

Chemical composition of tropical forages and their acceptability by the domestic rabbit (*Oryctolagus cuniculus*)

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Abstract *Corresponding author's E-mail address: ohiahmed@yahoo.com

The suitability of seven forages (*Moringa oleifera*, *Ficus thonningii*, *Leucaena leucocephala*, *Enterolobium cyclocarpum*, *G. Gliricidia sepium*, *Albizia saman* and *Azadirachta indica*) as feed resources for feeding domestic rabbits was studied. The acceptability, chemical analysis and crude fiber fractions were determined. The acceptability of the forages was assessed by cafeteria method using coefficient of preference (CoP). Five adult rabbits weighing 720 ± 20.5 g were used. The acceptability of the forages was best in *M. oleifera* (CoP > 1) followed by *F. thonningii*. *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. thonningii* had the least crude protein (CP) of 10.3% compared to the others forages that had CP ranging from 24 -30%. *M. oleifera* also had the least crude fibre (CF) of 9.0% compared to the other forages CF which ranged 14 -19% *F. thonningii* and *L. leucocephala* also had low ether extract (EE) of 6.0 and 8.0 % respectively. The acid detergent fibre (ADF) and neutral detergent fibre (NDF) fractions of the five most acceptable forages fell within the same range. In conclusion all the five most acceptable forages namely: *M. oleifera*, *F. thonningii*, *L. leucocephala*, *E. cyclocarpum*, *G. sepium* are possible legume feed resource for rabbits especially during the dry season.

Keywords: Crop-livestock system, tropical forage, feed preference, wet and dry seasons, rabbits

Introduction

Forages are coarse livestock feeds composed of leaves, stem and sometimes grains (Onwuka; 1983; Adeloye, 1994). In the tropics, cassava has been used as supplements for feeding ruminants (Than *et al.*, 2013; Phonethep *et al.*, 2016) and as well as legumes (Tshibangu *et al.*, 2015). Nutritious forages especially leguminous types are commonly used in monogastric feeding (Lukuyu *et al.*, 2017). Certain non leguminous forage such as neem leaves have also been tried for feeding ruminants (Adjorlolo *et al.*, 2016). Maize, soyabean cake, full fat soya and fish meal are quite expensive but are regarded as the major

sources of protein in finished feeds (Babayemi and Bamikole, 2006). 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). A study on forage legumes showed that most leguminous plants contain an average crude protein of about 17.2%, crude fiber 12-18%,

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xanthophylls 500-600ppm and dry matter of about 90% . Legume forages however, generally have high concentration of lignin and lower concentration of cell wall carbohydrates compared to grasses. In addition, feed intake and digestibility is also greater for legumes when compared to grasses. The use of forages by monogastrics is indeed limited by the high fiber content and the presence of anti-nutritional factors. The domestic rabbit possesses an enlarged caecum, inhabited by useful bacteria, which enables the caecum function like the rumen in the ruminants. The rabbit's ability to turn forages into high quality protein is an unequal advantage over other monogastric animals. Rabbit production has been reported to play an important role in livelihood of resource-poor households (Lukefahr, 2007). Forages are cheap and are available during the wet and dry seasons. Rabbits are termed non-ruminant herbivores and have a special ability to utilize plant fiber effectively, it is therefore important to assess the acceptability of some of these forages for feeding of rabbits. 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 to evaluate the acceptability of seven 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* (Figures 1-7)

Acceptability study

The acceptability study was carried out in

the Small Animal Room, Department of Animal Science for a period of five days. The aim of the test was to determine the four most acceptable forages. Five Chinchilla male rabbits whose average weight was $750.27g \pm 80g$ were used. The rabbits were fed with concentrate diets for an initial two days after their arrival after which the test forages were introduced gradually until the concentrate was totally withdrawn. The rabbit were fed the fresh forages randomly placed in a cafeteria feeding system allowing all the rabbits equal access to the seven forages (in replicates of three) at the same time. The rabbits were also given water *ad-libitum*. The forages were harvested overnight for each of the five days wilting before it was fed to the rabbits. This was done to reduce moisture content, the microbial load on the forages and any toxin or anti-nutritional factors present in the forages.

Co-efficient of preference

The forage preference was determined from the co-efficient of preference (CoP) value, calculated from the ratio between the intake of individual forages, divided by the average intake of the seven forages (Karbo *et al.*, 1993). On this basis, forage was taken to be preferred if the CoP value 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 dry matter was determined by placing the samples in an oven at 105°C for 24 hours. The protein content was determined by the Kjeldahl method ($CP = N \times 6.25$). The ADF and NDF were determined by the method of Van Soest *et al.* (1991). The ether extractives were determined by the Soxhac System using petroleum ether as the extracting solvent. The crude ash was determined by placing the samples in a muffle furnace at 560°C.



FIG 1: *L. leucocephala*



FIG 2: *G. sepium*



FIG 3: *A. saman*



FIG 4: *A. indica*



FIG 5: *M. oleifera*



FIG 6: *F. thonningii*



FIG 7: *E. cyclocarpum*

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Results and discussion

Feed Intake

M.oringa oleifera had the highest average feed intake of 70.75% followed by *Ficus thonningii* with 54%, *Leucaena*

leucocephala (41.7%), *Enterolobium cyclocarpum* (40.5%), *Glicidia sepium* (35.0%) and *Azadirachta indica* (34.7%). *Albizia saman* had the lowest average feed intake of 25.68%. Results are presented in Table 1

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

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	208.31	354.75	128.43	175.80	173.35	20150	245.
Mean	41.7±29.59 ^c	70.8±27.29 ^a	25.7±8.49 ^d	35.0±5.84 ^c	34.7±13.79 ^c	40.5±17.36 ^c	49.0±22.68 ^b

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

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 was 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

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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). The acceptability *A. indica* was also low compared to *M. oleifera*, *F. thonningii*, *L. leucocephala* and *E. cyclocarpum*. This observation could be due to the bitter taste of neem leaves as was reported 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. Nieves *et al.* (2004) had reported that a diet containing 40% *Leucaena leucocephala* leaf meal was accepted to rabbits but the report of Onwudike (1995) that New Zealand White rabbit fed *Leucaena* produced objectionable reddish brown urine may be a limiting factor in its acceptance as forage for feeding rabbits.

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

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

Chemical analysis and crude fiber fractions

The results of the chemical analysis are presented in Table 3. The results of the chemical analysis 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 its 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 showed that the forages 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 these 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) and Lang (1981). *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 being high in ether extract which is the fat content. 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) and 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. *Leucaena leucocephala* had an 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 (Atawodi *et al.*, 2008; Ayssiwede *et al.*, 2010).

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*

Conclusion

The study showed that all the forages had good 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*) showed that they could be utilized

by rabbit. The forages studied had potentials and could still be used as feed supplements but feeding trials are important for conclusive deductions about the use of these selected forages.

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