Nigerian J. Anim. Sci. 2017 (2):209 - 215

Evaluation of Nutrient Contents of *Gmelina arborea* leaves as Animal Feed in the Tropics

[1]Abiola-Olagunju, O., [2]Akinwande, V.O., [*2]Mako, A.A.,[3]Mosuro, A.O. and [2]Ayanwale, H.B

[1]Department of Microbiology, Lead City University, Ibadan
[2]Department of Agricultural Science, Tai Solarin University of Education, Ijagun. Ijebu-Ode
[3]Department of Animal Science, University of Ibadan,

[*]**Corresponding author:** jokemako2006@gmail.com

Target audience: ruminant farmers, feed millers, nutritionist, extension officers

Abstract

An evaluation of chemical and mineral composition different forms of Gmelina arborea (GA) leaves was investigated. Experiment 1 involve the determination of the chemical composition, mineral and anti-nutrient of green, yellow and brown leaves of GA. In experiment 2, a free choice intake study was carried out using fifteen adult West African Dwarf Sheep to determine the coefficient of preference (CoP) of the different leaves.Results revealed that the chemical composition of the leaves varied significantly (p.<0.05). The dry matter ranged from 80.15-91.24 % in green and brown leaves respectively, while the crude protein ranged from 24.4-26.44 % in brown and green leaves respectively. The neutral detergent fibre ranged from 60.92-6.77 % in green and brown leaves respectively. Value of all minerals analyzed did not differ significantly, but was within the tolerable limit for sheep consumption. Similar trend was observed for all anti-nutrients investigated. The CoP showed that all the different forms of leaves were accepted, but the green leaves were mostly preferred. These result showed that the different forms of Gmelina arborea leaves can be used as feed supplement for ruminants in the Tropics.

Key words: Acceptability, *Gmelina arborea*, leaves, minerals, nutrients, secondary metabolites

Description of the Problem

The attainment of sustainable livestock production largely depends on the availability, quality and quantity of feed. Seasonal fluctuations and scarcity of forage in Nigeria is the major factor limiting the productivity of ruminants as animals rapidly loss weight gained during the lush season which may lead to death, thus resulting in a great economic loss to farmers (1). Various efforts are being made by researchers in resolving these adverse effects. *Gmelina arborea* is a cheap non-conventional feed resource for ruminants in Nigeria. It is a fast growing deciduous Multi-Purpose plant of high nutritive value reaching up to 40 m tall and 140 cm in diameter and grows in climates with mean annual rainfall temperatures of 21-28^{0}C (2). The

leaves are very high in protein and it a suitable source of energy (3). The leaves are available all year round ensuring availability of feed to animals du ring the dry season (4). The objective of this study is to evaluate the chemical and mineral composition present in three different forms of *Gmelina arborea* leaves as feed supplements for ruminants.

Material and methods

Collection of samples

Green and yellow leaves are plucked from pear tree while the brown leaves were picked from the floor around the root of the plant. Reasonable numbers of each leaf type were collected and taken to the laboratory for analysis.

Chemical and mineral analysis

Crude protein (CP), crude fibre (CF), ether extract (EE) and total ash of samples were analyzed in triplicates using standard procedure of (5). The crude protein was determined with the micro kjeldahl distillation apparatus, while the Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) were determined by (6).

Analysis of minerals

Plant parts were digested with HNO_3 / $HCIO_3$ mixtures (nitric acid and perchloric acid) (20:5 v/v). The digest was made up to 100 ml in standard volumetric flask with deionzed water. Ca, Na, K, Fe, Cu, Mn, Zn, Mg and Pb in the digest were determined with the atomic absorption spectrophotometer model 420. (Gallenkemp and Co. Ltd). Phosphorus in the digest was estimated with vanadomolybdate solution. The colour so developed was read with spectrophotometer at 420 m/u.

Quantitative determination of tannin, saponin, oxalate and phytate

Tannin contents were determined as described (7). The Spectrophotometric method (8) was used for saponin analysis. While Oxalate and Phytate contents were determined as described (9) and (10) respectively.

Acceptability study

The acceptability study was carried out at the sheep and goat unit of the Department of Agricultural Science, Tai Solarin University of Education, Ijagun. Ijebu-Ode. Ogun State. Three different forms of *Gmelina arborea* leaves namely: green, yellow and brown leaves were used for the study. Fifteen adult West African Dwarf Sheep housed in group pen were used in the cafeteria feed preference study that lasted for two weeks, including one week of adaptation. The green and yellow leaves were harvested fresh each day, while the brown leaves were picked from the fallen ones around the base of *Gmelina arborea* trees, 4 kg each of the leaves were introduced on cafeteria basis to the animals in three different containers. The positioning of the leaves was changed daily to prevent bias by the animals taking a particular part of the pen as the position for a particular form of leaf. The amount consumed was monitored for eight hours daily and the quantity consumed for each form of leaf was recorded. The animals were then released for grazing. Feed preference was determined from coefficient of preference (CoP) value calculated from the ratio between the intakes of each individual feed sample

divided by the average intake of three feed samples (11). On this basis, a feed was taken to be relatively preferred if the CoP value is greater than unity

$$CoP = \frac{\text{intake of individual forage offered}}{\text{mean intake of all the forage offered}}$$

Statistical analysis

Data obtained were analyzed and subjected to analysis of variance procedure (ANOVA) of SAS (12). Significant means were separated by Duncan's Multiple Range Test of the same package.

Table 1: Chemical composition (%) of different forms of *Gmelina arborea* leaves

Parameters	Different forms of *Gmelina arborea* leaves			SEM
	Green	Yellow	Brown	
Dry matter (DM)	80.15^{c}	88.01^{b}	91.24^{a}	0.42
Crude Protein (CP)	26.44^{b}	25.63^{b}	24.84^{c}	0.20
EE	4.00^{c}	4.09^{b}	4.71^{a}	0.02
Ash	14.92^{c}	15.34^{b}	17.26^{a}	0.12
NDF	60.92^{c}	16.87^{b}	63.77^{a}	0.35
ADF	18.79^{c}	40.81^{b}	42.10^{a}	0.20

Table 1 shows the chemical composition of green, yellow and brown leaves of *Gmelina arborea*. All parameters analyzed differed significantly ($p<0.05$). The dry matter content of these leaves ranged from 80.15-91.24 % in green and brown leaves respectively. This result is in agreement with (13) reported 96.20% for Persea Americana leaf and *Gmelina arborea* leaf (88.18 %) (14). The CP ranged from 26.44- 24.84 % in green and brown leaves respectively. The value of CP obtained is higher than 11.59 % reported by (15) for *Gmeliana arborea* and some conventional forages elsewhere (16). However it is in agreement with the findings of (17) who reported CP range of 10-37% for most tropical forage and browse plants. The CP content of this plant is higher than the recommended 8% value for normal functioning of rumen micro organisms (6) and higher than the range of 11.0 – 13.05% known to be capable of supplying adequate protein for maintenance and moderate growth goats (18). Browse plants have been reported to have high CP of high digestibility, and are also high in vitamins and minerals (19). The NDF also varied from 60.92-63.77% in green and brown leaves. These values are within the recommend limit of 60.00% guaranteed for forage intake by ruminants (20).

Table 2: Macro and micro mineral content of *Gmelinaarborea* leaves

Leaves	Macro minerals (%)					Micro minerals (Mg/kg)				
	Ca	P	K	Na	Mg	Fe	Zn	Cu	Mn	Pb
Green	0.85	0.52	1.65	0.52	0.78	423.2	52.5	11.3	85.3	21.2
Yellow	0.87	0.55	1.70	0.53	0.79	428.5	54.3	11.5	87.4	22.5
Brown	0.93	0.62	1.75	0.61	0.86	526.1	61.3	12.8	89.6	25.4
SEM	0.29	0.12	0.13	0.30	0.29	10.9	2.3	0.7	9.3	0.5

Table 2 shows the mineral composition of the different leaves of *Gmelina arborea*. There was no significant variation among the different leaves for all minerals analyzed. However, the values of all the minerals analyzed were within the range recommended for grazing livestock (18) Browse plants are high are in vitamins and minerals (21). This is an indication that the leaves will supply the mineral requirement of animals.

Table 3: Secondary Metabolites (%) content of *Gmelina arborea* leaves

	Different forms of G*melina arborea* leaves			
Parameters	Green	Yellow	Brown	SEM
Tannin	0.50	0.39	0.44	0.42
Oxalate	0.537	0.472	0.51	0.45
Saponin	1.202	1.067	1.187	0.42
Phytate	0.848	0.919	0.826	0.44

SEM= Standard Error of mean

Table 3, shows the anti-nutrient contents of different leaves of *Gmelina arborea*. All the different leaves were implicated for all the anti-nutrients investigated. No significant variation occurred among the different leaves. The level of tannin, oxalate, saponin and phytate ranged from 0.39-0.50; 0.472-0.537; 1.067-1.202 and 0.826-0.919% respectively. All anti-nutrients investigated are below lethal level, there by safe for sheep consumption (22). Tannins are plant that have the ability to form complexes with metal ions and with macro-molecules such as proteins and polysaccharides in the rumen and remain indigestible due to high pH and invariably dissociates in the abomasums at a lower pH for proper digestion (23). Saponin will suppress methanogenesis which is major energy loss (24). Oxalate can form complexes with most essential trace elements, thereby making them unavailable for enzymatic activities and other metabolic processes (25). Phytic acid inhibit the absorption and utilzation of some mineral elements (25).

Table 4: Mean of daily intake of green, yellow and brown leaves of *Gmelina arborea* and the coefficient of preference by WAD sheep

Parameters	Green	Yellow	Brown
Mean daily intake by all fifteen animals (kg/DM)	4.23±0.43	3.26±0.35	3.40±0.30
Coefficient of preference	2.05±0.25	1.82±0.17	1.89±0.10
Ranking	1st	3rd	2nd

Presented in Table 4, is the Coefficient of preference (CoP) for different leaves of *Gmelina arborea*. The mean daily intake ranged from 1.82 to 2.05 kg/DM in yellow to green leaves respectively, same trend was observed in the value of CoP. Intake of green fodders is affected by plant species, stage of maturity and level of phytochemical present in the forage (26). The CoP was used to rank the different leaves of *Gmelina arborea* in order of preference: green > brown > yellow. This result is in agreement with preference study on *Gmelina arborea*

elsewhere (27).

Conclusion

The different forms of *Gmelina arborea* leaves investigated showed that the plant has potentials to meet ruminant nutrient requirements in the tropics. The plant would be a cheaper alternative feed supplement to ruminants especially during the dry season.

References

1. Babayemi, O.J., M.A. Bamikole, I.O. Daniel, A. Ogungbesan and B.O. Oduguwa, (2003). Growth and dry matter degradability of three Tephrosia species. *Nigerian Journal of Animal Production.* Volume 30, No. 1: pp. 62–70.
2. Jensen, M. (1995). Trees commonly cultivated in South East Asia: An illustrated field guide: FAO Regional office for Asia and Pacific (RAP), Bangkok, Thailand.
3. Amata, I. A and Lebari, T. (2011). Comparative evaluation ofthe nutrient profile of four slected browse plants in the tropics, recommended for use as non-conventional livestock feeding materials. African Journal of Biotechnology. Vol. 10. No. 64: 14230-14233
4. Amata, I. A. (2014). The use of non-conventional feed resources (ncfr) for livestock feeding in the tropics: a review. *Journal of Global Biosciences.* Vol. 3. No. 2: 604-614
5. AOAC 2012. Official methods of Analysis, 19th ed.(Association of Officials Analytical
6. Van Soest, P. J. (1994). Nutritional Ecology of Ruminants, 2nd edn. Cornell University Press,
7. Swain, T. (1979). Tannins and Lignins. In: Rosenthal, G. A and Janzen, H. D (eds) Herbivores: their interaction with plant metabolites. Academy press. New York
8. Brunner, J. H. (1984). Direct Spectrophotometer determination of saponin,. Analytical Chemistry. 43: 1314 - 1326
9. Oke, C. L (1969). Oxalic acid in plants and in nutrition. World Review of nutritional and Dietetics, New York
10. Maga (1983). Phytate: It's Chemistry: Occurrence, Food Interactions, Nutritional Significance and Method of Analysis.
11. Mako, A. A. (2009). Evaluation of water hyacinth (*Eichhornia crassipes* Mart. Solms – Laubach) as a potential feed for the West African Dwarf goats. PhD Thesis. University of Ibadan.
12. SAS (2012). Statistical Analytical Systems. SAS Version 9.2 user's guide. Carry, NY: SAS Institute.
13. Arikwe, U., Amadi, B. A., DURU,.M.K.C., Agomo, E.N., Adindu, E.A., Odika, P.C., Lele, K.C., Egejuru, L and Anudike, J. (2012). Chemical composition of *Persea Americana* leaf, fruit and seed. *International Journal of Research and Reviews on Applied Science*. Vol 2: 346-349
14. Okpara, O. and Akporhuarho, P. O.

(2017). Growth performance of West African Dwarf goats fed boiled, dried *Gmelina arborea* and sundried *Moringa oleifera* leaves. Proceeding of the 42nd Annual Conference of the Nigerian Society of Animal Production, held at Landmark University, Omu-Aran. Kwara State between 26th-30th March. Pp 421- 424

15. Falola, O. O. (2016). *In vitro* fermentation and preference of some browse plants by West African Dwarf goats. *African Journal of Agriculture, Technology and Environment.* 5 (1): 1-9
16. Ajayi, D. A., Adeneye, J. A. and Ajayi, F. T. (2005). Intake and Nutrient utilization of West Dwarf goats fed mango (*Mangifera indica)*, Ficus (*ficus thorningii*) Gliricidia (*Gliricidia sepum*) Foliages and Guinea grass (*Panicum maximum*) *World Journal of Agricultural Science.* 1(2): 184-189
17. Bamikole, M. A., Babayemi, O. J., Arigbede, O. M. and Ikhatua, U. J. (2003).Nutritive value of *Ficus religiosa*in West African Dwarf goats.*Journal of Animal Feed Science and Technology*. 105: 71 – 79. NRC (2002). Nutrient requirements for dairy cattle seventh revised edition. National Research Council. National Academy of Science press. Washington DC, US
18. NRC (2002). Nutrient requirements for dairy cattle seventh revised edition. National Research Council, National Academy of Science press. Washington DC, USA
19. Odeyinka, S. M. (2001). Effect of feeding varying levels of *Leucaena leucocephala* and *Gliricidia sepium* on intake and digestibility of West African Dwarf goats. *Nigerian Journal of Animal Production.* 28 (1): 61-65
20. Meissner, H. H., Viljoen, M. O., Van Niekerk, W. A. (1991). Intake and digestibility by sheep of Antephora, Panicum, Rodes and Smuts finger grass pastures In: Proceedings of the IVth international Rangeland Congress, September 1991. Monttpellier, France. 648-649.
21. Asaolu, V. O., Binuomote, R.T., Akinlade, J. A., Oyelami, O. S. and Kolapo, K. O. (2011). Utilization of Mpringa oleifera fodder combinations with *Leucaena leucocephala* and *Gliricidia sepium* fodder by West African Dwarf goats. *International Journal of Agricultural Research.* 6 (8): 607-619
22. Teferedgene, B. 2000. New perspectives in the use of tropical plants to improve ruminant nutrition. Proc. Nutr. Soc, 59, 209-214
23. Barry, T. N. and McNabb, W. C. (1999). The implication of condensed tannins on the nutrition value of temperature forages fed to ruminant. *Br. J. Nutri.* 18: 263-272.
24. Hess, H. D., Monslave, L. M.,

Lascano, C. E., Carcilla, J. E. Diaz, T. E.. Kreuzer, M. (2003a). Supplementation of tropical grass diet with forage legumes and sapindus sponaria fruits; effect on in vitro ruminal nitrogen turn over and methanogenesis. *Australian Journal of Agricultural Research.* 54 : 703-713

25. Eneobong, H. N. (2001). Eating Right (A Nutrition Guide). Zoometer print communications Ltd. Nigeria

26. Kalio, G.A., Oji, U. I. and Larbi, A. (2006). Preference and palatability of indigenous and exotic acid soli tolerance multipurpose trees and shrubs by West African Dwarf sheep *Agrofor. Syst.* 67: 123-128

27. Omokanye, A. T., Lamidi, O. S. and Oyeleke, L. S. (2014). Gmelina arborea at Shika, Nigeria Indices, Preference and Intake of Plant Parts by Yankasa Sheep. International *Journal of Research in Agriculture and Forestry* 1 (2): 31-36