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ORIGINAL RESEARCH ARTICLE

# Nutritive and anti-nutritive contents of some selected browse plants in the Derived Savanna zone of Nigeria

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**ABSTRACT**

***The nutritive values of some selected browse plant leaves were investigated in a completely randomized design. They browse plant were Blighia sapida, Cajanus cajan, Parkia biglobosa, Ficus thonningii, Piliostigma thonningii, and Gliricidia sepium. The plants were collected from Oyo State College of Agriculture and Technology, Igboora, Nigeria and were analyzed for Proximate, Minerals and anti-nutritive components. Results showed significant differences (P<0.05). Higher Crude protein (%CP) was recorded for all selected browse plant samples which ranged from 12.45 to 17.06 %. A range of 1.90 to 2.39%, 17.09 to 30.88% and 8.15 to 15.95% respectively were recorded for Ether extract (%EE), Crude fiber (%CF) and Ash values for the selected browse plants. Ficus thonningii had the highest value of K (1.14%), Ca (0.53%), P (0.43%), Mg (0.47%), Fe (183.30mg/kg) and Zn (71.30mg/kg) while the least value were recorded for Gliricidia sepium compared to others. The values reported for anti-nutritive factors ranged from 0.67 to 1.42% for Phytate, 0.40 to 0.85% for Oxalate and 3.17 to 7.66mg/g for Trypsin inhibitor. The results showed that the browse species investigated had good nutrients contents, low and safe levels of anti-nutritional factors and may therefore serve as a good feed resource for modern intensive ruminant animal production.***

**Key words:** Browse forage species, anti-nutritive factors, Phytate, Oxalate, Trypsin inhibitor

## INTRODUCTION

Browse plants, besides grasses, constitute one of the cheapest sources of feed for ruminants (Ahamefule *et al,* 2006). These plants are important for ruminant production owing to their potentially good nutritive value. Browse is usually the primary and most economical source of nutrients for livestock, particularly meat goats. While it was reported that goats as natural browsers, have the unique ability to select plants when they are at their most nutritious state. And that goats which browses, have fewer problems of internal parasites (Gaiballa and Lee, 2012).

Browse plants provide vitamins and frequently mineral elements, which are mostly lacking in grassland pasture. Their year round evergreen presentation and nutritional abundance provides for year round provision of fodder (Oji and Isilebo, 2000). It also enables standing feed reserve to be built so that herds can survive critical periods of shortfall, or even prolonged periods of droughts, without remarkable losses (Odoh and Adamu-Noma, 2000).

Tree fodders are important source of high quality feed for grazing ruminants and as supplements to improve the productivity of herbivores fed on low quality feeds. Tree fodders form part of the complex interactions between plants, animals and crops (Aganga and Tshwenyane, 2003). They help to balance a plant-animal soil ecosystem and from which there is a sustainable source of feeds (Devendra, 1994). The availability of a variety of these feeds and the selection process enable the herbivores, especially the goats to extend as well as meet their feed preferences. Traditional farmers in the semi-arid region of Nigeria allow their goats, sheep and cattle to browse on tree forages, in the range lands and they also cut and feed these tree foliages as supplements based on experience and convenience (Njidda, 2010).

The quality of any forage material depends to some extent on the presence or absence of anti-nutritional factors. The anti-nutrient components of forage materials limit the availability and utilization of nutrient by the animals (Njidda, 2010). Anti-nutrients factors are those substances generated in the natural feedstuffs by the normal metabolism of the species, which exert effects contrary to optimum nutrition (Aganga and Tshwenyane, 2003).

Hence, the effects of high protein forage could override the effect of the toxic compounds when used as supplement in the diets (Njidda, 2010). The present study therefore examines the nutritive and anti-nutritive contents of some selected browse plants in the derived savanna zone of Nigeria.

## MATERIALS AND METHODS

### Experimental Site

The experiment was carried out at the Teaching and Research Farm of Oyo State College of Agriculture and Technology, Igboora which is located within $7^0$ $15^1$ North and $3^0$ $30^1$ East of the equator with an average rainfall of 1278mm and average annual temperature of $27^0$C (Sanusi, 2011)

### Sample Collection

Samples were taken from edible part of *Baligiha sapida, Cajanus cajan, Parkia biglobosa, Ficus thonningii, Pilostigma thonningii* and *Gliricidia sepium* leaves within the college premises. The samples were oven dried at $70^0$C, cooled in a desiccator and finely ground. The dried sample was used for the analysis except for moisture content determination in which fresh sample was used.

### Proximate Analysis

The air-dried leaves were and ground into fine powder. About 10.0g of the grounded leaves was exhaustively processed for various parameters according to the Association of Official Analytical Chemists methods ;(AOAC, 1990 and AOCS, 2000). The proximate analysis (fats, crude protein, moisture, crude fiber and ash) of the leaves were determined using AOAC methods. Using weight difference, moisture and ash were obtained. The fiber content was estimated from the loss in weight of crucible and its content on ignition. The nitrogen value, which is the precursor for protein of a substance, was determined by micro kjeldahi method, involving digestion, distillation and finally titration of the sample (AOCS, 2000). The nitrogen value was converted to protein by multiplying with a factor of 6.25. The determination of crude lipids content of the samples was done using soxhlet type of direct solvent extraction method. The solvent used was petroleum ether (boiling range 40-600c). The result of proximate value was all estimated as percentage (AOAC, 1990 and AOCS, 2000).

### Mineral Analysis

The mineral elements were analyzed according to the method of Walinga *et al.* (1989). The elements in the sample were brought into solution by wet digestion technique using a mixture of concentrated Nitric, Perdhloric and Sulphuric acids in the ratio 9:2:1 respectively. Fe, Zn, Ca and Mg were determined by Atomic Absorption Spectrometer while K was determined using atomic emission spectrometer and Phosphorus was determined using Calorimetric method.

### Anti-Nutritional Analysis

Oxalate was determined by the method of Krishna and Ranjhna (1980) while Phytate was determined by the AOAC, (1990) method. The trypsin inhibitor was determined using the procedure of Smith *et al.,* (1980).

### Statistical Analysis

Data obtained were analyzed with the general linear model SAS (1998) and the Duncan multiple range tests of the same package were used to detect significant differences among means at a probability level of 5%.

## RESULTS AND DISCUSSION

### Proximate Composition

Table 1 shows the proximate composition of selected browse plants leaves of *Baligiah sapida, Cajanus cajan, Parkia biglobosa, Ficus thonningii, Piliostigma thonningii* and *Gliricidia sepium*.

The moisture contents varied from (55.04%) for *Cajanus cajan, Parkia biglobosa* (57.38%), *Giliricidia sepium* (66.75%), *Pilostigma thonningii* (69.73%), *Baligiah sapida* (69.81%) to *Ficus thonningii* (73.86%). Higher moisture contents of selected browse plant leaves at the month of January showed that water reserved in plants will aid acceptability and digestion of the feed by ruminant animals.

The Crude Protein (CP %) content in *Cajanus cajan* (17.06 %) was higher ($P < 0.05$) compared to *Gliricidia sepium* (16.76 %), *Ficus thonningii* (15.00 %), *Baligiah sapida* (14.75%), *Parkia biglobos* (13.15%) and the least value observed for *Piliostigma thonningii* (12.45%).

The CP contents of the selected browse plant leaves ranged from 12.45 to 17.06%, which was above the 7% CP requirement for ruminants which provides ammonia required by the rumen micro-organisms to support optimum microbial activity (Alalade, 2012). Norton (2003) justifies the use of browse forages in small quantities in order to argument poor quality pastures and crop residues. The high CP content in browse species is well documented and is one of the main distinctive characteristic of browse compared to most grasses. Norton (1998) reported a range of CP contents from 12 to 30 % for tropical tree legume. The high value of CP recorded in all the browse plants in the present study indicates that these browse plants could serve as potential protein supplements that will enhance the intake and utilization of low quality grass and fibrous crop residues by ruminants.

The Ether Extract (EE) of the selected browse plant leaves were significantly ($P < 0.05$) higher for *Cajanus cajan* (2.39%), *Baligiah sapida* (2.07%) and *Piliostigma thonningii* (2.01%). The lowest Ether Extract value was derived from *Ficus thonningii* (1.80%), *Parkia biglobosa* (1.90%) and *Gliricidia sepium* (1.93%). Ether Extract content of browse plants fell below the range of 4-10% recommendation for EE (Campbell *et al*., 2006). Okoli *et al*. (2001) also reported a range of 0.95 - 5.3%.The result of the present study fell within that range value. Plant materials contained a group of substances, insoluble in water and organic compounds like ether. They are referred to as lipid and acts as sources of energy (Verma, 2006). Ether Extract is the lipid component and the energy derived from it is utilized by the animal for body maintenance and production. The higher value of ether extracts in some of the tested samples is an indication of higher energy level for the animals (Babayemi and Bamikole, 2006) and this is a major form of energy storage in plants which is being utilized by the animals for body maintenance and production.

The crude fiber content of the selected browse plant leaves were shown in table 1. The values obtained were significantly ($P < 0.05$) different among browse plants. The values ranged from (17.09 - 30.88%). The crude fiber content of the sample was above the range of 15 - 20% recommended for improved intake and production in finishing ruminants (Buxton, 1996). The higher crude fiber of browse plants reported will aid digestion and improve absorption of water. Fiber softens stool and therefore prevents constipation (Ayoola and Adeyeye, 2009) in farm animals.

Higher crude fiber in diet is known to enhance digestibility, decrease the blood cholesterol and reduce the risk of large bowel cancers. Dietary fiber plays an important role in decreasing the risk of many disorders such as constipation, diabetes, cardiovascular disease (CVD) and obesity. Dietary fiber may play major role in determining the health and disease population in affected animals (Slinkard and Singleton, 1997).

The ash content of *Ficus thonningii* (15.95%) was high compared to some selected browse plant leaves of *Baligiah sapida* (8.15%), *Parkia biglobosa* (8.20%), *Piliostigma thonningii* (9.07%), *Cajanus cajan* (9.12%) and *Gliricidia sepium* (9.88%) respectively. The range (8.15 - 15.95 %) value obtained for ash in all browse plants in the present study were higher than 6.29% (Mecha and Adegboola, 1985) and also above a range of 3.0-9.6% (Okoli *et al*., 2001) for South East Nigeria browse plants except for *Ficus thonningii* value. Ash content is useful in assessing the mineral elements present in the selected browse leaves (Smart, 1996).This suggests that the sample could be a better source of essential valuable and useful minerals needed for good metabolic that will enhance good production.

**Table 1. Proximate Composition of selected browse plant species.**

| Browse plant | %M | %CP | %EE | %CF | %Ash |
|---|---|---|---|---|---|
| *Baligiah sapida* | $69.81^{b}$ | $14.75^{bc}$ | $2.07^{b}$ | $30.88^{a}$ | $8.15^{d}$ |
| *Cajanus cajan* | $55.04^{e}$ | $17.06^{a}$ | $2.39^{a}$ | $25.82^{a}$ | $9.12^{c}$ |
| *Parkia biglobosa* | $57.38^{d}$ | $13.15^{cd}$ | $1.90^{b}$ | $17.97^{e}$ | $8.20^{d}$ |
| *Ficus thonningii* | $73.86^{a}$ | $15.00^{b}$ | $1.80^{b}$ | $20.25^{d}$ | $15.95^{a}$ |
| *Piliostigma thonningii* | $69.73^{b}$ | $12.45^{d}$ | $2.01^{b}$ | $22.00^{c}$ | $9.07^{c}$ |
| *Gliricidia sepium* | $66.75^{c}$ | $16.76^{a}$ | $1.93^{b}$ | $17.09^{f}$ | $9.88^{b}$ |

| | | | | | |
|---|---|---|---|---|---|
| SEM | 2.07 | 0.53 | 0.06 | 1.43 | 0.81 |

[abcdef] Mean in the same column with different superscript differ significantly (P<0.05).

**Mineral Composition**

The results on mineral composition are indicated in Table 2. There were significant differences (P < 0.05) in the mineral composition of selected browse plant leaves samples. Potassium (K) content of selected sample were *Baligiah sapida* (0.97%), *Cajanus cajan* (0.85%), *Parkia biglobosa* (0.82%), *Piliostigma thonningii* (1.13%), *Ficus thonningii* (1.14%) and *Gliricidia sepium* (0.74%). The Potassium (K %) content value ranged from (0.74 to 1.14%) in the present study. Higher values were observed for *Ficus thonningii* (1.14%) and *Piliostigma thonningii* (1.13%) according to NRC, (1981). The concentration of Potassium required by livestock is 7.0mg/100g which is equivalent to (0.70%). The result value ranged from (0.74 -1.14%) which was above the NRC, (1981) recommendation. Potassium deficiency causes a decrease in feed intake and reduces weight gain. High amount of potassium were reported in *Ficus thonningii* (1.14%) and *Piliostigma thonningii* (1.13%). The potassium helps in, maintaining normal physiological function of the body, normal water balance in the body and in balancing the pH of the body (Tazoe *et al*, 2007; O'Shaughnessy, 2006). The calcium concentration of the selected browse plant leaves ranged from 0.31 - 0.53%. The result value of 0.49% calcium content of browse plants reported by Alikwe and Omotosho, (2013) fell within the range value in the present study. Calcium helps in regulating muscle contraction. It is also required by kid, pregnant and lactating does or in bone and teeth development (Margaret and Vickery, 1997). Calcium also helps to regulate the acid/ base status of blood, aids hormone secretion and cell division.

For the percentage phosphorus content, the results were showed the highest (0.43%) value for *Ficus thonningii* leaves. (0.41%) for *Baligiah sapida* and (0.40%) for *Piliostogma thonningii* and the similar least values was observed for *Gliricidia sepium* (0.35%). The value obtained in the present study was above the value (0.034%) reported by Alikwe and Omotosho, (2013). Phosphorus plays a vital role in normal kidney functioning and transfer of nerve impulse. Also phosphorus plays an important role in carbohydrate, lipid and amino acid metabolism. Phosphorylation plays a key role in muscle contraction. Phosphorus is also required for blood coagulation (thromboplastin) satisfactory bone calcification; optimum growth rate and optimum utilization of calcium and phosphorus require adequate levels of Ca and P (Olomu, 2011). Cellular calcium concentration is very important for blood coagulation (Okaka and Okaka, 2001).

Magnesium content of the selected plant leaves ranged from 0.33 - 0.47%. Significantly (P < 0.05) higher values were observed for *Ficus thonningii* (0.47%) and *Baligiah sapida* (0.40%) followed by *Cajanus cajan* (0.38%), *Piliostigma thonningii* (0.37%) and *Parkia biglobosa* (0.35%). The least values was observed for *Gliricidia sepium* (0.33%).The range of value recorded for magnesium in the present study is higher than the recommended requirement of 0.12 - 0.20% in the diet of ruminants (ARC, 1980; NRC, 1985). Magnesium plays fundamental roles in most reaction involving phosphate transfer. It is believed to be essential in the structural stability of nucleic acid. It plays significant role in intestine absorption of electrolyte in the body.

The values of iron Fe (mg/kg) in *Ficus thonningii* (183.30 mg/kg) and *Piliostigma thonningii* (174.10 mg/kg) were higher than those of *Baligiah sapida* (168.80 mg/kg), *Cajanus cajan* (163.40 mg/kg), *Parkia biglobosa* (161.30 mg/kg) and *Gliricidia sepium* (161.30 mg/kg). This was an indication that the selected browse plant leaves sample were rich source of dietary iron. The iron value in this present study (161.30-183.30mg/kg) was higher than (100mg/kg to 150 mg/kg recommendation daily allowance (RDA) for iron (NRC, 1985).

The zinc content of the selected browse plant leaves of *Baligiah sapida, Cajanus cajan, Parkia biglobosa, Ficus thonningii, Piliostigma thonningii* and *Gliricidia sepium* are present in Table 2. The zinc content of the leaves of *Ficus thonningii* (71.30mg/kg) is higher than *Piliostigma thonningii* (63.75 mg/kg), *Parkia biglobosa* (60.75mg/kg), *Baligiah sapida* (56.65mg/kg), *Cajanus cajan* (53.95 mg/kg) and *Gliricidia sepium* (52.50 mg/kg). The value reported in the present study was higher than 18.7 and 19 mg/kg reported by Diop *et al*., (2005). Zinc is said to be an essential trace element for protein and nucleic acid synthesis and normal body development during periods of rapid growth such as infancy and recovery of illness (Melaku, *et al*., 2005). As reported by Elinge *et al*.,(2012), minerals contribute to diverse functions of human body such as blood pressure, fluid balance and blood volume regulation (Sodium); nutrient passage through cell walls and muscle contraction (Calcium); releasing of parathyroid hormone and tissue respiration (Magnesium); buffering of the human body fluid for metabolism and facilitation of the nutrient crossing other cell membrane

(Phosphorus), formation of blood and transfer of oxygen and carbon dioxide from one tissue to another (Iron); important role in all mental functions and transfer of oxygen from lungs to cells (Manganese); boosting the health of hair and playing sensorial such as ability to tastes, sense and smell( Zinc). Based on the results obtained, these products consumed during the shortage periods have potential to contribute to alleviate the malnutrition during this period, if they are available in quantity and quality.

**Table 2. Mineral Composition of selected browse plant species**

| Browse plant | %K | % Ca | %P | %Mg | Fe(mg/kg) | Zn(mg/kg) |
|---|---|---|---|---|---|---|
| *Baligiah sapida* | 0.97 | 0.39$^{c}$ | 0.41$^{b}$ | 0.40$^{ab}$ | 168.80$^{c}$ | 56.65$^{d}$ |
| *Cajanus cajan* | 0.85 | 0.37$^{d}$ | 0.36$^{e}$ | 0.38$^{b}$ | 163.40$^{d}$ | 53.95$^{e}$ |
| *Parkia biglobosa* | 0.82 | 0.34$^{e}$ | 0.35$^{d}$ | 0.35$^{c}$ | 161.30$^{e}$ | 60.75$^{c}$ |
| *Ficus thonningii* | 1.14 | 0.53$^{a}$ | 0.43$^{a}$ | 0.47$^{a}$ | 183.30$^{a}$ | 71.30$^{a}$ |
| *Piliostigma thonningii* | 1.31 | 0.48$^{b}$ | 0.40$^{c}$ | 0.37$^{b}$ | 174.10$^{b}$ | 63.75$^{b}$ |
| *Gliricidia sepium* | 0.74 | 0.31$^{e}$ | 0.35$^{d}$ | 0.33$^{d}$ | 161.30$^{e}$ | 52.50$^{e}$ |
| SEM | 0.00 | 0.02 | 0.09 | 0.01 | 2.40 | 1.94 |

$^{abcde}$ Mean in the same column with different superscript differ significantly (P<0.05).

**Anti-Nutrient Contents**

Table 3 shows the result of the anti-nutrients composition of selected browse plant leaves. The Phytate level of *Baligiah sapida* (1.42%) was higher than *Ficus thonningii* (1.38%), *Gliricidia sepium* (1.21%), *Piliostigma thonningii* (1.30%), *Cajanus cajan* (0.89%) and *Parkia biglobosa* (0.67%). Anti-nutrient value (1.42%) in *Baligiah sapida* observed in the study falls below the maximum value of 2.5% reported for small ruminants (NRC, 1985). The phytate in food bind some essential mineral nutrients in the digestive tract and can result in mineral deficiencies (Bello *et al*., 2008). The phytate level of the samples might not pose any health hazard for ruminant animals when compared to a phytate diet of 10-60mg/100g which if consumed over a long period of time decrease bioavailability of minerals in monogastric animals (Thompson, 1993). High dietary phytate component is reported to cause reduction in feed utilisation (Redek and Savage, 2008), as it not only bind and make mineral ions un- available to consumers. Homeostatis of Zn and Fe, inhibit enzymatic digestion of protein by forming complexes with enzyme proteins and cause rickets in young dogs (Wallace *et al.,* 1998). Nevertheless, phytate was reported to be anti carcinogen and a potent antioxidant (Hassan and Ngask, 2007).

**Table 3. Anti-nutrient factors present in selected browse plant species.**

| Browse plant | %Phytate | % Oxalate | Trypsin Inhibitor (mg/g) |
|---|---|---|---|
| *Baligiah sapida* | 1.42$^{a}$ | 0.84$^{a}$ | 7.66$^{a}$ |
| *Cajanus cajan* | 0.89$^{e}$ | 0.59$^{c}$ | 3.17$^{f}$ |
| *Parkia biglobosa* | 0.67$^{f}$ | 0.40$^{d}$ | 4.25$^{e}$ |
| *Ficus thonningii* | 1.38$^{b}$ | 0.85$^{a}$ | 7.05$^{c}$ |
| *Piliostigma thonningii* | 1.30$^{c}$ | 0.83$^{a}$ | 6.91$^{d}$ |
| *Gliricidia sepium* | 1.21$^{d}$ | 0.78$^{b}$ | 7.31$^{b}$ |
| S.E.M | 0.08 | 0.05 | 0.51 |

$^{abcdef}$ Mean in the same column with different superscript differ significantly (P<0.05).

The oxalate level in *Ficus thonningii* (0.85%) leaves was higher compared to *Piliostigma thonningii* (0.83%), *Baligiah sapida* (0.84%), *Gliricidia sepium* (0.78%), *Cajanus cajan* (0.59%) and *Parkia biglobosa* (0.40%). The levels of oxalate in the selected browse plants were below the humans' toxic level of 2-5g (Hassan and Umar, 2004). Oxalate contents in this present study were below 20g/kg that was considered lethal to livestock (Acamovic *et al.*, 2004). Oxalate has been shown to deplete calcium, magnesium and phosphorus

(Akinsoyinu and Onwuka 1988) in the system. Ca and Carbon are also released from the hydrolysis of Ca Oxalate, some of which will be either absorbed or excreted by ruminant animals. With Ca absorption rate of ruminants put at 31% (Haenlein, 1987) and P at 4% absorption (Adeloye and Akinsoyinu, 1985) reasonable amount of the Ca and P intakes will be lost via faeces and urine to the soil. Such voided minerals/nutrients are thereby recycled for further use to support plants growth. This reduces the amount of organic manure required in farming. However given the times to adapt, the microorganism in the rumen can metabolizes moderate amounts of oxalate. Ruminants; unlike monogastric animals can ingest considerable amounts of high oxalate plants without adverse effects due principally to microbial decomposition in the rumen (Oke, 1969).

Trypsin inhibitor (mg/g) content of selected browse plant leaves ranged from 3.17 to 7.66mg/g. Higher value was observed for *Baligiah sapida* (7.66mg/g), followed by *Gliricidia sepium* (7.31mg/g), *Ficus thonningii* (7.05mg/g), *Piliostigma thonningii* (6.91mg/g), *Parkia biglobosa* (4.25mg/g). While the least value was observed for *Cajanus cajan* (3.17mg/g). Trypsin inhibitors are protease inhibitors occurring in raw legume seeds. Protease inhibitors are the most commonly encountered class of anti- nutritional factors of plant origin. Trypsin inhibitors have been implicated in reducing protein digestibility and in pancreatic hypertrophy (liener, 1976).

**CONCLUSION:** It can be concluded from the results of this study that the selected browse plants appeared to have the potential as protein feed supplements. Higher content of protein and minerals combined with relatively low levels of anti-nutrients would make them good supplements to poor quality roughage diets, especially during the dry season when the quality of available pasture based feed resources for ruminant animals are poor.

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