POTENTIAL FEEDING VALUE OF FOUR SELECTED BROWSE FODDERS IN GUINEA SAVANNAH, NIGERIA

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ABSTRACT

Many wild browse species are undervalued mainly due to paucity of knowledge of their feeding values. The objective of this study was to evaluate the nutritive potentials of four selected browse fodders *(Piliostigma thonningii, Detarium microcarpum, Stereo spermum kunthianum* and *Isober liniadoka)* by considering some of their nutritional and anti-nutritional attributes. There were variations in the chemical and mineral compositions and the secondary metabolites of the browse fodders. Dry matter and organic matter contents were similar (P<0.05) among the browse plants studied. *D. microcarpum* had the highest (P<0.05) crude protein and ether extract. *P. thonningi* and *I. doka* were higher in crude fibre (P<0.05) relative to *D. microcarpum* and *S. kunthianum*. Ash and oxaloacetate contents were lowest (P<0.05) in S. kunthianum. Calcium contents were higher (P<0.05) in S. kunthianum and I. doka compared with P. thonningii and D. microcarpum. Phosphorus and potassium contents were greatest (P<0.05) in S. kunthianum. Magnesium concentration was highest in D. microcarpum and S. kunthiarum but lowest in *P. thonningi* (P<0.05). the concentrations of condensed tannins, saponins, phytate and oxalates were higher (P<0.05) in I. doka than in other browse fodders. All the phytochemicals were below the threshold levels at which they induce toxicity in ruminants. The results indicate that the studied browse species are promising fodders that can either be fed solely or as supplements to low nutritive roughages predominantly used for ruminant feeding in smallholder ruminant production systems.

INTRODUCTION

Ruminant production in Nigeria depends almost absolutely on range pastures, since over 90% of the national herds are managed by transhumant and sedentary Fulani herdsmen who rarely supplement their stock (Olafadehan, 2007). Range pastures are seasonal due to fluctuation in rainfall which imposes nutritional stress on the grazing stock during the off season. Thus, the problem of animal feed supply and quality becomes exacerbated during the dry season when the growth of herbaceous species and biomass yield in rangelands are limited. Based on this, there is an increasing and renewed interest in the search for indigenous potential livestock feed resources such as browse species that well are adapted to the prevailing environmental conditions. The humid and sub-humid climatic zones of West Africa are habitats for a widevariety of indigenous multipurpose tree species that areimportant components of the agro-forestry systems ofthese areas (Oji and Kalio, 2004), and produce largeamounts of biomass (Kaitho *et al.*, 1997). The ability of the browse foliages to remain green and maintain their CP content makes them potential sources of protein and energy for sustainable ruminant production (Olafadehan, 2013). Nevertheless, some of these plants contain anti-nutritional secondary compounds, particularly tannins, with potential adverse effects such as inhibition of rumen microbial fermentation, decreased feed digestibility and animal performance (Min *et al.*, 2003; Waghorn and McNabb, 2003) and induced tannic acid toxicosis (Olafadehan, 2011). The present study considered the feeding potential of four selected browseby examining their nutritive and anti-nutritive components.

MATERIALS AND METHODS

Fresh leaves of *P. thonningii, D. microcarpum, I. doka and S. kunthianum*were harvested from several stands of the trees. The leaves were oven-dried to constant weight at 60°C for 72 h to determine DM. The dried samples were then ground to pass 1 mm sieve and stored in individual labelled tables pending analyses. Samples were analyzed in triplicate for their proximate constituents according AOAC (1995) procedures.Tannins were determined by the methods of Makkar (2003), while saponins by the method of Babayemi *et al.* (2004). The methods of Mega (1982) were used for phytate determination, while AOAC (1995) was used for determination of oxalate. The concentration of the minerals, Ca, Mg and P in the digested samples were estimated with the Pye-unicam atomic absorption spectrophotometer. K and Na were determined using flame photometer.Data were subjected to one way ANOVA using complete randomized design procedure of SPSS Base 15 (SPSS software products, USA), and treatment means were separated using Duncan's multiple range test of the same of the same software.

RESULTS AND DISCUSSION

Table 1 presents the proximate composition of the experimental browse fodders. The non-significantly ($P>0.05$) different DM values of the browse species are within the range of 922.6 to 984.6 g/kg reported by Njidda *et al.* (2013) for some semi-arid browses in Nigeria. The crude protein (CP) contents, which are within the range of 134.5 - 181.8 g/kg CP reported by Njidda *et al.* (2013) for some browse species, were highest in *D.microcarpum*, intermediate in *P. thonningii* and *I. doka* and lowest ($P<0.05$) in *S. kunthianum.* The CP values of the browse foliages are above the minimum level of 8%, required for optimal rumen microbial function (Norton, 2003), suggesting that all the fodders could support maintenance requirements and some production levels in ruminants (Van Soest, 1994). The leaves of the browses are thus a potential CP supplement for ruminants in the tropics. Organic matter (OM) contents of the browse sp. showed no ($P>0.05$) difference and arewithin the range of 836-910 g/kg reported for some browse species (Fadiyimu *et al.*, 2011). The generally high OM content of the browse fodders indicates their potential as good source of energy, because the OM of a feed reflects its potential energy value. The CFcontents, which were higher ($P<0.05$) in *I. doka* and *P. thonningii* than in *D. microcarpum* and *S. kunthianum*, are higher than the range (14.0-17.2%) indicated in some browse species by Fadiyimu *et al.* (2011). The ether extract (EE) contentsare generally low and were highest in *D. microcarpum* and lowest in *P. thonningii* and *I. doka* ($P<0.05$).The low EE value for the browse fodders suggests that they would not pose problem such as rumen acidiosis and/or displaced abomasums which have been associatedwith high dietary EE.The ash component ranged from 99.9 to 115.4 g/kg, and is within the range of 70.6 -180.6 g/kg DM obtained by Njidda*etal.* (2013). The relatively high CP and low CF contents of the browse species suggest them as good sources of nutrient supplements in ruminant nutrition. Though Calevel was different($P<0.05$) among the browse sp., all the browse fodders have sufficient Ca concentrationsthat meet the requirement (0.21-0.52% DM) of growing goats (McDowell, 1985).Phosphorus content varied from 3.0 in *D. microcarpum* to 4.1 g/kg DM in *S. kunthianum* which had higher($P<0.05$)content than the three other tree leaves. The potassium content varied ($P<0.05$) among the browse species; the rank order was: *S. kunthianum*>*P. thonningii*>*I. doka*>*D. microcarpum*. Going by the potassium requirement of 1.8-2.5 g/kg for goats (NRC, 1985), ruminants being browsed or zero grazed on these browse species would have adequate access to potassium. Magnesium ranged from 1.9 to 4.6 g/kg DM, and was ($P<0.05$) higher in *S. kunthianum* and *D. microcarpum* than in *I. doka,* which in turn had a higher ($P<0.05$) content than *P. thonningii*. Magnesium contents of the browse fodders were adequate and could meet the requirement of ruminants for this mineral going by the recommended value of 0.08-0.25% (Kessler, 1991).

Sodium ranged between 0.5 and 0.6g/kg DM; it was similar ($P>0.05$) among the browse species. Sodium content seems to be generally low in browse species, as only *D. microcarpum* and *I. doka* were able to meet the minimum requirements for ruminant feeding (NRC, 1985). However, the sodium contents of all the browse fodders are lower than 0.7 g/kg required in the diet of goats (Kessler, 1991). The mineral levels are lower than the mineral concentrations in some browse fodders reported by Norton (1994) but are higher than the minimum requirements for ruminants reported by Robertson (1988), with exception of sodium. This implies the foliages of the four browse species can be used as sources of mineral supplement for ruminant stock. However, there may be the need for Na supplementation.The CT contents varied ($P<0.05$) from 2.4 in *P. thonningii* to 9.2 g/kg DM in *I. doka* (Table 4) and are lower than the critical level (5-9%) reported by Barry (1983). According to Diagayette and Huss (1981), the level of tannins which adversely affect digestibility in sheep and cattle is between 2-5% whereas goats have a threshold capacity of about 9% dietary tannins (Nastis and Malachek, 1981). Therefore, all the experimental browse species contain the tolerable and beneficial CT level required by ruminants for improved performance. The CT of the browse leaves are lower than the values reported by Fadiyimu et al. (2011), but are higher than 0.09-4.0% reported by Onwuka (1992). Condensed tannins at low or moderate levelsgenerallydecrease the ruminal degradation of dietary proteins and thus enhance the protein bypass value with improved animal performance. Saponins content ranged from 9.9 in *S. kunthianum* to 28.6 g/kg DM in *I. doka*. It was lower ($P<0.05$) in *D. microcarpum* compared to *S. kunthianum* and *P.thonningii*, which were similar ($P>0.05$) but had lower values than *I. doka*. The values obtained in this study are higher than 0.07-0.8% reported for some browse species by Onwuka (1992). Recently, there has beenan increased interest in saponin-containing plants as a possible means of suppressing ruminal protozoa. Since dietary saponins are poorly absorbed, their biological effects occur in the digestive tract (Cheeke, 1996). Methane production can be mitigated by consumption of feed containing saponins in ruminants. Also feeding of tanniniferous browse plants has been found to decrease methane production both *in vivo* and *in vitro* (Waghorn *et al.*, 2002). Therefore, the browses can used as environmental friendly fodders for mitigating ruminant contribution to greenhouse emission. Phytate and oxalates contents varied from 4.8 to 10.2g/kgDM and 6.4 to 16.2 g/kg DM respectively. The rank orders were: *I.* doka>*D. microcarpum*>*S. kunthianum*>*P. thonningii* and *I.* doka>*D. microcarpum*>*P. thonningii*>*S. kunthianum*for phytate and oxalates respectively ($P<0.05$).The phytate content in this study is far lower than <5% prescribed as the phytic acid threshold level in ruminants (Laurena *et al.*, 1994). Both the phytate and oxalatesconcentrations are lower than the values reported by Fadiyimu *et al.* (2011). The major dietary importance of phytate is because of its ability to complex certain mineral elements such Ca, Mg, Fe and Zn thereby reducing their metabolic availability. Earlier reports have implicated oxalates in the impaired metabolism of magnesium in livestock (Mead *et al.*, 1985). Norton (1994) observed that the concentration of oxalic acid in leaves may decrease the availability of Ca during digestion. However, the relatively low content of oxalate in the experimental fodder would ensure Ca stabilization during digestion.The results of the present study underscore the potentials of studied browses as nutritive fodders for ruminant animals. However, further *in vivo* trials involving these browses should be conducted to establish their feeding value.

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Table 1. Proximate composition (g/kg) of the experimental fodders

	P. thonningii	*D. microcarpum*	*S. kunthianum*	*I. doka*	SEM
Dry matter	951.1	942.7	950.5	943.1	6.95
In g/kg DM					
Crude protein	161^{b}	181.9^{a}	132.5^{c}	163.8^{b}	1.95
Organic matter	891.2	884.6	900.1	891.1	15.53
Crude fibre	317.5^{a}	251.9^{b}	279.2^{b}	331.7^{a}	18.95
Ether extract	40.2^{c}	55.4^{a}	48.8^{b}	39.9^{c}	1.39
Ash	108.8^{a}	115.4^{a}	99.9^{b}	108.9^{a}	4.49

Means with different superscripts in the same row differ (P<0.05) significantly

Table 2. Mineral composition (g/kg DM) of the experimental fodders

	P. thonningii	*D. microcarpum*	*S. kunthianum*	*I. doka*	SEM
Calcium	7.5^{b}	7.5^{b}	8.5^{a}	8.3^{a}	0.12
Phosphorus	3.9^{b}	3.0^{b}	4.1^{a}	3.3^{b}	0.18
Potassium	12.0^{b}	7.0^{d}	14.0^{a}	9.3^{c}	0.30
Magnesium	1.9^{c}	4.4^{a}	4.6^{a}	3.4^{b}	0.13
Sodium	0.5	0.6	0.5	0.6	0.12

Means with different superscripts in the same row differ (P<0.05) significantly.

Table 3Phytochemical components (g/kg DM) of the experimental fodders

	P. thonningii	*D. microcarpum*	*S. kunthianum*	*I. doka*	SEM
CT	2.4^{d}	6.8^{b}	4.2^{c}	9.2^{a}	0.24
Saponins	25.5^{b}	14.6^{c}	9.9^{b}	28.6^{a}	1.06
Phytate	4.8^{d}	8.4^{b}	6.6^{c}	10.2^{a}	0.27
Oxalate	8.3^{c}	102^{b}	6.4^{d}	16.2^{a}	0.13

Means with different superscripts in the same row differ (P<0.05) significantly
CT, condensed tannins