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Chemical Evaluation of Foliage of some Tropical Leguminous Trees and Shrubs as Fodder

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ABSTRAK

Daun bagi tiga belas spesis iaitu; Afzelia africana, Albizia zygia, Baphia nitida, Cassia siamea, Delonix regia, Parkia biglobosa, Samanea saman, Caesalpinia pulcherrima, Cassia mimosoides, Desmodium velutinum, Flemingia macrophylla, Tephrosia bracteolata *and* T. densiflora *diambil dari penempatan terbiar dan kawasan penternak lembu Fulani sekitar Abeokuta, Nigeria. Contoh-contoh dianalisis untuk juzuk kehampiran : protein mentah {(CP) ekstrak eter, (EE), fiber mentah (CF), abu dan ekstrak tanpa nitrogen (NFE)}, dan paras makro - (Ca, P, Mg K dan Na) dan elemen-elemen mikro-mineral (Mn, Cu, Zn dan Fe). Nilai min CP, EE, CF, abu dan NFE untuk pokok-pokok masing-masing 15.2±3.5, 5.2±1.7, 17.8±3.7, 6.2±2.2 dan 46.8±3.1%. Nilai sepadan untuk tumbuhan renik ialah 15.4±1.3, 4.1±0.9, 19.3±1.1, 6.7±1.3 dan 46.4±2.8%. Daun yang dianalisis mengandungi paras Ca, Mg, dan Fe yang cukup untuk pembesaran pertumbuhan ternakan ruminan nilai min masing-masing 0.56±0.30%, 0.16±0.08% dan 131.1±74.2 ppm untuk pokok-pokok 1.15±0.49%, 0.2±0.06% dan 88.7±49.9 ppm untuk tumbuhan renik. Paras P, Cu, Zn dan K dalam daun tidak mencukupi dengan mengguna saranan NRC untuk ruminan (NRC 1981). Nilai min masing-masing ialah 0.09±0.06%, 3.9±3.1 ppm, 195±16.4 ppm dan 0.07±0.5%, 3.7±2.6ppm, 21.7±21.6 ppm dan 0.21± 0.14 bagi tumbuhan renik. Paras Na (0.11±0.07% bagi pokok; 0.06±0.04% untuk tumbuhan renik) dan Mn (96.0±142.9 ppm untuk pokok; 49.2±27.21 ppm untuk tumbuhan renik) lebih dari mencukupi. Dicadangkan supaya lebih usaha diambil bagi memelihara spesies ini kerana ianya mempunyai potensi nutrien yang lebih baik daripada rumput-rumput apabila digunakan sebagai foraj dalam musim kering.*

ABSTRACT

Foliage of thirteen leguminous species viz: Afzelia africana, Albizia zygia, Baphia nitida, Cassia siamea, Delonix regia, Parkia biglobosa, Samanea saman, Caesalpinia pulcherrima, Cassia mimosoides, Desmodium velutinum, Flemingia macrophylla, Tephrosia bracteolata *and* T. densiflora *were collected from the wild and the Fulani cattle rearers' settlement around Abeokuta, Nigeria. The samples were analysed for their proximate constituents: crude protein {(CP) ether extract (EE), crude fibre (CF), ash and nitrogen free extracts (NFE)}, and the levels of macro- (Ca, P, Mg, K and Na) and micro-mineral (Mn, Cu, Zn and Fe) elements. The mean values of CP, EE, CF, ash and NFE for trees were 15.2 ± 3.5, 5.2±1.7, 17.8±3.7, 6.2±2.2 and 46.8±3.1% respectively. The corresponding values for the shrubs were 15.4±1.3, 4.1±0.9, 19.3±1.1, 6.7±1.3 and 46.4±2.8%. The foliage analysed contained adequate level of Ca, Mg and Fe for growth of ruminant livestock with mean values of 0.56±0.30%, 0.16±0.08% and 131.1±74.2 ppm respectively for trees and 1.15±0.49%, 0.2 ±0.06% and 88.7±49.9 ppm for shrubs. The levels of P, Cu, Zn and K in the foliage were inadequate using the NRC recommendations for ruminants (NRC 1981). The respective mean values were 0.09±0.06%, 3.9±3.1 ppm, 19.5±16.4 ppm, and 0.07±0.5%, 3.7±2.6 ppm, 21.7±21.6 ppm and 0.21±0.14% for shrubs. The levels of Na (0.11±0.07% for trees; 0.06 0.04% for shrubs) and Mn (96.0±142.9 ppm for trees; 49.2±27.21 ppm for shrubs) were marginally adequate. It is suggested that more effort be undertaken to conserve these species as they have better nutritive potential than grasses when used as forage in the dry season.*

INTRODUCTION

The multiple advantages derived from the use of legumes in livestock feeding (Onwuka 1985) coupled with the lower levels of fertilizer needed for their establishment have led to the intensification of research on this group of plants. The escalating cost and fluctuating availability of livestock feedstuff in the tropics have created the need to seek cheaper alternative sources that are abundant for most of the year, are of high nutritive value, and are less harmful and non-competitive to arable crops.

Studies have been carried out on the growth and nutritive potential of leguminous plants, particularly well-known ones such as *Leucaena leucocephala, Gliricidia sepium* and *Stylosanthes gracilis* (Onwuka 1985; Akinsoyinu and Onwuka 1988; Alawa *et al.* 1990). However, a host of other promising leguminous shrubs are available and could be of importance to livestock production. These include *Cassia mimosoides, Tephrosia* spp., *Desmodium velutinum, Flemingia macrophylla* and *Caesalpinia pulcherrima*. Leguminous trees such as *Afzelia africana, Cassia siamea, Parkia biglobosa* and *Albizia zygia* produce green leaves in the dry season which can be harvested as fodder during drier spells.

The Fulani cattle rearers are known to use the leaves of *Afzelia africana* during the dry season to feed cattle when nutrients in grasses have decreased below the level that can maintain the minimum body requirements of their animals. In view of their potential as fodder, shrubs and trees which grow wild or are planted in parks and avenues, and whose foliage can be useful as forage, were identified and analysed for their proximate and mineral constituents.

MATERIALS AND METHODS

Foliage of 13 leguminous species consisting of 7 trees (*Afzelia africana, Albizia zygia, Baphia nitida, Cassia siamea, Delonix regia, Parkia biglobosa* and *Samanea saman*) and 6 shrubs (*Caesalpinia pulcherrima, Cassia mimosoides, Desmodium velutinum, Flemingia macrophylla, Tephrosia bracteolata* and *Tephrosia densiflora*) (Table 1) were collected from various locations, both from the wild and from areas around the Fulani settlements on the outskirts of Abeokuta, Nigeria.

Two samples of leaves (100 g wet weight) were harvested from mature trees and shrubs. Care was taken to ensure that each sample contained fairly equal quantities of young and mature but not dry leaves. Two trees/shrubs were sampled for each species.

The collection were carried out in the late dry season (1 December 1993–1 February 1994).

TABLE 1
Proximate chemical composition of foliage of some tropical leguminous trees and shrubs

Scientific Name	Dry Matter	Crude Protein	Ether Extract	Crude Fibre	Ash	NFE
Trees						
Afzelia africana	36.5	11.7	8.4	15.1	9.8	47.3
Albizia zygia	48.8	19.2	3.5	20.0	5.3	44.3
Baphia nitida	35.4	12.5	5.9	19.8	3.8	50.4
Cassia siamea	35.5	19.6	4.3	17.8	8.6	42.0
Delonix regia	40.6	13.3	4.3	20.4	6.4	47.9
Parkia biglobosa	49.3	12.1	4.0	20.6	5.3	50.3
Samanea saman	35.4	17.7	5.7	10.6	4.3	45.1
Mean	40.2	15.2	5.2	17.8	6.2	46.8
± SD	±6.3	±3.5	±1.7	±3.7	±2.2	±3.1
Shrubs						
Caesalpinia pulcherrima	38.3	14.3	4.8	18.4	4.6	50.2
Cassia mimosoides	50.0	15.5	4.7	20.5	6.4	45.2
Desmodium velutinum	40.8	15.7	4.8	21.1	8.4	42.4
Flemingia macrophylla	33.6	14.7	3.7	20.7	6.2	47.1
Tephrosia bracteolata	45.7	17.8	2.4	19.4	7.8	45.1
Tephrosia densiflora	40.3	14.4	4.0	18.9	6.7	48.3
Mean	41.5	15.4	4.1	19.3	6.7	46.4
± SD	±5.7	±1.3	±0.9	±1.1	±1.33	±2.8

An average temperature and relative humidity of 30.1°C and 69% respectively prevailed during the collection period. The plants were identified at the Forestry and Pasture and Range Management Departments of the University of Agriculture, Abeokuta, Forestry Research Institute of Nigeria (FRIN), Ibadan and the Department of Botany, University of Ibadan, Nigeria.

All samples were oven dried at 60°C for 48 h to determine the moisture content. The samples were milled and then representative samples (20 g dry weight) of the pooled samples for each tree or shrub species were stored in tightly corked and labelled bottles for further analysis.

The proximate analysis of the foliage (CP, CF, EE, ash and NFE) was determined by the AOAC (1990) methods. The mineral elements, such as Mg, Zn, Cu, Fe, and Mn, were analysed by using the Perkin-Elner atomic absorption spectrophotometer, while Na, K and Ca were determined using the flame photometer, and P was according to AOAC (1984) methods.

RESULTS AND DISCUSSION

Proximate Analysis

The dry matter range of the samples was 35.4-49.3% for trees and 33.6-50.0% for shrubs. These values are higher than those reported by Mecha and Adegbola (1980) (33.1±0.6%) who had collected samples in the wet season. The differences indicate the effect of season on the dry matter content of leaves. These results show that the foliage analysed in this study contained considerable levels of organic and inorganic matter. The highest mean crude protein content (19.6%) was recorded for *Cassia siamea* and the lowest (11.7%) for *Afzelia africana* (Table 1). The seven tree species had a mean CP value of 15.2±3.5% and the six shrubs 15.4±1.3%. In comparison, the CP content of dry grasses in the savanna during the dry season was 1.4% (Kapu 1975). Wilson (1977) showed that shrubs in some areas of Australia were remarkable in retaining their high N content and digestibility throughout dry periods in contrast to the low value of mature annual grasses. This indicates the considerable advantage of legume foliage over grasses in the dry season. The foliage with the highest EE content was *Afzelia africana* (8.4%) while *Tephrosia bracteolata* had the lowest value of 2.4%.

The foliage analysed (Table 1) had lower CF content than grasses (28.8%) analysed by Mecha and Adegbola (1980), but conform to those legumes analysed by Alawa *et al.* (1990). Grazing livestock in tropical countries usually do

TABLE 2
Mineral profile of foliage some tropical leguminous trees and shrubs

Scientific Name	Ca %	P %	Mg %	K %	Na %	Ma %	Cu %	Zn %	Fe %	Ca:P %
Trees										
Afzelia africana	0.49	0.05	0.08	0.20	0.04	68.0	0.8	6.5	132.7	9.8
Albizia zygia	0.27	0.11	0.09	0.32	0.07	40.0	0.8	6.5	49.3	2.5
Baphia nitida	0.40	0.04	0.20	0.10	0.03	47.2	3.5	12.9	98.6	10.0
Cassia siamea	0.57	0.16	0.31	0.39	0.16	416.9	5.9	54.6	254.8	3.6
Delonix regia	0.55	0.10	0.12	0.35	0.12	17.7	2.1	19.8	200.7	5.5
Parkia biglobosa	0.42	0.04	0.12	0.45	0.11	64.1	4.6	9.7	62.7	10.5
Samanea saman	1.22	0.17	0.22	0.33	0.21	17.9	9.3	26.5	120.3	7.2
Mean	0.56	0.09	0.16	0.31	0.11	96.0	3.9	19.5	131.1	7.0
± SD	±0.30	±0.06	±0.08	±0.12	±0.07	±142.9	±3.1	±16.4	±74.2	±3.2
Shrubs										
Caesalpinia pulcherrima	1.19	0.17	0.23	0.48	0.48	0.14	44.3	8.2	150.0	7.0
Cassia mimosoides	0.54	0.07	0.09	0.35	0.07	80.1	3.9	6.1	126.0	7.8
Desmodium velutinum	0.85	0.05	0.08	0.17	0.04	35.12	4.7	7.2	31.0	17.0
Flemingia macrophylla	1.35	0.02	0.16	0.06	0.03	15.0	1.8	13.7	77.3	67.5
Tephrosia bracteolata	0.88	0.04	0.19	0.14	0.04	83.3	3.2	60.9	101.2	22.0
Tephrosia densiflora	2.08	0.04	0.45	0.18	0.05	36.6	0.6	9.2	46.6	52.0
Mean	1.15	0.07	0.20	0.21	0.06	44.2	3.7	21.7	88.7	28.8
± SD	±0.49	±0.50	±0.06	±0.14	±0.04	±27.2	±2.6	±21.6	±45.9	±24.9
* Requirements	0.18	0.16	0.04	0.50	0.04	20.0	10.0	20.0	10.0	1.0
	-1.04	-0.37	-1.00	-0.80	-1.10	-40.0	-5.0	-50.0	-50.0	-2.0

* Nutrient requirement for domestic animals (NRC 1981)

not receive mineral supplementation except for common salt, and therefore depend upon forage for their mineral requirements (Akinsoyinu and Onwuka 1988). Mean values of ash in the foliage of trees and shrubs analysed in this study were 6.2±2.2 and 6.7±1.3% respectively.

Minerals

All the leguminous plants appear to be good sources of calcium, although the availability of calcium in such foliage needs to be ascertained. However, P content was fairly low (Table 2), ranging from 0.02% in *Fleminigia macrophylla* to 0.17% in *Samanea saman*. McDowell *et al.* (1984) stated that P is deficient in ruminant forage in Nigeria. These values compared favourably with those obtained by Le Houerou (1980) who also analysed foliage in West Africa.

The Ca : P ratio was remarkably wide in all leguminous species analysed, except *Albizia zygia* which was near the normal NRC (1981) recommended Ca : P ratio of 1 : 2 for ruminants. Magnesium values were fairly adequate but were less than the upper limit of the recommended 1.0% in all samples analysed. Hence supplementation will be necessary if the foliage is the sole source of fodder. All the values obtained for K were noticeably low. The Mn content of the foliage analysed was marginally adequate, but Na content was marginally inadequate. Almost 70% of the samples analysed had lower values for Cu and Zn than the NRC requirements. *Samanea saman, Caesalpinia pulcherrima* and *Cassia siamea,* however, had high values of these minerals relative to the foliage of the other species analysed. The values obtained for Cu and Zn were lower than those obtained by Akinsoyinu and Onkuwa (1988). Iron supplementation would not be necessary since all foliage analysed was far above required levels.

The results of this study show that foliage of these tropical leguminous trees and shrubs is of higher potential than grasses and is fairly adequate in all mineral elements analysed except Cu, Zn, P and K. More effort should be targeted at the development and utilization of these species as sources of fodder, particularly in the dry season.

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