Trop. Anim. Prod. Invest. 18 (1): 12-17 (2015)
ISSN: 1115-2540
http://animalsci.agric.ui.edu.ng/TAPI/index.php/tapijournal/index

ORIGINAL RESEARCH ARTICLE

Nutritional assessment of leaves and seeds of some horticultural trees and shrubs as feed for ruminants in southwest Nigeria

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ABSTRACT

The nutritional potential of leaf meal (LM), seed meal (SM) and a mixture of both LM and SM (LMSM) of Bauhinia monandra, Bauhinia acuminata, Acacia nilotica and Terminalia catappa were assessed for animal feeding. The LM, SM and LMSM were analysed for proximate composition, fibre fractions and antinutients. Crude protein (CP) contents ranged from 28.18 g/100gDM in Terminalia Catappa LM to 11.53 g/100g DM in Bauhinia acuminata LMSM). Ether extract (EE) was highest (P<0.05) in Bauhinia monandra LM (53.50g/100g DM) and followed by B. monandra SM and B. acuminata LM (38.00 and 16.50 g/100g DM respectively). Neutral detergent fibre (NDF) was highest (P<0.05) in Terminalia catappa SM (63.20 g/100g DM) and lowest (P<0.05) in A. nilotica SM and LMSM (39.95 and 40.00 g/100gDM respectively). The highest (P<0.05) saponin and tannin concentrations (565.5 and 48.0 mg/100g DM respectively) were observed in Terminalia catappa SM and the least values (19.5 and 3.0 mg/100g DM respectively) were observed for Bauhinia acuminata LM. It is concluded that the leaf meal, seed meal and leaf + seed meals of the tropical trees and shrubs and the horticultural plants could be used as animal feeding resources, apart from their aesthetic values.

Keywords: Feeding resources, horticultural plants, leaf meal, nutritive value, seed flower

INTRODUCTION

Ruminant production systems are based on forages with pasture grass and legumes being predominant (Mohammed and Halim, 2014). However, the ruminant productivity is hampered in the recent times by forage scarcity, particularly in the dry season. This scarcity is hugely as a result of prevailing climate change phenomenon and urbanization which has affected in no small measure the availability of vast grazing lands for feeding ruminants. The resultant effect is the low productivity of these ruminants, high cost of meat, meat products, conventional feedstuff that hitherto had been cheap.

Foliages from browse and fodder trees, legumes and shrubs have high protein content ranging from 14% to 25% (Yashim *et al*. 2013). Some of these foliages are available and evergreen. However, Alawa and Amadi (1991) reported that some of the limiting factors associated with using browse plants, herbs and shrubs as animal feeds include harvesting, storage, high fibre content, toxic substances, poor digestibility and low performance when fed to the animals. Thus, there is need to further investigate the use of these browses, herbs and shrubs because of their relative availability as alternative feed resources to livestock (Tegbe *et al*. 2006).

Bauhinia acuminata and Bauhinia monandra are tree-legume plants or shrubs which belong to the family of Caesalpiniaceae. They grow in a fair range of soils. The flowers are pink, blue or white in colour. *Bauhinia acuminata* is a species of flowering shrub native to tropical southeastern Asia, but are also found locally. It grows two to three meters tall. Like the other *Bauhinia* species, the leaves are bi-lobed, shaped like an ox hoof. It is widely cultivated throughout the tropics as an ornamental plant (Anhwang, 2005). *Bauhinia monandra* is an ornamental tree commonly found in West Africa and India. In Nigeria *B. monandra* is fairly widely distributed throughout the natural grassland of northern Nigeria, stretching throughout the savanna. It is a spreading tree with large leaves, pink and white flowers. Pods are flattened, leathery and green when fresh but brownish to black when dry. Agbede (2007) submitted that the leaf meal as well as the seed flours from processed *Bauhinia tomentosa* apart from its aesthetic value could be used as animal feed. The study was therefore focused on investigating the nutritive composition of the leaf meals (LM), seed meals (SM) and a mixture of the leaves and seed meals (LMSM) of *Bauhinia acuminata* and *Bauhinia monandra* in comparison with other tropical forages as feed for ruminants.

MATERIALS AND METHODS

Sample collection and preparation

Leaves and seeds of two browse trees: Acacia (*Acacia nilotica*), Almond fruit (*Terminalia catappa*), and two horticultural plants: Bauhinia (*Bauhinia monandra* and *Bauhinia acuminata*) were sampled for the study. The leaves and seeds of *Acacia nilotica*, *Bauhinia monandra* and *Bauhinia acuminata* were harvested during the dry season from mature trees in Akure, Nigeria. The leaves and seeds of *Terminalia catappa* were harvested in Ipara Remo, Ogun State, Nigeria. The leaves were washed to remove dirt and air-dried under shade till the leaves crumpled.

Seed flour

The almond fruit was first dried and then cracked manually to remove the seeds. Pods of the other plants were split open, and seeds were removed, sorted and then hammer-milled through a 1 mm sieve. The milled seeds and leaves of each plant were mixed together in the ratio 1:1 to form leaf and seed meal. All samples were kept in cellophane bags till required for analysis.

Chemical Analysis

Leaves and seeds of trees were oven dried at 65°C to constant weight for dry matter determination. Crude protein, crude fibre, ether extract and ash were analyzed as described (AOAC, 1999). Neutral detergent fibre, acid detergent fibre and acid detergent lignin were determined according to the methods of Van Soest *et al* (1991)

Antinutritional factors determination

The saponin and tannin levels were determined following the methods of Harborne (1980) while the level of oxalate in the sample was determined by titration (Onwuka, 2005). Phytates were determined as described (Makkar and Goodchild, 1996).

Statistical Analysis

All data were subjected to analysis of variance (ANOVA) using SPSS 16.0 software package. Significant treatment means were compared using multiple range test (Duncan, 1955) of the same package.

Table 1: Chemical composition (g/100 g DM) of leaves and seeds of some trees and shrubs in Southwest Nigeria

Samples	CP	CF	EE	ASH	DM
B. acuminata LMSM	11.53±0.25^{bcd}	25.00±1.41^{ab}	11.00±1.41^{d}	7.50±2.12^{ab}	90.41±1.26^{ab}
T. catappa LMSM	15.05±5.94^{bcd}	27.00±0.00^{a}	10.50±0.71^{d}	8.00±1.41^{ab}	89.08±2.64^{ab}
B. monandra LMSM	15.25± 0.49^{bcd}	21.50±4.95^{ab}	12.50±0.71^{d}	11.50±0.71^{a}	90.80±0.35^{ab}
A. nilotida LMSM	22.23± 6.68^{abc}	22.50±3.54^{ab}	9.50±0.71^{d}	8.00±0.00^{ab}	90.00±0.33^{ab}
B. acuminata LM	24.85±0.49^{ab}	17.50±2.12^{bc}	16.50±3.54^{c}	4.00±1.41^{b}	90.52±0.21^{ab}
T. catappa LM	28.18±8.66^{a}	8.00±1.41^{d}	11.50±0.71^{d}	3.50±0.71^{b}	91.35±0.72^{a}
B. monandra LM	21.35±0.49^{abc}	8.50±0.71^{d}	53.50±0.71^{a}	6.50±3.54^{ab}	86.62±0.84^{c}
A. nilotida LM	21.60±4.81^{abc}	18.00±9.90^{bc}	10.50±0.71^{d}	13.13±8.66^{a}	90.12±0.91^{ab}
B. acuminata SM	19.25±4.95^{abc}	25.00±1.41^{ab}	12.50±2.12^{d}	8.00±0.00^{ab}	90.32±0.44^{ab}
T. catappa SM	21.88±5.69^{abc}	23.00±0.00^{ab}	11.50±0.71^{d}	7.50±0.71^{ab}	90.34±0.24^{ab}
B. monandra SM	13.13±1.24^{d}	11.50±0.71^{cd}	38.00±1.41^{b}	7.50±0.71^{ab}	88.31±0.62^{bc}
A. nilotida SM	18.73±0.25^{abc}	23.50±3.54^{ab}	10.00±0.00^{d}	6.50±0.71^{ab}	90.51±1.14^{ab}

a, b, c, d; Means within the same column with different superscripts are significant ($P<0.05$); CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, DM = Dry Matter; LM = Leaf meal, SM = Seed Meal, LMSM = Mixture of Leaf meal and Seed Meal

RESULTS AND DISCUSSION

Chemical composition of leaves and seeds of the trees and shrubs harvested are shown in Table 1. *Terminalia catappa* LM had the highest (P<0.05) values for crude protein (CP) (28.18 g/100gDM) and closely followed by *Bauhinia acuminata* LM. The least CP value of 13.13 g/100gDM was for *Bauhinia monandra* SM. The CP values reported for *Bauhinia monandra* LM, *Acacia nilotida* LM, and *Bauhinia acuminata* SM and *Terminalia catappa* SM were 21.35, 21.60, 19.25 and 21.88 g/100gDM, respectively. The CP values of the leaves and seeds for all trees and shrubs sampled were high enough to be used as forage for animals, since values obtained in this study are higher than the critical values of 60–70 g/kg as reported by Minson (1983). The values of CP for the bauhinia species ranged from 21.35 to 24.85 g/100g DM. These values were similar to CP value (19.9 g/100gDM) reported for *Ficus polita* (Abegunde *et al*., 2011), but lower than 26.75 - 31.69 g/100g DM reported for *Bauhinia monandra* (Agbugui *et al*., 2010). The values were also lower than that of 34.5g/100g DM reported for whole raw seeds of *Bauhinia tomentosa* (Agbede, 2007). The high values of CP in bauhinia species which are horticultural plants make them suitable as protein supplement in ruminant diets.

Crude fibre (CF, g/100gDM) was observed to be highest (P<0.05) for *Terminalia catappa* LMSM (27.00), while the least value was observed for *Terminalia catappa* LM and *Bauhinia monandra* LM (8.00 and 8.50 g/100gDM, respectively). Crude fibre values (8 to 27.00) in both the seeds and leaves of the trees and shrubs under study were lower than 74.1 to 58.9 reported for some dry season grasses, legumes and browse plants (Babayemi, 2007). This observation may be due to the effect of season, since the samples used by Babayemi were sourced during the dry season.

Table 2: Fibre fractions (g/100g DM) in leaves and seeds of some trees and shrubs in Southwest Nigeria

Samples	NDF	ADF	ADL
B. acuminata LMSM	44.75±0.35[f]	23.00±0.00[e]	10.03±0.04[fg]
T. catappa LMSM	51.00±0.00[e]	39.05±0.07[b]	18.50±0.71[b]
B.monandra LMSM	41.65± 0.49[g]	25.00±0.00[d]	10.95±0.07[ef]
A. nilotica LMSM	40.00± 0.00[h]	22.05±0.07[f]	9.75±0.35[g]
B. acuminata LM	55.00±0.00[d]	34.25±0.35[c]	16.45±0.78[c]
T. catappa LM	60.50±0.71[b]	45.05±0.71[a]	20.00±0.00[a]
B. monandra LM	58.60±0.57[c]	45.25±0.35[a]	20.23±0.32[a]
A. nilotica LM	58.00±0.00[c]	44.58±0.81[a]	18.00±0.00[b]
B. acuminata SM	44.28±0.39[f]	24.74±0.37[d]	12.45±0.64[d]
T. catappa SM	63.20±0.28[a]	45.00±0.00[a]	20.55±0.64[a]
B. monandra SM	41.10±0.14[g]	24.50±0.35[d]	11.10±0.14[e]
A. nilotica SM	39.95±0.07[h]	21.50±0.71[f]	10.20±0.28[efg]

[a,b,c,d,e,f,g]; Means within the same column with different superscripts are significant (P<0.05); NDF = Neutral detergent fibre, ADF = Acid detergent fibre, ADL = Acid detergent lignin; LM = Leaf meal, SM = Seed flower, LMSM = Mixture of Leaf meal and Seed Meal

Ether extract (g/100g/DM) was highest (P<0.05) in *Bauhinia monandra* LM (53.50) and lowest (P<0.05) in *Acacia nilotida* LMSM (9.50) Ether extract value for *Bauhinia monandra* leaf meal were higher than values of 13.1% reported for *Myrianthus arboreus* (Amata, 2010) and 0.5% for *Gmelina arborea* (Moemeka *et al*., 2013). The ash content varied between 13.13 g/100g DM for

Acacia nilotida LM and 3.50 g/100g DM in almond leaf meal. These are similar to values of 13.33% and 9.15% for *Gmelina arborea* and *Pennisetum purpureum* respectively (Moemeka *et al*, 2013)

Variations in the fibre fractions (g/100g DM) of leaves and seeds of these selected trees and shrubs are shown in Table 2. The NDF values were observed to be highest (P<0.05) in *Terminalia catappa* SM (63.20) and lowest (P<0.05) in both *Bauhinia monandra* LMSM (41.65) and *Bauhinia monandra* SM (41.10). NDF values reported in this study ranged from 39.95 to 63.20 g/100g DM with *Terminalia catappa* SM having the highest value. The NDF in the seeds and leaves of shrubs and trees were comparable to those reported for some multipurpose trees in Nigeria (Larbi *et al*., 1993). The ADF values were similar in *Terminalia catappa* LM, *Bauhinia monandra* LM, and *Acacia nilotida* LM (45.05, 45.25 and 44.58 respectively). The Acid detergent lignin **(**ADL) values ranged from 9.75 g/100g DM in *Acacia nilotida* LMSM to 20.55 g/100g DM in *Terminalia catappa* SM. The ADL values for *Bauhinia acuminata* in this study (12.45g/100g DM) was similar to 12.50g/100g DM reported for *Celtis integuifolis* (Njidda, 2010).

Table 3: Antinutrient composition (mg/100g DM) of leaves and seeds of some trees and shrubs in Southwest Nigeria

Samples	Saponin	Tannin	Phytate	Oxalate
B. acuminata LM	19.5±2.12^{f}	3.0±0.14^{f}	2.4±0.14^{e}	1.4±0.21^{e}
T. catappa LM	23.5±2.12^{f}	3.8±0.14^{f}	4.5±0.21^{e}	3.5±0.28^{e}
B. monandra LM	44.0±1.41^{e}	6.0±0.41^{d}	7.1±0.21^{d}	6.3±0.21^{d}
A. nilotica LM	275.5±2.12^{b}	32.0±1.41^{b}	296±1.41^{b}	176.5±2.12^{b}
B. acuminata SM	82.5±2.12^{d}	17.0±1.41^{d}	84.5±2.12^{c}	57.0±1.41^{c}
T. catappa SM	565.5±2.12^{a}	48.0±1.41^{a}	472.5±2.12^{a}	313.0±2.83^{a}
B. monandra SM	260.0±1.41^{c}	26.5±2.12^{c}	289.5±2.12^{b}	172.0±1.41^{b}
A. nilotica SM	247.0±1.41^{c}	24.50±2.12^{c}	282.0±1.41^{b}	166.0±1.41^{b}

a, b, c, d, e, f; means along the same column with different superscripts are significant (P<0.05); LM = Leaf meal, SM = Seed meal, LMSM = Mixture of Leaf meal and Seed meal

The *Terminalia catappa* SM contained highest saponin level (0.57 mg/100g DM) while the least value was observed in both *Bauhinia acuminata* LM and *Terminalia catappa* LM (0.02g/100g DM respectively). Tannin concentrations was highest (P<0.05) in *Acacia* nilotida SM (0.25) while it was absent in *Bauhinia acuminata* LM and *Terminalia catappa* LM. Phytate and oxalate levels were both significantly highest (P<0.05) in *Terminalia catappa* SF and absent in *Bauhinia acuminata* LM and *Terminalia catappa* LM. Antinutritive factors are substances generated in natural feedstuffs during the normal metabolic process within the plant e.g. inactivation of some nutrients, interference with the digestive process or metabolic utilization of feeds which exerts effects contrary to optimum nutrition (Aganga and Tshwenyane, 2003). *Terminalia catappa* SF had the highest saponin and tannin levels (565.5 and 48.0 mg/100g DM, respectively). The results corroborate the findings of Akpabio (2012), who reported mean value of 39.40mg/100g tannin in *Terminalia catappa* seeds. *Acacia nilotica* LM and *Acacia nilotica* SF also showed relatively high levels of antinutrients investigated. However the values of tannins reported in this work are relatively low such as to confer some advantages to the animals taking them since D'Mello, (2000) suggested that at moderate levels (30 to 40 g/Kg legume dry matter), condensed tannin may result in nutritional advantages in respect of increased bypass protein availability and bloat suppression in cattle. Higher levels (100 to 120 g CT's/Kg legume dry matter) reduced gastrointestinal parasitism in lambs (D'Mello, 2000). Nyaganga (2001) reported tannin value of 65.3 mg/100g in *Acacia nilotica*, which is higher than those reported in this study. The levels of antinutrients were low in the Bauhinia species. Such low levels of antinutrients in the Bauhinia species could suggest that apart from its aesthetic values to man, *Bauhinia monandra* and *Bauhinia acuminata* could be of use in animal feeding. The leaves could be an important source of relish to rabbit and ruminants (Agbede, 2007).

CONCLUSION

The study shows that the leaves and seeds of *Bauhinia acuminata and Bauhinia monandra* could be of use as supplement in ruminant feeding. These plants are available, and ever-green, all year round, which indicate their importance as dry season forage for ruminants. Further investigations on other anti nutrients, herbage/forage yield and acceptability to ruminants should be made.

CONFLICT OF INTEREST

The authors declare that there is no known conflict of interest as regards the conduct of this study and the data reported in this work.

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