EVALUATION OF PROXIMATE COMPOSITION OF SOME PLANT SPECIES IN NORTH CENTRAL AGRO-ECOLOGICAL ZONE OF NIGERIA

Babas Indige Samuel[1] and Danbaba Goma[2]
[1]Department of Parks and Recreation, Federal Capital Development Authority
[2] Department of Environmental Management, Faculty of Environmental sciences, Bingham University, Kodape-Karu, Nigeria
Corresponding Author: danbaba.goma@binghamuni.edu.ng or danbaba.goma@gmail.com
08067045111

Abstract
This study evaluated the proximate composition potentials of thirteen (13) species of fodder crops used by livestock farmers in the North-Central Agro-ecological zone of Nigeria. Leaf samples from each of these fodder plants were harvested at the vegetative stage from mature plants around Jos, Lafia and Abuja vicinity: five (5) multi-purpose trees; (Leucaena leucocaphala, Gmelina arborea, Daniella olioverii, Mangifera indica and Acacia albida), four tropical browse crops; (Arachis hypogea, Manihot spp, Vigna spp. And Zea mays), and four grasses (Digitaria exillis, Sorghum bicolor, Panicum maximum, and Andropogon gayanus). Their proximate compositions were investigated. There was significant ($p<0.05$) difference in the proximate composition of selected browse plant foliage. The DM values range from 91.60 to 88.60% for multipurpose trees, 92.40 to 90.40% for grasses and 91.57 to 83.97% for crop residues, while Zea mays foliage (83.97%) had least overall DM content. Vigna spp haulm (14.88%) and Gmelina arborea (15.46%) recorded the highest value for crude protein (CP) with the least value (6.27%) observed in Manihot spp foliage while the highest value of 13.03% (Acacia albida) was recorded for ether extract (EE) and the low set value was 5.30%(Digitaria exillis). Ash content range from 8.67% to 11.67% and the highest value of 10.10% for non-fibre carbohydrate (NFC) was recorded in Mangifera indica. In conclusion, the high CP content observed in all the crop residues and multi-purpose trees indicates that the plants have the potential of being used as protein complement by ruminants nourished low quality grasses especially during dry season. It is therefore recommended that crop residues and multi-purpose trees foliage among the fodder crops should be used as feed supplements to feed ruminant in time of shortage of other feed resources like grasses because of its availability at this time.

Key words: Proximate composition, Plant species, North-Central, Agro-Ecological Zone

Introduction

Provision of adequate, good and quality feed to livestock to obtain an optimal performance is a major challenge all over the world. Ruminants are mostly fed on low quality roughages, which are poor in protein, energy, minerals, and vitamin contents. The ideas of improving the usage of poor-quality fibers by ruminants include supplementation with fermentable nitrogen and minerals which may perhaps by-pass the rumen (Habib et al., 1991). The importance factors in animal nourishment have been recognized. The determination of in-take and digestibility of feedstuffs *in vivo* is time-consuming, difficult and costly, needs enormous quantities of fodder and is unfitting for large-scale feedstuff appraisal.

A quantity of fodder plants can be globally obliged as alternate feeds for livestock (Khazaal et al, 1994; Ammar et al., 2004). As a consequence, animals undergoing semi-intensive and unconfined methods have been matter-of-fact feeding on them (Isah 2012; Isah et al. 2013). The site-specific studies on some sets of livestock have established that their production method is founded on free grazing of way side and bush fodders complimented with home wastes (Upton, 2003; Isah 2018). Mutual trees, shrubs and fodder species that are continuously fed by ruminants and pseudo-ruminants in diverse parts of Nigeria include *Leucaena leucocaphala,* Gmelina arborea, *Daniella olioverii, Mangifera indica, Acacia albida, Digitaria exillis, Panicum maximum, Andropogon gayanus,* Moringa oleifera, (Babayemi and Bamikole, 2006; Ogunbosoye and Babayemi, 2010; Fayemi et al., 2011). The obtainability of these forage properties has completely become a vital part of the silvo-pastoral methods of grazeable resources in the diet of range animals (Njidda and Ikhimoya, 2010). Nevertheless, there are petty information on their nutritional standards and proximate configuration. Proximate analysis is the chemical method used in the partitioning of foodstuff into various fractions: Ash, crude protein (CP), and Ether extract (EE).

The growing demands and consequently high cost of conventional animal feedstuffs in the tropics has fashioned the need for sustained substitutes, particularly natural feed properties native to the area. In Nigeria, ruminants slowly gain weight in the rainy season and rapidly loose it in the dry season, yet in the traditional animal husbandry, ruminants in the tropics especially in Nigeria, are mainly fed with grasses, so that improved livestock production is not likely attainable and sustainable by grasses forage alone (Babayemi and Bamikole, 2006). Babayemi et al., (2004) had earlier reported that the forages are unimproved and low in nutritive values during the wet seasons, while during the dry season proper, they are fibrous, lignified with low protein values and even in short in supply. Recently, Lamidi et al., (2010) agreed to this by reporting that, the available forages for most part of the year are low in protein contents, which leads to marked decrease in voluntary intake and digestibility, and subsequently leads to substantial weight loss of the animals during this period. However, the expensive nature of conventional feeding ingredients, especially as a result of competition between man and livestock (Ogunbosoye and Babayemi, 2012), makes this combination difficult. Thus, there is the need to source for locally available feedstuffs, which are less expensive and viable.

There is therefore the need for continuous screening of non-conventional browse plants to identify those with good potentials as livestock fodder which can serve as alternatives to those species that have already been evaluated. Consequently, this study is aimed at determining the proximate composition of some plant species in the North Central Agro-ecological zone of Nigeria.

Materials and Methods

The study was carried out in Teaching, Research Farm and Laboratory of Department of Animal science, Faculty of Agriculture, Nasarawa State University Keffi, Shabu-Lafia. Nasarawa state is situated at Guinea Savannah Region of North-Central Nigeria.
It lies between latitudes 8° 35' and 9° 33'N of the equator and Longitude 8° 33'

and 9° 31'E of the Greenwich meridian. The climate of Nasarawa State is largely controlled through two major air masses, the tropical maritime air mass and tropical continental air mass (Nasarawa State Government, 2001).
The vegetation of Nasarawa State falls within the Southern Guinea Savannah zone. However, clearance of vegetation for farming, fuel-wood extraction for domestic and cottage industrial uses and saw milling has led to development of re-growth vegetation at various levels of development. Dense forests are few and far apart. Such forests are found in lowland areas, particularly where population pressure of both human and animals are less on the land (Nasarawa State Government, 2001).

Leaf samples from each of the following fodder plants were harvested at the vegetative stage and mature plants around Plateau, Nasarawa State and Federal Capital Territory vicinity, which lies within the Guinea Savanna, Agro-ecological zone of North-Central Nigeria. The samples were weighed, air dried and further oven-dried at 60°C until crisp. The samples were then stored in airtight containers for two days. Thirteen (13) tropical fodder crops were investigated. They were categorized into three:

a. Four tropical crops (Vigna spp, Arachis hypogea, Manihot spp and Zea mays), collected as farm by-product, sundried, milled and stored at 30g for analysis.
b. Four tropical grasses, which include Digitaria exillis, Sorghum bicolor, Panicum maximum and Andropogon gayanus were collected at stage of maturity.
c. Five multi-purpose tree plants include Acacia albida, Gmelina arborea, Mangifera indica, Daniella olioverii and Leucaena leucocephala were collected before flowering for the season.

Laboratory Analysis
Proximate composition: The dry matter, crude protein, ether extract and Ash substances of the milled grass sample were determined according to A.O.A.C. (2000). Non-fibre carbohydrate was premeditated as NFC = 100 - (CP+Ash+EE+NDF).

RESULTS AND DISCUSSION
Proximate composition (%) of selected browse plant foliage
The proximate composition of selected browse plant foliage was significantly difference ($p<0.05$). The dry matter (DM) value ranges from (83.97%) in Zea mays to (92.40%) in Panicum maximum. Vigna spp (14.88%) and Gmelina arborea (15.46%) recorded the highest value for crude protein (CP) with the least value (6.27%) observed in Manihot spp while the highest value of 13.03% was recorded for ether extract (EE) in Acacia albida and the low set value (5.30%) in Digitaria exillis. Meanwhile, Ash content range from 8.67% in Sorghum bicolor to 11.67% in Daniella olioverii and the highest value of 10.10% for non fibre carbohydrate (NFC) was recorded in Mangifera indica (Table 1).

Table 1: Proximate composition (%) of selected browse plant foliage

Sample	DM	CP	EE	ASH	NFC
Multi-purpose Trees					
Acacia albida	88.60^{bc}	11.96^{c}	13.03^{a}	10.00^{abcd}	8.34^{ab}
Gmelina arborea	90.90^{ab}	15.46^{a}	9.67^{b}	10.33^{abcd}	7.58^{abc}
Mangifera indica	91.57^{ab}	11.67^{c}	8.57^{bc}	10.33^{abcd}	10.10^{a}
Daniella olioverii	91.60^{ab}	11.96^{c}	10.13^{b}	11.67^{a}	5.58^{cde}
Leucaena leucocephala	90.67^{ab}	13.13^{b}	6.53^{cd}	11.33^{ab}	7.68^{abc}
Grasses					
Digitaria exillis	90.40^{ab}	8.75^{e}	5.30^{d}	10.00^{abcd}	6.62^{bcde}
Sorghum bicolor	91.57^{ab}	9.04^{e}	9.47^{b}	8.67^{d}	6.16^{bcde}
Panicum maximum	92.40^{a}	8.02^{e}	10.50^{b}	9.33^{cd}	4.81^{de}
Andropogon gayanus	92.13^{a}	8.75^{e}	8.20^{bc}	9.00^{cd}	6.72^{bcde}
Tropical Crops Residues					
Vigna spp (haulm)	87.47^{c}	14.88^{a}	12.67^{a}	9.67^{bcd}	9.46^{a}
Arachis hypogea (haulm)	86.53^{cd}	12.40^{bc}	12.83^{a}	10.67^{abc}	7.44^{abcd}
Manihot spp (leaves)	91.57^{ab}	6.27^{f}	6.63^{cd}	9.67^{bcd}	8.67^{ab}
Zea mays (leaves)	83.97^{d}	10.21^{d}	9.80^{b}	10.00^{abcd}	4.66^{e}
SEM	0.45	0.43	0.42	0.18	0.32

[a, b]:Means in same column with different superscripts are significantly ($p<0.05$) different

SEM = Standard Error of Mean NFC = Non fibre carbohydrate

DM = Dry matter CP = Crude protein

EE =Ether extract

Tropical crop residues: stovers, haulms and leaves are usually fed to ruminants

Fodder crops constitute an extremely valuable source of feed for the ruminant livestock. Generally, browse and multi-purpose tree classes are better-off in CP, minerals and digestible nutrients than pastures. High difference in the nutrient content of fodder crops were also stated by Dicko and Sikena (1992). According to Solomon (2001), the high difference in the nutrient content of fodder crops may perhaps be ascribed to within species difference owing to features such as plant part, harvesting regime, season and location, and these features seem to impact chemical composition, palatability, rumen degradability, digestibility, voluntary intake and nutrient utilization by animals.

Ambient temperature, seasonal or climatic elements may be accountable for the difference in the standards gotten in this study as supported by Agriculture (2011). The high CP content of tropical crops residues and multi-purpose trees foliage species is well documented and is one of the core unique characteristics of multi-purpose trees likened to most grasses. Generally, the CP content in some crop residues and multi-purpose trees foliage has been displayed to be above the minimum level necessary (7%) for microbial actions in the rumen (Norton, 1998). Isah (2018) also posited that some crop residues and multi-purpose trees foliage are able to meet the energy requirements of livestock at preservation and often well above, and thus some crop residues and multi-purpose trees species are measured to be excellent feed, with very few exemptions. The variance in CP content amongst studied fodder crops can be explained by inherent characteristics of each plant species related to the ability to extract and accumulate nutrients from soil and/or to fix atmospheric nitrogen, which revealed in the high CP contents of farm residues from legumes plants like *Vigna spp* and *Arachis hypogea*. The other elements causing difference in the chemical composition of fodder crops include soil type (location), the plant part (leaf, stem and pod), age of leaf and season. The high value of CP recorded in all the crop residues and multi-purpose trees foliage investigated is an indication that these various plants could aid as potential protein complements to enhance the intake and utilization of low-quality grass by ruminants. The result is in consonance with the report of Getachew et al. (2004), which stated that browse forages are higher in CP than tropical grasses and roughages such as hay, straw and stover. However, the CP content of the various plants studied were all above 8% CP required to satisfy maintenance requirement of ruminant animals (Norton, 1998) and above the minimum level necessary to provide sufficient nitrogen required by rumen microorganisms to support optimum activity and for adequate intake of forages.

Conclusion

Based on the study, the high CP content was seen in all the crop residues and multi-purpose trees, which indicates that the plants have the potential of being used as feed supplement by ruminants fed low quality grasses especially during the dry season. Crop residues and multi-purpose trees foliage intake will improve digestibility of low-quality fodders and lead to an overall increase in intake of overall digestible dry matter.

From the result of the findings of this study, it is therefore recommended that crop residues and multi-purpose trees foliage among the fodder crops should be used as feed supplements to feed ruminant in time of shortages and dry season of other feed resources like grasses because of its availability at this time.

References

A.O.A.C. (2000).Official Methods of Analysis 15th edition. Association of Official Analytical Chemists, Washington D.C. 40-50, 237-238

Agriculture (2011).Potatoes: Factors Affecting Dry Matter .Department of Primary Industries, Victoria, Australia.

Ammar H, Lopez S, Gonzalez, J.S. and Ranilla MJ (2004).Chemical Composition and In-vitro Digestibility of some Spanish Browse Plant Species. Journal Science Food Agriculture 84:197–204.

Babayemi, O. J., Demeyerand, D. and Fievez, V. (2004)."Nutritive Value and Qualitative Assessment of Secondary Compounds in Seeds of Eight Tropical Browse, Shrub and Pulse Legumes".Comm. Applied. Biological Science. 69:103-110.

Babayemi, O.J. and Bamikole, M. (2006). Supplementary Value of Tephrosia bracteolata, Tephrosia Candida, Leucaena leucocephala and Gliricidia sepium hay for West African Dwarf Goats Kept on Range. Journal Cent. Euro. Agric., 7(2): 323 - 328.

Dicko, M. S. and Sikena, L. K. (1992).Feeding Behavior, Quantitative and Qualitative Intake of Browse by Domestic Ruminants. In: Speedy, A. and P.L. Pugliese (eds). Legume Tree and Other Fodder Trees as Protein Sources for Livestock. FAO Animal Production and Health Journal. 102: 129-144.

Fayemi, P.O., Onwuka, C.F.I., Isah, O.A., Jegede, A.V., Arigbede, O.M and Muchenje, V. (2011).Effects of Mimosine and Tannin Toxicity on Rabbits Fed Processed Leucaena leucocephala (Lam) De Wit. Leaves. African Journal Agriculture Research, 6(17): 4081-4085.

Getachew, G., De-Peters, E. and Robinson, P.H. (2004). "In-vitro Gas Production Provides Effective Methods for Assessing Ruminant Feeds". California Agriculture Journal. 58(1):54-58

Habib, G., Basit, A.S.S., Wahidullah, J. and Ghufranullah, G. (1991). The Importance of Ureamolasses Blocks and Bypass Protein in Animal Production: The Situation in Pakistan, Proc. Symp. Isotope and Related Technology in Animal Production and Health. Vienna, Austria (1991) 133–144.

Isah, O.A. (2012). Nutritional Characteristics of Four Browse Plants Consumed by Free-ranging Ruminants in Western Part of Nigeria. African Journal of Agricultural Research Vol 7 (12), pp 1944-1949.

Isah, O. A., Omorogiuwa, L. E. and Okunade, S. A. (2013).Chemical Evaluation of Some Browse Plants Eaten by Local Breeds of Goats in Edo State, Nigeria.The Specific Journalof Science and Technology 14(1) 406-412

Isah, O. A. (2018). Oral Communication in the Department of Animal Science, Faculty of Agriculture Nasarawa State University Shabu-lafia Campus.

Khazaal, K.A., Boza, J. and Orskov, E.R. (1994). Assessment of Phenolics-related Antinutritive Effects in Mediterranean Browse: A Comparison between the Use of the In-vitro Gas Production Technique with or Without Insoluble Polyvinylpolypyrrolidone or Nylon Bag. Journal Animal Feed Science Technology 49: 133-149.

Lamidi, A.A., Aina, A.B.J and Sowande, S.O. (2010). Nutrient Digestibility and Nitrogen Balance in West African Dwarf Goats Fed Blended Diets for Dry Season. Proc. 35th Conf. Nig. Soc. Anim. Prod. Held 14th – 17th March, 2010 at the Univ. of Ibadan, Nigeria. Pp.499 – 501.

Nasarawa State Government (2001).Nasarawa State Government Official. Gazette Ministry of Information Lafia. 23-34

Njidda AA, Ikhimoya I (2010). Correlation between Chemical Composition and In-vitro Dry Matter Digestibility of Leaves of Semi-arid Browses of North-Eastern Nigeria. American-Eurasian Journal Agriculture Environment Science 992: 169-175.

Norton, B. W. (1998). "The Nutritive Value of Tree Legumes", In: Gutteridge, R.C., Shelton, H.M. (Eds.), Forage Trees Legumes in Tropical Agriculture. Tropical Grasslands Society of Australia Inc., St Lucia Queen land.

Ogunbosoye, D. O. and Babayemi, O.J. (2010).Potential Values of Some Non-leguminous Browse Plants as Dry Season Feed for Ruminants in Nigeria. African Journal of Biotechnology, 9 (18): 2720-2726.

Ogunbosoye, D. O. and Babayemi, O.J. (2012).The Utilization of Some Tropical Browse Plants by Pregnant West African Dwarf Goats in Southern Nigeria. International Journal of Environmental Science 1(4) 224-229

Solomon, M. (2001).Evaluation of Selected Multipurpose Trees as Feed Supplements in Teff (Eragrotis tef) Straw Based Feeding of Menz Sheep. PhD Thesis, Berlin, Germany.

Upton, M. (2003).Returns from Small Ruminant Production in South West Nigeria. Agricultural System, 17 (2): 65-83.