85%DM) was higher than those catalogued in *Tephrosia bracteolata* (0.20 to 0.56% DM) by Ogungbesan *et al*. (2005) and favourably compared with the reports of Ologhobo (1989) (0.54 to 0.82% DM) in some Nigerian browse plants. Tanning content (%DM) of the forages in the present study (0.47 to 0.62% DM) were still within the range 0.03% DM in *Cobretum paniculatum*, 4.00% in *Dialum guinensis* reported by Onwuka, (1992), favorably compared with the contents reported by Ogungbesan *et al*. (2005) (0.12-0.58% DM), Oduguwa *et al*, (1998) (0.17 to 1.36 % DM). Saponin content (% DM) in the present study (0.26 to 0.57% DM) is in consonance with that of Onwuka (1992) (0.002 to 0.87% DM) in browse species who successfully fed West Africa Dwarf goats. However, the HCN content (mg/kg) of cassava peel used for small ruminant animal production (38.62mg/kg) is still below the 50mg/kg lethal dose which can induce cyanide toxicity (Bolhuis, 1954 and Taiwo *et al.*, 2003). The least value of ANF obtained in the present study for cassava peel indicated that cassava peel had no significant value of other ANF except HCN, this assertion is supported by the reports of Ogbonna (1991) and Taiwo *et al*. (2003) who reported that cassava peels do not contain any chelating agents (such as phytate, tannin, silica or lignin) that can bind the nutrients in strong chemical binding thereby hindering their easy solubility in water.

CONCLUSIONS & RECOMMENDATIONS

Conclusively, all the feed stuffs assed in this study has a great potential as for feeds and feeding small ruminant animals in the South-west, Nigeria and Nigeria at large except cassava peel which has low CP consequently which will required fortification with other protein feedstuffs in other to meet the requirement of the animals. The RMP shows an appreciable level of minerals for effective and efficient production of small ruminants which will available in quantity and quality at low cost because it is made of locally available materials.

The following recommendations were made based on the findings of this study:

i. Simple collection and processing techniques of the crop residues, forages and AIBPs should be designs for small ruminant animal farmers.
ii. Livestock extension services should be intensify towards utilization of these feedstuffs for sustainable production of small ruminant animal.

REFERENCES

Adu, I.F., Abi Udedibie and Okeleye, K.A. (1996) On-farm establishment and productivity of Gmelina and Gliricidia as browse for goats. Nig. Anim. Prod. 23 (1 and 2): 47-52.

Ahamefule, F.O., Obua, B.E., Ibeawuchi, J.A. and Udosen, N.R. (2006) The nutritive value of some plants browsed by cattle in Umudike, South-eastern Nigeria. Pakistan Journal of Nutrition 5 (5): 404-409

Aina, A.B.J and Onwukwe, S.C. (1997) The determination of nutrient contents of some selected grasses as affected by growth and development. B. Agric Project of the University of Agric Abeokuta.

Aina, A.B.J. (2012) Goat (*Capra hircus*): A Misunderstood Animal. 35th Inaugural Lecture 2012, Federal University of Agriculture Abeokuta, Nigeria. 28th March, 2012.

Aletor, V.A. and Omodara, O.A. (1994) Studies on some leguminous browse plants with particular reference to their proximate mineral and some endogenous anti-nutritional Constituents. *Animal Feed Sci. & Tech. 46. 343-348*

Animashahun, R.A.,Omoikhoje, S.O. and Bangbose, A.M. (2006) Haematological and biochemical indices of weaner rabbits fed concentrate and *Syndrella_nodiflora*_forage supplement Proc. 11th conf. ASAN, September 18-21, 2006. I.A.T. Ibadan, Nigeria. 29-31.

AOAC (1990) Association of Official Analytical Chemists, Official methods of analysis 15th edition. Washington D.C., Arlington, V.A. Pp. 503-513.

Aye, P.A., Agbede, J.O., Alokan, J.A. and Aletor, V.A. (2006) Chemical Characterization from Gliricidia and Leuceana. Proc. 11th Annual conf. Asan September 18-21, 2006. I.A.R. and T. Ibadan, Nigeria Pp. 84-87.

Bamikole, M.A. and Ikahtua, U.J. (2006) Supplementary value of *Terminalia catapa* fruit based concentrate to goats on *Panicum maximum* based diet Proc. 11th Ann. Conf. ASAN September 18-21, 2006 I.A.R and T Ibadan, Nigeria. Pp. 88-91

Bolhis, G.G. (1954) The toxity of cassava roots *Neth. J. Agric. Sci* 2 (3) 176-185.

Carew, B.A.R. (1983) *Gliricidia Sepium* as a sole feed for small ruminants. Tropical grassland Vol. No. 4, December 1983. Pp. 181-184.

D'Mello, J.P.F. (1992) Nutritional potentialities of fodder trees and shrubs as protein sources in monogastric nutrition. In: Legume trees and other fodder trees as protein sources for livestock. A Speedy and P Pugliese (Editors) FAO Animal Production and Health Paper 102. FAO Rome, Italy. Pg.115–127. http://www. fao.org/ DOCREP/ 003/ T0632E/ T0632E08. htm

Gatenby, R.M. (2002) Sheep Revised edition-Tropical Agricultural Series. MacMillan Publishers Ltd. Pp. 8.

Hamzat, R.A., Tiamiyu, A.K. and Raji, A.M. (2003) Effect of Dietary Inclusion of Kola pod husk on growth performance of West African Dwarf (WAD) Goats, proc. 28th Ann. Conference, NSAP, 16-20th March, 2003. IAK Ibadan, Oyo State. Pp. 271-273.

Ifut, O.J. and Inyang, U.A. (2007) Effect of brewers spent grains supplementation on the utilization of guinea grass (*Panicum maximum*) and Gliricidia (*Gliricidia sepium*) foliage by West African Dwarf Goats. In: Proc. of the 32nd Ann. Conf. of NSAP March 18-21, 2007 Calabar, Nigeria pp. 204-206.

Jensen, M. (1985) Trees Commonly Cultivated and South East Asia, Illustrated field guide, RAP Publication: 1995/38 FAO Bangkok. Thailand, Pp. 93.

Lamidi, A.A. (2004) Ruminant Estimation of Mineral Profiles of *Tephrosia bracteolata* and *Gmelina arborea* Pruning using Fistulated sheep. M. Agric. Dissertation University of Agriculture Abeokuta, Nigeria.

Lamidi, A.A., Aina, A.B.J., Sowande, S.O and Johosho, A.O. (2009) Assessment of *Panicum maximum* (Jacq), *Gliricidia sepium* (Jacq) and *Gmelina arborea* (Roxb) - based diets as all year round for West Africa Dwarf goat. Proceedings of 14th Annual conference of Animal Science Association of Nigeria (ASAN), Sept. 14th-17th LAUTECH Ogbomosho, Nigeria.

Matlebyane, M. M., Ng'ambi, J.W.W. and Aregheore, E.M. (2009)Relationships Between Chemical Composition and *in Vitro* Digestibility of Some Common Forage Species Used for Ruminant Livestock Production in Three Chief Areas of Capricorn Region, Limpopo Province, South Africa. *Research Journal of Agriculture and Biological Sciences,* 5(2): 138-149

National Research Council (1980) Mineral tolerance of domestic animals. National Academy of Sciences. NRC. Washington. D.C. USA.

Ogbonna, J.U. (1991) Studies on the value of processed Cassava peels in the nutrition of Cockerel. Ph.D. Thesis University of Ibadan, Ibadan, Nigeria.

Okoli, I.C., Anunobi, M.O., Obua, B.E. and Enemuo, V. (2003) Studies on selected browses of southeastern Nigeria with particular reference to their proximate and some endogenous anti-nutritional constituents. *Livestock Research for Rural Developmentt* 15(9). http://www. lrrd.org/ lrrd15/9/okol159.htm

Ologhobo, A.D. (1989) Minerals and Antinutritional contents of forage in Nigeria. In Wilson Trever, R. and Melaku Azeb (Eds) African Small Ruminant Res. And Derk Proc. of and of Ann. Conf. at Banada, Cameron 18-23 Jan. African small ruminant network. Pp. 219-229.

Osie, S.A., Asiamah, M. and Atuahene, C.C. (1990) Effects of fermented cassava peel meal on the performance of layers. *Anim. Feed sci. Technology 24, 295-301.*

Statistical Analysis System (1990**)** *SAS/STAT User's guide*, version 6 http://www.mekarn.org/proprf (Volume 2; Fourth Edition). Cary North Carolina, SAS Institute, Incorporated 846p

Taiwo, A., Raji, A.M., Enola, F.S., Adebowale E.A. and Afolabi, O.O. (2003) Effect of Soaking Cassava (*Manihot esculenta* crantz) Peels in Water on its Hydrogenly amid and Chemical Composition. In: A.A Taiwo, A.M Raji, J.U Ogbonna and K.E.A. Adebowale (Eds) Nigerian livestock: A Goldmine for Economic Growth and food security. Proc. Of the 28th Ann. Conf. of the NSAP, Vol. 28, 2003. I.A.R & T. Ibadan, Nigeria.

Wheeler, E.L. & Ferrel, R.E. (1971) A method for phytic acid determination in wheat and wheat fractions. *Cereal chem*. 48:312-320.