Nutrient utilization by West African Dwarf (WAD) goats fed selected tree forages and legume.

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Abstract

Multipurpose tress and legumes could be well thought-out as a more reliable feed resource of high quality forages especially during the dry season. The study was carried out to compare the nutrient utilization of selected tree forages and legume. Five male West Africa Dwarf (WAD) goats, weighing 19 ± 12 kg, were used for this study in a 4*4 Latin Square within a complete randomized design with four treatments comprising *Gliricidia sepium* (GS), *Leucaena leucocephala* (LL), *Centrosema pubensce* (CP), *Moringa oleifera* (MO) and four experimental periods of 21 days each. Three consecutive periods were separated by 7 days animal rest. Result obtained indicates that ash, crude protein and crude fibre were not significantly ($p>0.05$) affected by the forage groups. However, significant ($p<0.0$) differences were observed in dry mater, ether extract, acid detergent fibre, neutral detergent fibre, acid detergent lignin, cellulose and hemi cellulose digestibility among the forage groups, with LL group giving optimum result for digestibility. It is concluded that *Leucaena leucocephala* (LL) could be used as alternative to other conventional basal diets in order to increase the feed resource base of ruminants.

Keywords: Nutrient utilization, *Gliricidia sepium, Leucaena leucocephala, Centrosema pubensce, Moringa oleifera*, WAD goats.

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Introduction

Goats are considered the second most important livestock species in Nigeria and also contribute 24% of meat supply in the country [1]. However, nutrition has remained a challenge to sustainable production of goats. The principal natural diets of ruminants are the natural pastures, and they abound in the tropics. These natural pastures are said to be scarce and have fluctuating quality all year round [2] especially in the dry season. Tolera et al. [3] has opined that during dry seasons, goats are generally plagued by low production, reproductive performance, slow growth rate and increased susceptibility to pests and diseases. Strategies to alleviate the seasonal supply natural pastures has been advocated.

Sultana et al. [4] has suggested that the utilization of fodder trees and shrubs could be a potential strategy for increasing the quality and availability of feeds for ruminant livestock farmers especially during the dry season. Legumes which are considerably rich in nitrogen and micronutrients can be useful. The trees are said to offer an excellent and cheaper source of gamely fermentable energy, nitrogen and micronutrients [5]. They are perennial and also establish easily and require few agronomic inputs [6]. These multipurpose tress [7] and legumes could be well thought-out to be a dependable feed resource of high quality which will help to develop sustainable feeding systems and also increase livestock productivity. More attention is now being given to trees, shrubs [8] and legumes for feeding sheep and goats in most parts of the world with potential results. Some of the trees and shrubs found in the tropics especially in Nigeria include *Gliricidia sepium, Leucaena leucocephala, Centrocema pubensce* and *Moringa oleifera.* They are not just abundant but are also available even in dry season.

Gliricidia sepium is an enormously resourceful plant capable of fulfilling a number of roles in smallholder agricultural production systems [9]. The forage has been identified as one of the fodder legumes that promote weight gain and rumen ammonia in animals [2].

In Nigeria, the leaves of *Leucaena leucocephala* plants have enjoyed a lot of research awareness for all classes of livestock [10] for about three decades now.

Centrosema pubensce leaves are commonly found in the tropics. The abundance of these succulent leguminous plants around homestead and villages that contain reasonable levels of certain valuable nutrients appears not to have been fully explored.

Moringa oleifera is a remarkable species with excellent biomass production and high nutritional value can be used as a nutritional supplement [11]. As a non-leguminous multipurpose tree, it is one of the fastest growing trees in the world, with leaves high in good quality, highly digestible protein and contains negligible amounts of anti-nutritive compounds [12-15]. The leaves of *Moringa oleifera*, as fresh fodder [16,17], in animal production, especially goats, Asaolu et al. [18,19] and Moyo et al. [5] are gradually gaining importance in the West African sub-region to address the observed crude protein shortages of natural pastures and crop residues [4].

Assessing the level of utilization of these trees and legume will help widen the feed resource base of natural pasture for feeding of ruminants in the tropics especially in the dry season.

The objective of the present study was to compare the nutrient utilization of West African Dwarf (WAD) goats receiving *Leucaena leucocephala* (LL), *Gliricidia sepium* (GS), *Moringa oleifera* (MO) and *Centrosema pubensce* (CP) foliages, singly.

Materials and Methods

Experimental site

The experiment was carried out at Akpehe, Logo II area, Makurdi. Makurdi is located in the Southern Guinea Savannah zone of Nigeria. Makurdi is located between latitude 7° 44' 1.50" N and longitude 8° 31' 17.00" E (Google earth, 2018).

Procurement of experimental foliages

Fresh *Leucaena leucocephala* (LL) *Gliricidia sepium* (GS), *Moringa oleifera* (MO) and *Centrosema pubensce* (CP) forages were harvested daily from around Makurdi town. They were allowed to wilt before offered to the animals.

Experimental design and animal management

Five male West Africa Dwarf (WAD) goats, weighing 19 ± 12 kg, were used for this study in a 4*4 Latin Square within a complete randomized design with four treatments and four experimental periods of 21 days each. Three consecutive periods were separated by 7 days animal rest. During the rest periods, the goats were fed freshly-harvested *Panicum* maximum before the next treatment diet to be introduced. The animals were obtained from a small holder goat farmer in Makurdi. These animals were quarantined for three weeks prior to the commencement of the study. During this period, they were treated with oxytetracycline antibiotic injection for three days, drenched with Amprolium® against coccidia, administered Ivermectin® against ecto-parasites and gastrointestinal nematodes. During this period, the animals were fed in the first two weeks freshly-harvested *Panicum* maximum, *Gliricidia sepium*, *Centrosema pubensce, Leucaena leucocephala* and *Moringa oleifera* foliages but only *Panicum* maximum was fed to the animals in the last week of quarantining. The animals were housed in individual metabolic cages designed for the complete separation of faeces.The animals were provided with access to fresh clean water through the duration of the experiment.

Four dietary treatments were:

- 100% *Gliricidia sepium* (100% GS)
- 100% *Leucaena leucocephala* (100% LL)
- 100% *Centrosema pubensce* (100% CP)
- 100% *Moringa oleifera* (100% MO)

Data collection

Record of feed intake was taken during the faecal collection period. Feed refusals were collected each day and weighed to assess intake before any new feed was offered. The animals were fed ad libitum. Feeding was seperated into twice a day to minimize waste. Faeces voided by each animal were collected and measured between 08.00 and 09.00 h before morning feeding. Total daily faecal output for each goat was weighed. Faeces were bulked separately for each goat during each period; milled with a simple laboratory mill and stored in airtight bottles until required for further analysis.

Chemical analysis

At the end of the experiment, stored forages, and faecal samples were pooled together and subsequently analyzed for the proximate contents using the standard methods of AOAC [20]. The ADF,NDF and other fibre contents of the experimental forages and faeces were determined by the methods of Van Soest et al. [21].

Statistical analysis

The data on the nutrient utilization indices were subjected to analysis of variance using the General Linear Model of SAS [22]. Significant ($p<0.05$) differences between means were separated using the Duncan's New Multiple Range Test (DNMRT) of the same package.

Result

The chemical compositions of the experimental fodders are shown in Tables 1 and 2. Crude protein for all four fodders ranged between 20.56% and 21.30%. While crude protein was highest in *Moringa oleifera* leaves, the least crude protein observed in this study was in the *Gliricidia sepium* leaves. Ash content of the various forages ranged between 8.89 and 11.00%. The highest value (11.00%) was observed in CP while LL had the least value (8.89%) of ash. For ether extract, the highest value (8.19) was found in LL while the least value (4.10) was observed in CP. GS and Mo had ether extract values of 6.12 and 6.00% respectively. Crude fibre ranged between 9.63% and 11.15%. The highest crude fibre was observed in LL group while the least crude fibre value was observed in CP group. GS and MO had crude fibre values of 11.00% and 10.00% respectively. Fibre fractions also varied among the various forage groups.

Dry matter digestibility was generally high in all forage groups with significantly ($p<0.05$) higher dry matter digestibility in GS, LL, MO than CP. All the other parameters measured were also significantly ($p<0.05$) different among the treatments groups except for ash, crude fibre and crude protein digestibility. Ether extract was significantly ($p<0.05$) higher in the GS, LL, and MO groups (75.77%, 77.23% and 75.51% respectively) than the CP group (69.95%). The same trend as ether extract was observed in hemi cellulose digestibility. GS, LL and MO groups (72.13%, 74.55% and 73.43% respectively) had significantly ($p<0.05$) higher values than CP group (65.25%). The trend was however different from the other fibre fractions. While LL

Table 1. *Proximate composition of selected forages fed to WAD goats.*

Parameter (%)	GS	LL	CP	MO
Dry matter	87.00	87.23	88.00	88.00
Crude protein	20.56	20.61	21.03	21.30
Ash	10.00	8.89	11.00	9.00
Ether extract	6.12	8.19	4.10	6.00
Crude fibre	11.00	11.15	9.63	10.00
Acid detergent fibre	41.23	45.35	37.23	39.26
Nutrient detergent fibre	30.00	58.67	26.00	32.00
Acid detergent lignin	4.00	14.76	5.00	4.00
Cellulose	12.00	30.59	7.00	10.00
Hemicellulose	14.00	13.32	14.00	18.00

Abbreviation: GS: *Gliricidia sepium*, LL: *Leucaena leucocephala*, CP: *Centrosema pubensce*, MO: *Moringa oleifera*.

Table 2. *%Apparent nutrient digestibility of selected forages fed to West African Dwarf (WAD) goats.*

Parameter	100% GS	100% LL	100% CP	100% MO	SEM
Feed intake gDM/animal/day)	683.43	700.33	634.16	583.56	
Dry Matter	90.99[a]	93.46[a]	83.54[b]	91.49[a]	1.44
Ash	62.01	70.50	61.02	67.67	2.26
Ether Extract	75.77[a]	77.23[a]	69.95[b]	75.51[a]	1.10
Crude Fibre	71.76	73.42	68.29	70.93	1.25
Crude Protein	77.12	78.37	73.92	76.85	0.82
Acid Detergent Fibre	59.41[b]	76.03[a]	49.02[c]	62.32[b]	3.17
Neutral Detergent Fibre	66.41[b]	75.70[a]	52.51[c]	68.57[ab]	2.76
Acid Detergent Lignin	55.07[b]	75.30[a]	51.60[b]	58.48[b]	2.96
Cellulose	63.52[b]	76.39[a]	53.84[c]	64.19[b]	2.56
Hemi cellulose	72.13[a]	74.55[a]	65.25[b]	73.43[a]	1.27

[abc]Means with different superscript along the same row differ significantly (P<0.05).

Abbreviation: GS: *Gliricidia sepium*, LL: *Leucaena leucocephala,* CP: *Centrosema pubensce*, MO: *Moringa oleifera*, SEM: Standard Error of Mean.

group had significantly (p<0.05) higher values of acid detergent fibre, Acid detergent lignin and cellulose digestibility (76.03%, 75.30% and 76.39% respectively), lower values were observed in other groups. While neutral detergent fibre digestibility was statistically similar in LL and MO groups (75.70% and 68.57% respectively), they were significantly (p<0.05) different from GS group (66.41%) which also differed significantly (p<0.05) from the CP group (52.51%). In all CP group had the least digestibility of all fibre fractions.

Discussion

Observed crude protein values for *Gliricidia sepium* (GS), *Leucaena leucocephala* (LL) and *Moringa oleifera* (MO) were below the values reported by Asaolu et al. [18]. Oyedele et al. [23] has also reported higher values of crude protein for GS and MO (26.65% and 29.14% respectively). Crude protein value (88.00%) for *Centrosema pubensce* (CP) in this present study was below 24.89% reported by Nworgu [24]. The differences in the Crude protein values in the present study and others could be as a result of the different locations the forages were harvested, genetic background of forages or variations due to sample preparation and analysis [25]. All the experimental fodders had crude protein up to 20% which is consistent with observations by Waldroup and smith [26] that multipurpose tress contain 20% crude protein and above in their leaves. Crude protein values recorded in all forage groups were higher than the minimum recommended values (7.0-8.0%) for the efficient functioning of rumen micro-organism [27]. In all the forage groups, crude protein values were above values adequate (12-16%) for maintenance and moderate growth in goats [28]. Crude fibre value for CP was comparable with the value reported by Nworgu [24] while those of GS and MO were slightly lower than values reported by Oyedele et al. [23]. LL group could be a lesser source of minerals for the animals followed by MO group because of their relatively lower ash content when compared to GS and CP groups. Crude fibre values of all experimental forages were below 18% which is expected of all forages fed fresh [29]. Sowande [30] has reported similar crude fibre values for goats as being important in the maintenance of best possible ruminal actions. Acid detergent fibre and Neutral detergent fibre values in GS, LL and MO groups were comparable to values reported by Asaolu et al. [18] and such values has been reported to be low to moderate when compared with low quality forages which ruminant graze effectively [7]. The higher crude protein value and other nutritional profile observed could be seen as an insight as to the potential value of the forages as a sole feed for ruminant feeding.

Dry matter intake and dry matter digestibility are said to be dependent on the cell wall constituents; especially neutral detergent fibre and lignin [31]. In this present report, dry matter digestibility which is significantly higher in LL group which correspond to higher values of neutral detergent fibre. Also dry matter intake was higher in the LL group. Dry mater digestibility was reported not to differ significantly between GS and MO groups by Oyedele et al. [23] which is consistent with this present report. The significantly high ether extract digestibility observed also correlates with the amount of Ether extract that was recorded in the feed. CP group which had the least value ether extract digestibility also had the least amount of ether extract in the diet, and this is consistent with the report of other researchers [23]. The higher fibre fractions digestibility especially is an indication that more energy would have been made available to the animals. In all, the least digestibility of all the fibre fractions exception of acid detergent fibre and hemi cellulose was observed in the CP group. The higher fibre fraction digestibility especially in the LL group is an indication a better proportion of energy was provided for the enhancement of growth performance in the goats. In general the high digestibility values recorded in this study is indication that the diets were well degraded in the rumen.

Conclusion

All forages used in the study had sufficient amount of protein that required by small ruminants, however highest dry matter, ether extract and fibre fractions digestibilities by West African Dwarf goats resulted from the LL group. *Leucaena leucocephala* (LL) could be used a basal diets in feeding of West African Dwarf goats in order to optimize the use of available feed resources.

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