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Nutritional composition and secondary metabolites of some selected forages consumed by small ruminants

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Target Audience: Ruminant nutritionist, forage scientist, researchers

Abstract

This study was conducted to investigate the nutritive values and secondary metabolites of some selected forage species (Diallium guinensis, Calopogonium mucunoides and Terminalia catappa) consumed by small ruminants. Results obtained showed significant (P < .05) variability in the values of Dry matter (77.56 – 84.53g/100g) in Terminalia catappa and Diallium guinensis, Moisture content (15.64 – 21.48 g/100g) in Diallium guinensis and Terminalia catappa, Crude protein (13.57 – 16.63 g/100g) in Terminalia catappa and Calopogonium mucunoides and Ash (4.51 – 7.16 g/100g) in Terminalia catappa and Calopogonium mucunoides respectively. Diallium guinensis had highest (4.10%) oxalate value while the least (P < .05) was noticed in Terminalia catappa (1.97%). Calopogonium mucunoides recorded highest NDF, ADF, ADL, Cellulose and hemicellulose (59.41, 45.38, 20.48, 24.9 and 14.03%) respectively among the selected forages. NDF ranged from 41.22% in Terminalia catappa to 53.69% in Diallium guinensis. This study showed that selected forage species are rich in the nutrient contents and have tolerable secondary metabolites which could be used as supplements to grasses during the raining and dry seasons to enhance the efficiency of small ruminant performance throughout the year.

Keywords: Nutritional composition; secondary metabolites, forages, small ruminants

Description of problem

Browse forages constitute one of the cheapest and available sources of feeds for ruminants in the tropics (1). Their year round evergreen and nutritional abundance enable them to provide year round fodders for livestock especially ruminants (2). Ruminant diets are limited in amount and quality of available forage (3), crop residues or by products (4) which reduced livestock productivity in the tropical countries mostly in the dry season (5). (6) and (7) further reported that browse forages are increasingly acknowledged worldwide and they provide protection, vitamins and mineral elements to ruminants which are lacking in grassland pastures. Forage plants are important sources of nourishment for grazing ruminants and as supplements to improve the productivity of herbivores fed on low quality feeds. They also form part of the complex interactions between plants and animals (8), the positive aspect of

which is to help balance a plant-animal-soil ecosystem from which there is sustainable source of feeds (9). The availability of variety of these feeds and the selection process enables the herbivores especially the small ruminants to extend as well as meet their feed preferences. Traditional farmers in the semi-arid region of Nigeria allow their ruminants to browse on these forage plants on the range lands and also cut and feed these plants as supplements based on experience and convenience (10).

Despite the handiness and proximity of these forages there is need for continuous screening of these plants to identify those with good potentials as livestock fodders and which could serve as alternatives to those species which have already been evaluated (11).

Therefore, the study was to determine the nutritional composition and secondary metabolites of some selected forages consumed by small ruminants.

Materials and Methods

Study location

The study was carried out at Yaba college of Technology, Epe campus, Odoragunshin, Lagos state, Nigeria. The location lies within the savanna agro-ecological zone of southwest Nigeria.

Sample collection and preparation

Three tropical browse plants (*Diallium guineensis, Calopogonium mucunoides and Terminalia catappa)* were used for the study.

The fresh samples (leaves and tender stems) of selected forage species were collected from different mature plants at different locations within Epe local government area of Lagos state between June and August, 2013. A portion of the harvested samples was weighed and oven-dried at 65^0 C for 72 hours, ground through a 1 mm screen and stored in a polythene bag prior to chemical analysis in triplicates. Laboratory analysis was carried out at Biological laboratory, Federal University of Agriculture, Abeokuta, South-West, Nigeria.

Chemical analysis: Chemical composition (CP, CF, EE, Ash, carbohydrate and DM) of the plant samples was determined according to (12) procedures. Neutral detergent fibre (NDF), Acid detergent lignin (ADL) and acid detergent fibre (ADF) were determined according to the procedure of (13). Cellulose and hemicellulose were derived from NDF, ADF and ADL by simple calculation as follows: Hemicellulose = NDF – ADF, Cellulose = ADF – ADL

The second portion was air-dried, ground and analysed for the anti-nutritional factors: Tannin (14), phytate (15), Saponin and alkaloid were determined according to the procedures as described by (16), (17) while oxalate was determined by spectrophotometric methods of (18).

Statistical analysis: Data collected were subjected to one way analysis of variance and significant differences among means were compared using Duncan multiple Range test (19).

Results and Discussion

The proximate composition of the selected forage species are shown in Table 1. The lowest ($P < .05$) DM recorded in *Terminalia catappa* (77.55 g/100g) differed from those reported (23.52%, 44.95% and 19.39%) by (1) for *Ficus sur*, (20) for *Newbouldia laevis* and (21) for *Ficus exasperata* respectively. However, no significant ($P > .05$) difference was observed in the DM of *Diallium guinensis* (84.53 g/100g) and *Calopogonium mucunoides* (82.28 g/100g) in spite the variation in the values. These values fell within the findings (85.71%) of (22). The difference in the dry matter content could be due to the processing methods adopted; period of harvesting of the

forage plant, ambient temperature, seasonal or climatic factors as corroborated by (1), (23) and (24). No significant variation (P>.05 was observed in the ether extract, crude fiber as well as carbohydrate values among the selected forages.

Table 1: Proximate composition (g/100g) of the selected forage species

Forage sample	Dry Matter	Crude protein	Ether extract	Ash	Crude fiber	Carbohydrate
Diallium guineensis,	84.53^{a}	13.62^{b}	6.62	5.93^{ab}	9.30	48.68
Calopogonium mucunoides	82.28^{a}	16.63^{a}	6.42	7.16^{a}	9.79	48.17
Terminalia catappa	77.56^{b}	13.57^{b}	6.29	4.51^{b}	5.64	52.39
SEM	1.15	0.57	0.38	0.49	0.90	1.51

a,b, means on the same column with different superscripts are significantly varied (p<0.05). SEM= Standard error of mean

Table 2: Secondary metabolites (%) of the selected forage species

Forage species	Tannin	Saponin	Alkaloid	Oxalate	Phytate	Steroid
Diallium guinensis	4.51	0.90	0.49	4.10^{a}	1.91	0.68^{b}
Calopogonium mucunoides	2.96	1.26	0.90	2.77^{ab}	0.94	1.65^{a}
Terminalia catappa	3.20	0.85	0.62	1.97^{b}	0.95	0.95^{ab}
SEM	0.34	0.09	0.13	0.37	0.21	0.19

a,b, means on the same column with different superscripts are significantly varied (p<0.05). SEM= Standard error of mean

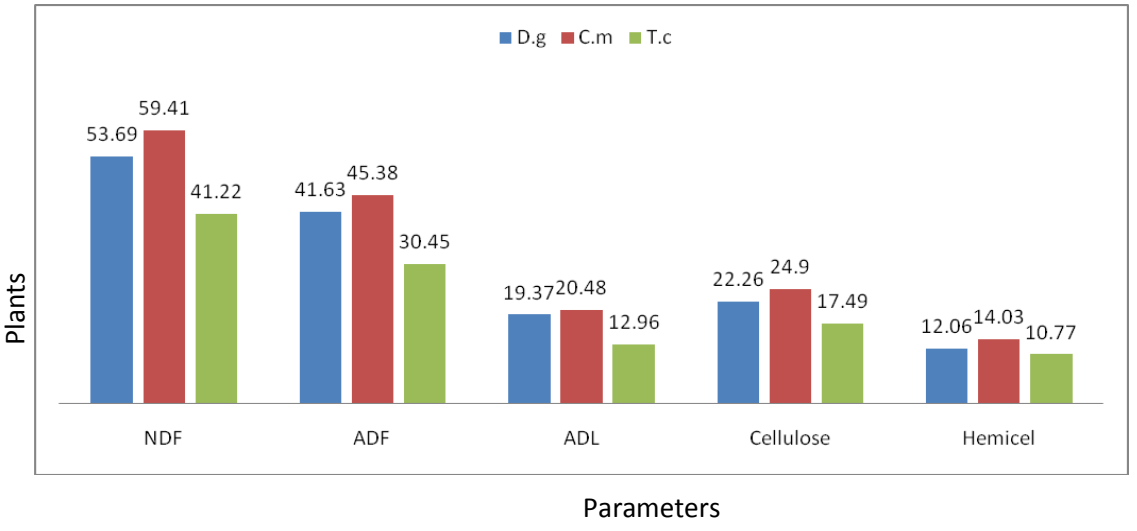

Fig 1: Fiber fraction of the selected forage species
D.g = *Diallium guinensis***, C.m =** *Calopogonium mucunoides***, T.c =** *Terminalia catappa*

Significant highest CP value (16.63 g/100g) observed in *Calopogonium mucunoides* when compared with other forage species was lower than the values of 24.15% and 17.07% reported by (25) as well as (26) respectively. These CP values compare favourably with 16.56 and 16.19% observed in *Gmelina arborea* and *A.saman* (1) and *(*26) The least CP value (13. /100g) recorded in *Terminalia catappa* was above 8% required to satisfy the maintenance requirement for ruminants (27) and above the minimum level necessary to provide sufficient nitrogen required by rumen microorganisms to support optimum rumen activity (28) and also for adequate intake of forages. The crude fiber (5.64 g/100g) and Ash (4.51 g/100g) values observed in *T. catappa* were higher (P <.05) compare with the values (1.98 and 0.039%) reported for the same plant by (29). However, *T. catappa* recorded highest carbohydrate value (52.39 g/100g) among the selected browse forages which was lower to 78.14% reported by the same author. The observed variations in the chemical composition of the forages could be ascribed to the ratio of leaf to twigs, seasonal variations in climatic and soil conditions of the area, age of leaf, and inherent genetic characteristics of each plant also go a long way to determining the level of nutrients in its foliage (30), (31), (1), (32).

However, the high variability (P <.05) in the nutrient content of plants often encountered in research have been attributed to species variability, plant part, leaf age, season, harvesting regimen, soil type, location (33); (34), and soil nutrient status and the time of harvest (35). The forage species examined in the present study were collected from different locations and were at different maturity stages which could probably be the source of variation in the observed chemical composition in this finding as reported above.

No significant differences (P >.05) were observed in the tannin, saponin, alkaloid and phytate levels across the forage species except in the values of oxalate and steroid as shown in Table 2. *Diallium guinensis* had highest oxalate value (4.10%) which exceeded the reported values (1.41%) by (1) for *Albizia saman*, 1.41% observed in digesta from cattle, goat and sheep (36), 0.77 mg/g in *G. celosioides* (37) as well as 1.24% and 1.07% by (31) for the same plant while the least value (P <.05) was noticed in *Terminalia catappa* (1.97%). According to (38) oxalates affect calcium and magnesium metabolism. Steroid content ranged (P < .05) from 0.68 – 1.65% in *Diallium guinensis* and *Calopogonium mucunoides* respectively.

As shown in Figure 1, *Calopogonium mucunoides* recorded highest NDF, ADF, ADL, Cellulose and hemicelluloses among the selected forages. Neutral detergent fibre (NDF) ranged from 41.22% in *Terminalia catappa* to 53.69% in *Diallium guinensis*, Least ADF value (30.45%) recorded in *Terminalia catappa* was higher when compare with the values (16.00, 16.00, 17.00 and 23.00%) reported by (39) for *Morus alba, Acacia nilotica, Ziziphus jujuba and Syzygium cumuni* leaves respectively while (40) reported (17.7, 23.3, 26.7 and 33.2 gkg^{-1}) for *Vangueria cyanescens, Acacia karoo, Cynodon dactylon and Acacia rehmanniaana respectively. Terminalia catappa* had least ADL value (12.96%) which was higher when compare with the reported values (7.59 and 11.29%) by (41) for *Spondia mombin* and *Merremia aegyptia* but lower to 34.53% observed in *Tithonia diversifolia*.

Conclusion and Applications

From the result of this finding, it can be concluded (1) that the selected forage species are rich in the nutrient composition as well as tolerant in secondary metabolites (2) they

could be used as supplements to grasses during dry season to enhance the efficiency of small ruminant performance throughout the year.

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