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Physico-Chemical and Anti-Nutritional Properties of Some Lesser Known Tree and Leguminous Seeds

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Abstract: Seeds of *Adansonia digitata*, *Voandzeia subterranean* (L.) Thouars, *Bilighia sapida*, *Entada africana*, *Leucana leucocephala* and *Mucuna preta* were evaluated for their nutritional quality and possible inclusion in ruminant diet. The seeds were analysed for their proximate composition, fibre fractions, mineral composition, energy value and the anti-nutritional factors. The results revealed that the seeds contained between 10.5 and 41.4% crude protein, 7.5 and 22.5% ether extract, 15.5 and 19.5% crude fibre, 17.0 and 39.0% acid detergent fibre, 41.0 and 84.0% neutral detergent fibre and 4.38 and 5.46 kcal/100 g ME. It was also observed that the sodium content was between 0.10 and 0.30 mg/100 g, 1.9 and 15.5 mg/100 g calcium, 8.95 and 46.10 mg/100 g magnesium while the potassium was between 8.95 and 45.15 mg/100 g and the iron content falls between 0.17 and 0.95 mg/100 g. Some anti-nutritional factors (tannin and saponin) were detected and quantified. In conclusion, all the seed samples are potential good sources of dietary energy, protein and mineral content in livestock diet.

Key words: Proximate composition, fibre fractions mineral content, anti-nutritional factors, tree and leguminous seeds

INTRODUCTION

Agriculture has played a key role in kick-starting economic growth and reducing poverty and hunger in many developing countries. Most of the developing countries that have failed to launch an agricultural revolutions remain trapped in poverty, hunger and economic stagnation (Hazell, 2006). The situation is worsened by lack or insufficient availability of feed for livestock, mostly during the dry season.

Recently, some developed countries like USA, China, Brazil, etc. are worried over the use of maize in the production of biofuel ethanol. The yellow corn used in feed formulation also is the feedstock for a projected capacity of 27 billion litre of ethanol from a total of more than 130 plants. It was reported that about 15% of the country's corn crop goes into ethanol production. The aforesaid situation creates nervousness about the future availability of maize for use in animal feed around the globe. The situation could be saved if appropriate alternative energy and protein could be sourced for through research.

Reynolds and Ekurukwe (1988) opined that protein rich supplement improves nutrition of sheep in small holder grass based system; it also increased resistance to disease such as trypanosomes. The raising of ruminant animals under traditional and subsistence agricultural systems make good use of low quality feed in keeping the animals.

Although, poor performance of the animals occur as a result of the use of cheaper and lesser known and unconventional feed supplements which also represent low-cost towards improving animal performance. In this regards, many attempts have been made in evaluating the chemical composition

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and the nutritional potentials of some legumes and browse plants as feed supplements (Morton, 1987; Balogun and Fetuga, 1989). However, there are still many leguminous and tree seeds (*Bilighia sapida*, *Leucana leucocephala*, *Mucuna preta*, *Etanda africana*, *Adansonia digitata*) that need to be evaluated for their nutritional qualities in livestock feed.

Bilighia sapida (Akee apple) plant is indigenous to forest of the Ivory coast and Gold coast of West Africa. It belongs to the family, Sepiaceae. The seed could be eaten raw or in soup or after frying in oil (Lewis, 1965). However, the seed was equally reported to be toxic. *Bilighia sapida* poisoning is evidence by acute vomiting, sometimes with diarrhoea followed by drowsiness, convulsion, coma and often death (Anderen, 1975).

The importance of *Bilighia sapida* includes its use in laundering, soap making, stimulant and cologne. The sapwood is use for construction and pilings in railway sleepers, oars, paddle and casks while the aqueous extract of the seed has been used to expel parasites. When the aril is blend with sugar and cinnamon, it can be used in the treatment of dysentery. Various parts of the tree can be used for the treatment of epilepsy and yellow fever.

Adansonia digitata plant is also known as baobab, cream of tartar tree, monkey-bread tree, dead-rat tree. The leaf of the plant is rich in vitamin C, sugar, potassium tartrate and calcium. It is also useful as vegetable. The seeds are edible and it can be roasted and use as coffee substitute.

Voandzela subterranean (Bambara nut) nut is the second most vital legume which has about 24% protein with a good balance of amino acids and high proportion of lysine and methionine. It is also rich in starch, vitamins and it has also some anti-nutritional factors like saponin, phytic acids and tannins (Poulter, 1981).

Leucaena leucocephala plant originated from America and the Yucatan Pennisula of Mexico. It is thornless long lived shrub or tree. The value of the tree is multifaceted and the potential of increasing and diversifying the use of this wonderful species is enormous. The leaves are highly nutritious in ruminant diets, the strips serve as a form of alley farming, the trunk could be used for paper pulp while the seed could be used as necklace. Also, the young leaves and the seed can be used as vegetable for human consumption. The tree could also produce gum which is similar to that of Arabica gum. However, it has some anti-nutritional factors like mimosine, which when consumed excessively could results in alopecia.

Mucuna preta is also known as Ojo de venado (clear eyes) and sea beans because they often become drift seeds. The seeds are collected and can be used as necklace and bracelets or can be used as violent cathartic. Additionally, the plant can be used to suppress weeds.

Etanda africana tree is found in Guinea savannah and Sudano. It is evenly distributed from Senegal to Cameroon as well as Sudan, Central and Eastern Africa.

The plant flowers at the end of rainy season and at the same time the leaves open. It is a medicinal plant used for the treatment of cough and other respiratory disorder, the leaves was also found to be a good fodder.

The seed which is used as toxic abortifiacient (Oduguwa *et al*., 1997) contained the following anti-nutritional factors, protease inhibitor, lectin/ricin, saponin, tannins, phytic acid, oxalic acid, glucosinolates, gossypol and mimosine. Therefore, the thrust of this work was to evaluate the nutritional and anti-nutritional properties of these lesser-known seeds (*Bilighia sapida*, *Adansonia digitata*, *Voandzeia subterranea*, *Leucana leucocephala*, *Mucuna preta* and *Etanda africana*. The information is intended to serve as a pre-requisite for further investigation into their feeding values.

MATERIALS AND METHODS

About 1 kg of each of the six different lesser known mature seed (*Adansonia digitata*, *Voandzeia subterranea*, *Bilighia sapida*, *Entada africana*, *Leucena leucocephala* and *Mucuna preta*) were obtained

from the Teaching and Research Farm, University of Ilorin, Nigeria. The seeds were handpicked so as to eliminate all unwanted materials.

Sample Preparation

Each of the seed was carefully cleaned and divided into 10 lots to represent 10 replications. Each of the replicate was sundried for three days, later milled and kept in individual labeled airtight containers until needed for analysis.

Physico-Chemical Analysis

The physico-chemical analysis of the seeds comprised of the following basic determinations which were carried out according to the method of AOAC (1990): crude protein, crude fibre, ether extract, dry matter and ash. The fibre fractions were determined using the method of Van Soest (1966), while mineral composition (Calcium, Magnesium, Sodium, Potassium and Iron) was determined by using Atomic absorption spectrophotometer model 200A (Issac and Johnson, 1975). Various anti-nutritional factors (Tannin and saponin) were determined by using the procedure of Mahmod *et al*. (1994).

Statistical Analysis

All data collected were subjected to analysis of variance of a completely randomized design model (n = 10) (Steel and Torrie, 1960) while treatment means were separated using Duncan (1955) multiple range test.

RESULTS AND DISCUSSION

The results of the proximate composition are shown in Table 1, along with the fibre fractions. It is worth noting that more than 60% of the parameters evaluated showed significant differences ($p<0.05$). The dry matter percentages are within the range in which it could be safely stored.

The crude protein content varied from 10.5 to 41.3% (Table 1). The crude protein content was greatest for *Etanda africana*, *Leucana leucocephala* and *Mucuna preta*, greater for *Adansonia digitata* and great for *Voandzeia subterranea* and *Bilighia sapida* which are significantly different ($p<0.05$). Except, *Bilighia sapida* which has the lower crude protein content, other seeds have crude protein content which was higher than the commonly cultivated legumes such as Black grain, green gram (Kadule *et al*., 1974; Gupta and Wagle, 1978) Chickpea (Jambunathan and Singth, 1980), Pigeon pea (Nwokolo, 1987) and some *Acacia* species (Ijayakumari *et al*., 1994).

The higher crude protein content of these seeds is adequate for lactating and non lactating animals. Additionally, the higher crude protein content of the seeds could be stored by cattle in their blood, liver and muscle (Platt *et al*., 1964).

The crude fibre content was highest for *Leucaena leucocephala* followed closely by *Voandzeia subterranea*, *Adansonia digitata*, *Bilighia sapida*, *Mucuna preta* and *Etanda africana* in that order (Table 1). The crude fibre content reported herein was within the limits established by NRC (1978) for ruminant animals, thus ensuring proper digestion and rumination.

The ether extract content recorded for all the seeds were higher than the value recorded for Acacia leucophloea (Ijayakumari *et al*., 1994). The improved ether extract would equally influence the energy available to animals if such seeds are included in ruminant diet (NRC, 1978).

The high lipid (ether extract) rich nature of the seeds resulted in higher energy value than the commonly cultivated pulse crops (Kuzayi *et al*., 1966). The metabolizable energy recorded for all the samples indicated adequacy for ruminant animals. The result fell within the values recommended by NRC (1978).

Table 1: Proximate composition and fibre fractions of the lesser known seeds**

Components	*Etanda africana*	*Leucaena leucocephala*	*Voandzeia subterianea*	*Adansonia digitata*	*Bilighia sapida*	*Mucuna preta*	±SEM
Dry matter (%)	80.00	81.00	83.00	92.00	85.00	90.00	4.45^{NS}
Crude protein (%)	39.81^{a}	41.34^{a}	23.41^{c}	37.63^{b}	10.50^{d}	38.50^{a}	3.15*
Crude Fibre (%)	15.50^{c}	19.50^{a}	17.00^{b}	16.50^{b}	17.00^{b}	18.50^{a}	2.02*
Ether extract (%)	17.50^{b}	12.50^{c}	12.50^{c}	22.50^{a}	17.50^{b}	7.50^{d}	2.13*
Metabolizable energy (kcal kg^{-1})	4.88^{b}	4.58^{d}	4.38^{e}	5.46^{a}	4.48^{c}	4.62^{b}	1.45*
Acid detergent fibre (%)	39.00^{a}	24.00^{c}	18.00^{d}	17.00^{d}	36.00^{b}	35.00^{b}	3.76*
Neutral detergent fibre (%)	53.00^{c}	53.00^{c}	47.00^{d}	84.00^{a}	41.15^{c}	65.30^{b}	3.89*

Mean with same superscript are not significantly different from each other (p>0.05), **: Mean of 10 determinations

Table 2: Mineral analysis of the lesser known seeds**

Components	*Etanda africana*	*Leucaena leucocephala*	*Voandzeia subterianea*	*Adansonia digitata*	*Bilighia sapida*	*Mucuna preta*	±SEM
Sodium (%)	0.20^{a}	0.10^{b}	0.30^{c}	0.10^{b}	0.10^{b}	0.20^{a}	0.05*
Calcium (%)	7.66^{a}	5.77^{b}	3.72^{c}	15.50^{d}	5.46^{b}	1.98^{a}	0.98*
Magnesium (%)	45.42	42.21	42.31	46.11	43.47	39.54	3.67^{NS}
Potassium (%)	44.92^{a}	46.15^{c}	45.65^{a}	45.38^{a}	8.98^{b}	45.96^{a}	3.45*
Iron (%)	0.17^{a}	0.17^{a}	0.26^{b}	0.17^{a}	0.17^{a}	0.95^{c}	0.08*

Mean with same superscripts are not significantly different from each other (p>0.05), **: Mean of 10 determinations

Table 3: Qualitative and quantitative evaluation of the lesser known seeds**

Components	*Etanda africana*	*Leucaena leucocephala*	*Voandzeia subterranea*	*Adansonia digitata*	*Bilighia sapida*	*Mucuna preta*
Saponin	+++	++	+	+	---	---
Tannins	C	++	---	---	---	C
Saponin (%)	6.00	5.00	3.60	3.00	1.00	3.50
Tannin (%)	0.17	0.29	---	---	0.12	0.23

**: Mean of 10 determinations, +++: High concentration, ++: Medium concentration, +: Low concentration, C: Condensed Tannin, H: Hydrolyzed Tannin, ----: Nil

The higher acid detergent fibre recorded for all the seeds could maintain higher fat percentage at essentially normal levels (NRC, 1978).

The lower lignin content recorded is an indication that the animal will be able to consume and digest the seed better.

The higher Acid Detergent Fibre (ADF) and neutral detergent fibre (NDF) revealed that more energy will be available to the ruminant animals. The percentage distribution of the aforesaid fibre fractions are comparable to that of *Vigna sesquipedalis* (Rajarams and Janardhanan, 1990).

The mineral analysis (Table 2) reported in this study suggested that all the seeds are very rich in most of the mineral components. The values are higher than those reported for all cultivated legumes (Kuzayi *et al*., 1966) and various rice bean varieties (Singth *et al*., 1980). Most of the minerals are present in more than adequate levels when compared with NRC recommendation for ruminant animals (NRC, 1978).

However, screening of the seeds showed that some seeds have very low percentage of tannin and saponin (Table 3). The highest percentages of tannin and saponin were recorded in *Etanda africana* and *Leucaena leucocephala* (Table 3). The tannin content of all the seeds was lower than the results reported for *Acacia leucophloea*, green gram, cowpea, pigeon pea, blackpea (Khan *et al*., 1971; Rao and Deasthale, 1982; Ijayekumari *et al*., 1994).

CONCLUSION AND IMPLICATIONS

The results of this study revealed that all the seeds are potential good sources of dietary energy, protein and mineral for ruminant animals. The anti-nutritional factors detected in the seeds are heat liable hence, they can be eliminated easily by different processing methods (cooking, heating etc.). Due

to the overall nutritional qualities of the seeds their inclusion as alternative cheap source of protein and energy in livestock diet by economically weak farmers found mostly in the developing countries should be encouraged.

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