CHEMICAL COMPOSITION AND THE COEFFICIENT OF PREFERENCE BY RABBITS OF TROPICAL FORAGES

O. A. ABU* AND LYDIA S. TURNER
Agricultural Biochemistry and Nutrition Unit
Department of Animal Science, University of Ibadan, Ibadan, Nigeria
**Correspondence: ohiahmed@yahoo.com*

ABSTRACT
The suitability and chemical composition of seven forages (*M. oleifera, F. thonningii, L. leucocephala, E. cyclocarpum, G. sepium, A. saman* and *A. indica)* as feed resources for feeding domestic rabbits during the dry season was studied. The acceptability was determined by cafeteria method using five adult rabbits weighing 700-750g. The acceptability of the forages was best in *M. oleifera* followed by *F. thoninngii. G. sepium, L. leucocephala* and *E. cyclocarpum* had similar acceptability while *A. indica* and *A. Saman* had low acceptability. The order of acceptability was: *M. oleifera, F. thonningii, L. leucocephala, E. cyclocarpum, G. sepium, A. indica, and A. saman.* The chemical analysis of the five most acceptable forages showed that *F. thoninngii* had the least CP of 10.3% compared to the others forages that had CP ranging from 24 -30%. *M. oleifera* also had the least CF of 9.0% compared to the other forages CF which range 14 -19% *F. thonningii* and *L. leucocephala* also had low EE of 6.0 and 8.0 % respectively. The ADF and NDF fractions of the five most acceptable forages were in the same range. In conclusion all the five most acceptable forages namely: *M. oleifera, F. thonningii, L .leucocephala, E. cyclocarpum, G. sepium* are possible feed resources suitable for feeding rabbits especially during the dry season.
Key words: crop-livestock system, tropical forage, feed preference, wet and dry seasons

INTRODUCTION
Forages are coarse livestock feeds that are composed of leaves, stem and sometimes grains (Adeloye, 1994). Leguminous forages are cherished for their high protein content which is usually the most deficient component of animal diet. Some non leguminous forage such as neem leaves have also been tried for feeding non ruminants (Sokunbi and Egbunike, 2000) and ruminants (Adjorlolo *et al.*, 2016). The high cost of protein concentrates has made farmer to shift attention to non-conventional protein sources with emphasis on forage legumes as possible alternatives for feeding rabbits. Forages are often available in both dry and wet seasons and can also be preserved as leaf meals, hays or silages. Forages rank amongst the high value crop in many countries and contribute to sustainability of crop-livestock systems (Odedire and Babayemi, 2007). The domestic rabbit however possesses an enlarge caecum, inhabited by useful bacteria, which enables the caecum function like the rumen in the ruminant. Rabbit production has been reported to play an important role in livelihood of resource-poor households (Lukefahr, 2007). Forages are cheap and can be available during the wet season but not always in the dry season. This study was therefore conducted to determine proximate composition and crude fibre fractions and coefficient of preference of seven selected dry season tree forages by rabbits

MATERIALS AND METHODS
A pre-experiment was carried out acceptability of seven (7) selected forages by rabbits. These forages were selected because they survive both wet and dry seasons. The forages included; *Leucaena leucocephala, Moringa oleifera, Albizia saman, Gliricidia sepium, Azadirachta indica, Enterolobium cyclocarpum* and *Ficus thonningii*. The acceptability study was carried out in the Small Animal Room, Department of Animal Science for a period of 5 days. The aim of the test was to determine the four most acceptable forages. Five Chinchilla male rabbits weighing 750.27g ± 80g were fed concentrate diets for an initial two days of arrival then the selected fresh forages were introduced gradually until the concentrates was totally withdrawn. The forages were harvested and wilted overnight then offered to the rabbits by randomly placing them

in a cafeteria feeding system allowing all the rabbits equal access to all 7 forages (replicated thrice) at the same time. The rabbits were also given water *ad-libitum*.

Co-efficient of preference

The forage preference was determined from the co-efficient of preference (COP) value, calculated from the ratio between the intakes of individual forages, divided by the average intake of the seven forages (Karbo *et al.*, 1993).On this basis, forage was chosen as a potential candidate if the value of COP was greater than unity that is 1.00.

Chemical analysis of selected forages

The five most acceptable forages among the seven selected forages were analyzed for their chemical compositions. The proximate composition was determined by AOAC (1995). The ADF and NDF were determined by the method of Van Soest *et al.* (1991).

RESULTS AND DISCUSSION

Feed Intake

M. oleifera had the highest average feed intake of 70.75% followed by *F. thonningii* with 54%, *L. leucocephala* (41.7%), *E. cyclocarpum* (40.5%), *G. sepium* (35.0%) and *A. indica* (34.7%). *A. saman* had the lowest average feed intake of 25.68%. Results are presented in Table 1.

Co-efficient of preference

Results of the coefficient of preference (COP) and preference ranking are presented in Table 2.The COP of showed that *M. oleifera* had the highest acceptability with a COP of 1.51 and this was followed by F. thonningii (1.32), *G. sepium* (1.00), *L. leucocephala* (1.00), *E. cyclocarpum* (1.00), *A. indica* (0.75) and *A. saman* (0.63) having the lowest value meaning that they were not acceptable has COP value is 1.0. The leaves of *M. oleifera* are known to be highly nutritious, and a rich source of some vitamins and minerals, this could be responsible for the higher intake compared with the other forages. *G. sepium* and *L. leucocephala* have been documented to contain growth inhibiting factors (Raharjo *et al.*, 1987), but this could be minimized by wilting before feeding the animals as was the case in this study. Lowry (1990) also reported that *G. sepium* acceptability and palatability is also affected by the smell of the leaves which is as a result of the volatile compounds released from leaf surface which makes the animals reject the leaves without tasting it, but this can also be solved by wilting for 12-24 hours before giving the animals (Hawkins *et al.*, 1990). *A. indica* acceptability was also low compared to *M. oleifera, F. thonningii, L. leucocephala* and *E. cyclocarpum* this could be due to the bitter taste of neem leaves as was also observed by Sokunbi and Egbunike (2002) and Adjorlolo et al 2016 who reported that neem leaves contain some bioactive anti-nutritive compounds. The reduced intake of leaves of *A. saman* could be a result of the non-succulent nature of the leaves. On the first two days of the acceptability trial, it was observed that the urine of the rabbits turned reddish brown. This could be as a result of the anti-nutritional factors present in *L. leucocephala* and *G. sepium* (mimosine and tannins respectively. Onwudike (1995) reported that rabbits fed leucaena leaves produced objectionable reddish brown urine may be a limiting factor in its acceptance as forage for rabbits.

Chemical analysis and Crude Fiber fractions

The chemical analysis (Table 3) showed that *F. thonningii* had the highest dry matter (31.4) compared to *L. leucocephala* (28.5), *E. cyclocarpum* (27.6) and *M. oleifera* (26.6) while *G. sepium* had the lowest dry matter (17.09) which is significantly different to what was obtained by Devendra and Mcleroy (1982).The low dry matter content of *M .oleifera* is an indication that it has a high moisture content hence a larger volume would be needed to feed the Animal to meet up with it dry matter requirement of the animal. *F. thonningii* had the lowest crude protein (10.3%) which cannot meet up to the protein requirement of rabbits which falls between the range of 12-16 % depending on the stage of production .*L. leucocephala* had the highest crude protein of 29.8% followed by *E. cyclocarpum, G. sepium* (28.7%) and *M. oleifera* (24.5%).This shows that they can be used as supplement to replace grain legumes such as soyabean and groundnut in concentrate feeds or in low quality diets since they have crude proteins that are comparable to this legume seeds. The chemical analysis showed that *L. leucocephala, G. sepium, E. cyclocarpum and F. thonningii* had a crude fiber range of between 14 – 19% which is acceptable has crude fiber requirement for the rabbit falls between 12-16 % has reported by Lebas (1979). *M. oleifera* on the

other hand had the lowest crude fiber (9.0%) which means it would be a nearly good fibre supplements and rabbit require a crude fiber supplement of between 12-14% for proper movement of their gastro-intestinal tract because they practice coprophagy. However, the high level of ADF in *Moringa oleifera* as in other forages may be indicative that its possible low fibre effect on rabbits may be ameliorated. *M. oleifera* had the highest ether extract value of 23%; though it is low in crude fiber it would still server as a good source of protein and energy has ether extract represent the fat content which is a source of energy.

Foidl *et al.* (2001) also reported that the high ether extract in *M. oleifera* is associated with the rich source of carotene and pigment. *E. cyclocarpum* and *G. sepium* had ether extract values of 17 and 14% respectively while *L. leucocephala* and *F. thonningii* had the lowest values at 8 and 6%. The results also showed that *F. thonningii* had the highest NFE (53.72) this could be responsible for the low crude protein content and the leaves may have sugar fraction stored in them due to the hard nature of the leaves. *L. leucocephala* had NFE of 39.38%, *M. oleifera* 34.50%, *G. sepium* 30.09% and *E. cyclocarpum* had the lowest NFE 18.34%. All the five selected forages had high ADF and NDF values indicative of high content of cell wall and lignin which is typical of tropical forages (Van Soest *et al.*, 1991). The chemical composition of forages obtained in this study were somewhat varied from some values reported in literature and variation may be due to factors such as climatic condition under which forage plants were grown, plant age as well as both soil type and fertility as reported by Ayssiwede *et al.* (2010).

CONCLUSION

All the forages are available all the year round and also have appreciable levels of nutrients particularly protein and fiber, although *F. thonningii* had a low protein and *M. oleifera* had a low fiber. The assessment of the acceptability and nutritive characteristics of five selected dry season forages: *M. oleifera, F. thonningii, E. cyclocarpum, L. leucocephala* and *G. sepium* are recommended for rabbit feeding. The forages studied have potential and could still be used as feed supplements but extended feeding trials are important for conclusive deductions about the comparative nutritive values of these selected forages.

REFERENCES

Adeloye A. A. 1994 Preliminary investigations of *Parkia filicoidea* and *Tephrosia bracteolata* leaf meals in the diet of goat. *Nigeria Journal of Animal Production* 21: 105 - 107.

Adjorlolo L. K., Timpong-Jones E. C., Boadu S. and Adogla-Bessa T. 2016: Potential contribution of neem (*Azadirachta indica*) leaves to dry season feeding of ruminants in West Africa. *Livestock Research for Rural Development. Volume 28, Article #75.* Retrieved May 26, 2016, from http://www.lrrd.org/lrrd28/5/adjo28075.htm

AOAC 1995 Association of Official Analytical Chemists (1995): Official method of analysis 16th edition, Washington DC.

Ayssiwede S. B., Dieng A., Chrysostome C., Ossebi W., Hornick J. L., Missohou A. 2010: Digestibility and metabolic utilization and nutritional value of *Leucaena leucocephala* (Lam.) leaves meal incorporated in the diets of indigenous Senegal chickens. *International Journal Poultry Science*, 9:767–776.

Devendra C. and Mcleroy G. B. 1982: Goat and Sheep Production in the Tropics. Longman, Harlow, Essex, UK.

Foidl N., Makkar, H. P. S. and Becker, K. 2001: The potentials of *M. oleifera* for agricultural and industrial uses .In: "The miracle Tree-the multiple attributes of *Moringa*

Karbo N., Barnes, P. and Rudat, H. 1993: An evaluation of browse forages preferences by sheep and goats in Northern Guinea Savannah Zone Ghana. In: J. Ndikumana and P.de Leeuw (ed).Proceedings of the 2nd African Feed Resource Network(AFRNET) on sustainable Feed Production and Utilization for Smallholder Livestock Enterprise in Sub-Saharan Africa, Harare, Zimbabwe, 107-110.

Lebas, F. C., Couder, P. , Roweler, R., Rochambeal, H. 1986: The rabbit husbandry, health and production. FAO. 235 pp.

Lowry J. B. 1990: Toxic factors and problems: methods of alleviating them in animals. In: *Shrubs and Tree Fodders for Farm Animals.* C. Devendra (ed.) IDRC, Canada pp.76–88.

Lukefahr S. D. 2007: Strategies for the development of small- and medium-scale rabbit farming

in South-East Asia. *Livestock Research for Rural Development. Volume 19, Article #138.* Retrieved November 22, 2015, from http://www.lrrd.org/lrrd19/9/luke19138.htm

Odedire J. A. and Babayemi O. J. 2007: Preliminary study on *Tephrosia candida* as forage alternative to *Leucaena leucocephala* for ruminant nutrition in Southwest Nigeria. *Livestock Research for Rural Development. Volume 19, Article #128.* Retrieved November 22, 2015, from http://www.lrrd.org/lrrd19/9/oded19128.htm

Onwudike O. C. 1995: Use of the legume tree crops *Gliricidia sepium* and *Leucaena leucocephala* as green feeds for growing rabbits. *Animal Feed Science Technology*, 51 (1-2)

Raharjo Y. C., Cheeke, P. R., Arscott, G. H., Burke, J. M. and Glove N. 1987. Performance of broiler chicks feed *Gliricidia* leaf meal. Nitrogen Fixing Tree Research Report 5, pp. 44-45.

Sokunbi A. O. and Egbunike G. N. 2000: Physiological response of growing rabbits to neem (*Azadirachta indica*) leaf based diets: Hematology and serum biochemistry. *Tropical Animal Production Investigations.* Vol. 3: 81-87.

Van Soest P. J., Robertson J. B., Lewis B. A. 1991: Methods for dietary fiber, neutral detergent fiber and non starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science*, 74, 3583–3597

Table 1. Intake of selected forages by rabbits (g, DM)

Days	LL	MO	AS	GS	AI	EC	FT
1	53.3	57.5	25.0	37.5	22.5	25.0	37.5
2	12.5	31.25	12.5	37.5	56.25	62.5	37.5
3	25.00	75.00	25.3	25.0	25.01	25.0	25.0
4	87.51	90.00	30.29	39.9	29.60	35.0	65.0
5	30.00	100	35.34	34.9	39.99	55.0	80.0
Total	**208.**	**354**	**128.**	**175.**	**173.**	**201**	**270.**
Mean	41.7^{c}	70.8^{a}	25.7^{d}	35.0^{c}	34.7^{c}	40.5^{c}	54^{b}

LL= *Leucaena leucocephala*, MO= *Moringa oleifera*, AS= *Albizia saman*, GS= *Gliricidia sepium*, AI= *Azadirachta indica*, EC= *Enterolobium cyclocarpum*, FT= *Ficus thonningii*

Table 2. Mean coefficient of preference and preference ranking of the five selected forages

FORAGES	COP	PR
M. oleifera	1.51	1
F. thonningii	1.32	2
G. sepium	1.00	3
L. leucocephala	1.00	4
E. cyclocarpum	1.00	5
A. indica	0.75	6
A. saman	0.63	7

Table 3. Chemical composition (%) of selected forages

Forage	% DM	% CP	% CF	% EE	% ASH	% NFE	ADF	NDF
LL	28.5	29.8	14.0	8.0	9.1	39.3	39.4	55.8
MO	26.6	24.5	9.0	23.0	9.2	34.5	34.4	56.3
GS	17.1	26.9	18.0	14.0	11.0	30.1	36.3	57.3
EC	27.6	28.7	19.0	17.0	23.0	18.3	31.9	53.9
FT	31.4	10.3	19.0	6.0	11.0	53.7	34.3	55.9

LL- *Leucaena leucocephala*, **MO-** *Moringa oleifera*, **GS-** *Gliricidia sepium*, **EC-** *Enterolobium cyclocarpum*, **FT-** *Ficus thonningii*