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Chemical composition and *In Vitro* Digestibility of five selected forages used for production and management of small ruminants in Odoragushin of Epe Local Government Area, Lagos State.

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Abstract

A large number of forages exist in Nigeria with varying adaptations pertaining to ecological zones. These forages are known for their acceptability and nutritive value by ruminants during dry season. Being different in structure and texture, physiochemical component may differ. Thus, this study was undertaken to determine chemical composition of five selected forage species (Mimosa pudica, Aspenlenum bulbiferum, Commelina benghalensis, Chamaecoustus cupidatus and Panicum maximum) used as feed resources in Odoragunshin, Epe Local Government Area, Lagos state. 500g sample of each plant was collected from different mature plants before flowering. Chemical composition and in vitro digestibility parameters were measured. The result obtained showed variations (P< 0 .05) in the proximate composition and invitro digestibility. The crude protein content was highest in Commelina benghalensis (21.46%) and was least in Chamaecoustus cupidatus (11.88%). Ether extract ranged from 7.70% - 15.38% in Mimosa pudica and Chamaecoustus cupidatus respectively. Higher ash value (15.38%) was recorded in Commelina benghalensis. The estimated organic matter digestibility (OMD), metabolizable energy (ME) and short chain fatty acid (SCFA) were significantly different (P< 0.05). The study showed that the selected forages could be used as part of feed for ruminants, especially during the period of scarcity without harmful effect to the animals.

Keywords: Forages, Nutrition, Organic matter digestibility, *In vitro* gas, Ruminants.

Composition chimique et digestibilité *in vitro* de cinq fourrages sélectionnés utilisés pour la production et la gestion des petits ruminants à Odoragushin de la zone de gouvernement local d'Epe, État de Lagos.

Résumé

Un grand nombre de fourrages existent au Nigeria avec des adaptations variables selon les zones écologiques. Ces fourrages sont connus pour leur acceptabilité et leur valeur nutritive par les ruminants en saison sèche. Étant différents en termes de structure et de texture, les composants physicochimiques peuvent différer. Ainsi, cette étude a été entreprise pour déterminer la composition chimique de cinq espèces fourragères sélectionnées (Mimosa pudica, Aspenlenum bulbiferum, Commelina benghalensis, Chamaecoustus cupidatus et Panicum maximum) utilisées comme ressources alimentaires à Odoragunshin, dans la zone de gouvernement local d'Epe, dans l'État de Lagos. Un échantillon de 500 g de chaque plante a été collecté sur différentes plantes matures avant la floraison. La composition chimique et

les paramètres de digestibilité in vitro ont été mesurés. Le résultat obtenu montre des variations (P< 0,05) dans la composition immédiate et la digestibilité in vitro. La teneur en protéines brutes était la plus élevée chez Commelina benghalensis (21,46 %) et la plus faible chez Chamaecoustus cupidatus (11,88 %). L'extrait d'éther variait de 7,70 % à 15,38 % respectivement pour Mimosa pudica et Chamaecoustus cupidatus. Une valeur de cendres plus élevée (15,38 %) a été enregistrée chez Commelina benghalensis. La digestibilité estimée de la matière organique (DMO), l'énergie métabolisable (EM) et les acides gras à chaîne courte (AGCC) étaient significativement différents (P < 0,05). L'étude a montré que les fourrages sélectionnés pouvaient être utilisés dans le cadre de l'alimentation des ruminants, notamment en période de disette, sans effet nocif sur les animaux.

Mots-clés: Fourrages, Nutrition, Digestibilité de la matière organique, Gaz in vitro, Ruminants.

Introduction

Potentials of forage plants as alternative fodder resources in ruminant nutrition is attracting attention of researchers worldwide. Several indigenous and exotic browse species have been investigated and evaluated for inclusion in ruminant feeding systems in Nigeria. Unfortunately, the adoption of most of these species by farmers has been faced with several challenges such as pests and diseases attack and presence of anti-nutritional factors. There is, therefore, the need for continuous screening of browse plants to identify those with good potentials as livestock fodder and which could serve as alternatives to those species which have already being evaluated (**Fadiyimu *et al.,* 2011**). D'Mello (1992) stated that results of proximate analyses are extensively employed in research and industry for quick estimation of nutrient potentials of feedstuffs; although such results may not give a true indication of the nutritive value of a feed, they supply clues in research to plants of potential value for further *in vitro* or *in vivo* studies. Buttressing this assertion, Okoli *et al.,* (2003) stated that proximate analysis is specifically useful in screening the array of tropical browse plants utilized by indigenous farmers for ruminant feeding.

Thus, this study was undertaken to determine chemical composition and *in vitro* digestibility of *Mimosa pudica, Aspenlenum bulbiferum, Commelina benghalensis*, *Chamaecoustus cupidatus* and *Panicum maximum* used as feed for goats and sheep at Odoragunshin of Epe local government, Lagos State.

Materials and methods

Sample collection and preparation

Five native forage species which included *Mimosa pudica, Aspenlenum bulbiferum, Commelina benghalensis*, *Chamaecoustus cupidatus* and *Panicum maximum* were used for the study. Fresh samples of the forage species were collected after been identified as the major consumed plants by sheep and goats in the area. The plants were collected from different mature plants within the aforementioned Local Government Area of Lagos state. Laboratory analysis was carried out at Biological laboratory, Federal university of Agriculture, Abeokuta, South- West, Nigeria. A portion of the harvested samples was weighed and oven-dried at 65^0 C for 72hours, ground through a 1 mm screen and stored in a polythene bag prior to chemical and *in vitro* analysis.

Chemical analysis procedure

Chemical composition (CP, CF, EE, Ash and NFE) of the plant sample was determined according to AOAC (1995)

protocol. Neutral detergent fibre (NDF), Acid detergent lignin (ADL) and acid detergent fibre (ADF) were determined according to the procedure of Van Soest *et al*., (1991). Cellulose and hemicellulose were derived from NDF, ADF and ADL by simple calculation as follows: Hemicellulose = NDF – ADF, Cellulose = ADF – ADL

In vitro gas production

Rumen liquor was obtained from three WAD female goats through suction tube before morning feed. The preparation is buffer solutions and rumen innocula was as described by Menke and Steingass (1988). Gas production was measured three hourly and at 24h gas production, 4mL sodium hydroxide (10mL) was introduced after 24h post incubation to estimate methane production. The volume of gas produced from the blank was deducted from the volume of gas produced per sample. Metabolizable Energy (ME) was calculated as ME = 2.20 + 0.136GV + 0.057CP + 0.0029CF (Menke and Steingass), organic matter digestibility (OMD, %) = 14.88 + 0.88Gv + 0.45CP + 0.651 XA (Menke and Steingass, 1998). Short chain fatty acids (SCFA) as 0.0239 Gv – 0.0601 (Getachew *et al*, 1991) was obtained where Gv, CP, CF and XA are total gas volume, crude protein, crude fiber and ash respectively. Data obtained were subjected to analysis of variance, where significant differences occurred, the means were separated using Duncan multiple range F-test of the SAS (Statistical Analysis System Institute Inc, 1988 options).

Statistical analysis

Data collected were subjected to One way Analysis of Variance and significant differences among means were compared using Duncan multiple Range test (SAS, 1990).

Results and discussion

Table 1: Proximate Composition and Crude Fiber fractions

	Proximate composition parameters					Crude fibre fraction parameters				
Sample	EE	Ash	CF	CP	NFE	ADF	ADL	NDF	Cellulose	Hemicellulose
T_1	11.09^{c}	7.73^{c}	4.60^{c}	13.56^{d}	52.01^{b}	43.6^{d}	24.55^{b}	65.34^{d}	19.09^{d}	21.70^{b}
T_2	12.08^{b}	15.38^{a}	1.98^{e}	21.46^{a}	38.10^{e}	30.19^{e}	18.87^{e}	61.88^{e}	11.32^{e}	31.68^{a}
T_3	15.38^{a}	8.77^{b}	5.25^{b}	11.88^{e}	49.10^{d}	59.62^{b}	23.08^{c}	71.54^{b}	36.54^{b}	11.92^{d}
T_4	7.70^{e}	4.64^{d}	2.99^{b}	20.25^{b}	53.49^{a}	62.26^{a}	29.06^{a}	78.23a	33.20^{c}	15.97^{c}
T_5	8.45^{d}	4.46^{e}	5.33^{a}	20.09^{c}	50.70^{c}	58.25^{c}	19.03^{d}	69.59^{c}	39.22^{a}	11.34^{e}
SEM	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003

^{a,b,c,d,e} means along the same column with different superscripts are significantly different (P<0.05)

T_1– *Panicum maximum*, T_2 – *Commelina benghalensis,* T_3 – *Chamaecoustus cupidatus,* T_4 – *Mimosa pudica,* T_5 – *Aspenlenum bulbiferum,* EE – Ether extracts, CF – Crude fiber, CP – Crude protein, NDF – Neutral detergent fiber, ADL– Acid detergent lignin, NFE – Nitrogen free extracts, ADF – Acid detergent fibre, SEM – Standard error of mean

Table 2: In *vitro* Gas Production and Characteristic

	Period of incubation (hour)							Fermentation parameters				
Sample	3h	6h	9h	12h	15h	18h	21h	24h	ME	SCFA	OMD	CH_4
T_1	1^{a}	2^{a}	8^{a}	9^{a}	11^{a}	14^{a}	21^{a}	28^{a}	8.64^{a}	0.61^{a}	50.91^{a}	5.33^{a}
T_2	1^{a}	2^{a}	5^{bc}	8^{a}	9^{ab}	11^{ab}	13^{b}	18^{b}	5.78^{c}	0.37^{b}	50.55^{a}	3.33^{b}
T_3	1^{a}	2^{a}	3^{c}	5^{a}	6^{b}	9^{b}	10^{b}	16^{b}	7.38^{b}	0.32^{b}	40.16^{c}	3.33^{b}
T_4	1^{a}	2^{a}	6^{ab}	7^{a}	9^{ab}	13^{a}	15^{b}	18^{b}	6.36^{c}	0.37^{b}	43.02^{b}	3.67^{ab}
T_5	1^{a}	2^{a}	5^{bc}	9^{a}	11^{a}	13^{a}	14^{a}	19^{b}	7.83^{ab}	0.39^{b}	43.7^{b}	3.67^{ab}
SEM	0	0	0.45	1	0.73	0.68	0.9	1.09	0.45	0.078	2.92	0.96

^{a,b,c} means along the same column with different superscripts are significantly different (P<0.05)

Table 1 shows the proximate composition and crude fibre fractions of *Mimosa pudica, Aspenlenum bulbiferum, Commelina benghalensis*, *Chamaecoustus cupidatus* and *Panicum maximum.* The CP was best in *Commelina benghalensis (21.46%)* and least in *Chamaecoustus cupidatus* (11.88%). CP value observed in *Commelina benghalensis* was higer than 14.6% reported for *Gmelina arborea* (*Amata and Lebari, 2011*). Least CP value (11.88%) observed in *Chamaecoustus cupidatus* when compared with *Panicum maximum* value (13.56%) negates the report of Getachew *et al.,* (2004) that browse forages are higher in CP than tropical grasses and roughages such as hay, straw and stover but this value is above 8% required to satisfy the maintenance requirement for ruminants (Norton, 2003). The neutral detergent fibre (NDF) ranged from 38.10% in *Commelina benghalensis* to 53.49% in *Mimosa pudica,* these values compared favourably with the report of Okoli *et al*., (2003), Ahamefule *et al.,* (2006) as well as Ogunbosoye and Babayemi (2010) for some selected browse plants in Nigeria. NDF observed in *Commelina benghalensis and Panicum maximum* was lower than the safe upper limit of 60% (Meissner *et al*., 1991) for guaranteed forage intake by sheep. The values reported for cellulose across the examined forage species compared favourably to the report of Odedire and Babayemi (2008). *Disparity observed could be* probably due to differences in species, climatic and edaphic factors as confirmed by Fadiyimu *et al.,* (2012). *Aspenlenum bulbiferum* relatively showed higher ($P<0.05$) gas production values from 9^{th} – 24^{th} hour of incubation (Table 2). The organic matter degradability of the forages differ significantly ($P<0.05$) ranging between 40.16 and 50.91 (Table 2). The amount of gas released when feed are incubated in *in vitro* has been reported to be closely related to digestibility of feed for ruminants (Mebratu and Tenaye, 1997). Thus, the gas volume can be considered a good reflection of substrate fermentation to Volatile fatty acids and an estimate of potential digestibility in the rumen.

Conclusion

The forage species investigated have high CP and high *in vitro* degradability. They can be used as supplement to poor quality feeds during the period of scarcity without having any harmful effect on ruminants.

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