

# PHYTOCHEMICAL, PROXIMATE AND MINERAL ANALYSES OF THE LEAVES OF *BAMBUSA VULGARIS* L. AND *ARTOCARPUS ALTILIS* L.

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## Abstract

The need to boost livestock production in Nigeria calls for a provision of feed that is adequate in both quality and quantity as well as accessible to animals all year round. The quest to assess and exploit plants for their potentials in feeding livestock animals all year round necessitated this study. The phytochemical and nutritional composition of the leaves of *Bambusa vulgaris* and *Artocarpus altilis* were assayed. Phytochemical screening of the two plant leaves revealed the presence of alkaloids, saponins, flavonoids and tannins. Terpenoids and steroids were absent in the two plants. Further phytochemical quantifications revealed *B. vulgaris* and *A. altilis* leaves contained alkaloids (10.64% and 14.80%), saponins (2.33 and 3.90%), flavonoids (4.60 and 3.70%), tannins (0.67 and 1.89 mg/100g) and phenol (0.23 and 1.89 mg/100 g) respectively. The proximate analyses revealed low moisture content (12.27% and 14.88%), crude protein (2.84 and 2.15%), moderate crude fat (6.00 and 6.91%) and high crude fiber (16.96 and 9.96%), ash (11.82 and 15.92%) and carbohydrate (50.12 and 50.19%) respectively. The leaves were equally rich in Ca, K, P, Mg with low Na. Similarly, the results show that leaves of the two plants investigated could provide dietary and medicinal needs of livestock.

## Introduction

*Bambusa vulgaris* belongs to the family Poaceae. It is known as bamboo in English language and Oparun in Yoruba language. Rao *et al.* (1988) reported that the origin of species of bamboo is unknown. *B. vulgaris* has lemon-yellow culms (stems) with green stripes and dark green leaves. Culms grow 10 - 20 meters high and four to 10 centimetres thick (Dieter, 1999 and Rao *et al.*, 1988). Several branches arise from mid-culm nodes and above. Culm leaves are deciduous with dense pubescence. *B. vulgaris* rarely flowers and this might help the plant build and store protein and minerals for

the dry season period. Louppe *et al.* (2008) reported that the fruits of the plant are rare due to low protein viability caused by irregular meiosis. Reproduction is by vegetative propagation through culm by rhizomes, stem and branch cutting, layering and marcotting (Louppe *et al.*, 2008). In Nigeria, the plant is an indigenous medicine and an infusion of macerated leaves is taken as abortifacient (Oteng & Brink, 2008). *B. vulgaris* woody culm (stem) can be used for panel, lumber, veneer, plywood, pulp and paper as well as charcoal (Zehui, 2007). *A. altilis* (Breadfruit) belongs to the family *Moraceae*. It is an important staple crop. The

fruits can be cooked and eaten at all stages of maturity. *A. altilis* tree can reach the height of 21 metres at maturity. The trunk may grow to 90 ft. (27 metres) when fully grown. Its leaves are large, multi-lobed, extremely beautiful and often used in decorations. The breadfruit is seedless and is propagated either by suckers or root cuttings. The leaves have yellow veins and are glossy dark green, leathery, alternate up to 3 ft. (91cm) long, and barely lobed to deeply pinnate lobed. Breadfruit may be eaten ripe as a fruit or unripe as a vegetable. The fruits are usually round, oval or oblong ranging from 9 to 20 cm wide and more than 30 cm long. The plant contains milk latex sap. The latex is used to treat skin ailments and fungus diseases. The latex and sap from crunched stems of the leaves are used traditionally to treat sore eyes and ear infections. Recent research has been focussed on the effective use of breadfruit in treating tumours and leukaemia (Ragone, 1997). The use of herbal medicine in the treatment of various ailments has been in existence from the ancient days. Medicinal plants are endowed as natural sources of a large proportion of medicines for the treatment of several human ailments (*Yakubu et al.*, 2007). The plants are cheaper to purchase within the rural people means (Goonasekera *et al.*, 1995) compared to synthetic drugs which are costly and not readily available at people's disposal and need expertise for their application. In addition, researchers have proved that plant extracts can be used to cure many health ailments and it has lesser side effects compared to other forms of medications. Most existing plants have medicinal values of which steps are being taken by scientific research to properly test and utilize these plants for therapeutic purposes. Animal feed has always been a major limiting factor in the growth of the livestock industry in developing countries. Apart from the high and unstable costs

of feeds, some of the ingredients used in preparing livestock feeds are in high demand for human consumption. The decrease in supply of the conventional feed resources coupled with the high cost of importation has led to alternative sources being produced locally. Attempt to provide adequate supplement both in quality and quantity prompted this research work.

## Experimental

### *Collection and preparation of plant samples*

The fresh leaves of *B. vulgaris* and *A. altilis* were obtained from Ifaki –Ekiti in Ido- Osi Local Government area of Ekiti State, Nigeria. The plants were authenticated in the Department of Plant Science and Biotechnology Herbarium. The leaves were thoroughly washed with distilled water and air dried at room temperature (25-30°C) for two weeks. The air-dried leaves were ground into a powdery form and stored in air tight containers. The samples were taken to the laboratory of Chemistry Department, University of Lagos, Lagos State, Nigeria, for phytochemical, proximate and mineral analyses.

### *Phytochemical Analyses*

#### *Qualitative Phytochemical Screening*

Phytochemical analysis was conducted to determine the presence of alkaloids, saponins, tannins, flavonoids, steroids, phenols, cardiac glycoside and terpenoids using the procedures of Trease and Evans (1989); Sofowora (1993).

#### *Quantitative Phytochemical Analyses*

Further quantification of the phytochemical constituents in the samples were determined using the standard procedures of Obadoni and Ochukwo (2001), Boham and Kocipal (1994).

#### *Determination of the proximate composition*

The proximate analyses of the samples were carried out according to the standard procedures of Association of Official Analytical Chemist (AOAC, 2000). Moisture content was determined by heating about 5 g of the sample placed in a crucible inside an oven at temperature of 105°C to a constant weight. Ash content was determined by heating about 5 g of the plant sample in a crucible placed in a muffle furnace maintained at 450°C. Crude protein was determined by multiplying the nitrogen content of the sample by 6.25 (AOAC, 2005). Crude fat was determined by extracting 2 g sample in a soxhlet extractor apparatus with petroleum ether in an oven at 50°C (James, 1995), Crude fibre was determined by digesting about 5 g of the sample with H<sub>2</sub>SO<sub>4</sub> and NaOH. The residue was placed into a crucible in a muffle furnace at about 550°C for five hours. Carbohydrate was determined according to Onwuka (2005). Available carbohydrate was calculated as follows:

% Available carbohydrate = 100 – (% moisture + % Ash + % protein + % fibre).

#### *Determination of mineral composition*

The mineral constituents (potassium and sodium) in the samples were determined by digesting the ash of the samples with perchloric acid and nitric acid, and then taking the readings on Jenway digital flame photometer/spectronic 20 (Bonire *et al.*, 1990). Calcium and magnesium were determined spectrophotometrically

by using Buck 200 atomic absorption spectrophotometer (Buck Scientific, Norwalk) (Essien *et al.*, 1992) and their absorption compared with absorption of standards of these minerals.

### **Results**

The results obtained for the preliminary phytochemical screening of the leaves of *Bambusa vulgaris* and *Artocarpus altilis* are presented in Tables 1 and 2 respectively. The results revealed the presence of alkaloids, phenols, saponins, flavonoids and cardiac glycoside in the plants investigated. It was noted that terpenoids and steroids were absent in the leaves of both plants. Quantitative analyses of the phytochemicals in the two plants indicated that the leaves of *B. vulgaris* and *A. altilis* have fairly high concentration of alkaloids 10.64 ± 0.79% for *B. vulgaris* and 14.80 ± 0.00% for *A. altilis*. This was followed by flavonoids 4.60 ± 0.00% and 3.70 ± 0.14 in *B. vulgaris* and *A. altilis* respectively. The results obtained for the proximate and mineral compositions of *B. vulgaris* and *A. altilis* are shown in Tables 3 and 4 respectively. The results revealed high value of carbohydrate (50.12 ± 0.25% and 50.19 ± 0.45%), crude fibre (16.96 ± 0.06% and 9.96 ± 0.06%), ash content (11.82 ± 0.08 and 15.92 ± 0.11%), low moisture content (12.27 ± 0.28 and 14.88 ± 0.53%), low crude fat (6.00 ± 0.00% and 6.91 ± 0.01%) as well as crude protein (2.84 ± 0.05% and 2.15 ± 0.01%) in *B. vulgaris* and *A. altilis*. and *A. altilis* respectively.

TABLE 1  
Quantitative analysis of *Bambusa vulgaris* and *Artocarpus altilis* leaves

Sample	Alkaloids	Saponins	Tannins	Cardiac Glycosides	Flavonoids	Terpenoids	Steroids
<i>B. vulgaris</i>	+	+	+	+	+	-	
	-						
<i>A. altilis</i>	+	+	+	+	+	-	
	-						

Key = present, - = absent

TABLE 2  
Quantitative analysis of *Bambusa vulgaris* and  
*Artocarpus altilis* leaves

Parameters	<i>A. vulgaris</i>	<i>A. altilis</i>
Alkaloids (%)	10.64 ± 0.79	14.80 ± 0.00
Saponins (%)	2.33± 0.04	3.90 ±0.00
Flavonoids (%)	4.60 ± 0.00	3.70± 0.14
Tannins (mg/100g)	0.67± 0.00	1.89± 0.00
Total phenol (mg/100g)	0.23± 0.00	1.09 ±0.00

Values are expressed as means ±SD, n=3

TABLE 3  
Proximate composition of *Bambusa vulgaris* and  
*Artocarpus altilis* leaves

Parameters (%)	<i>B. vulgaris</i>	<i>A. altilis</i>
Moisture content	12.27 ± 0.28	14.88 ± 0.53
Ash	11.82 ± 0.08	15.92 ± 0.01
Crude fat	.00 ± 0.00	6.91± 0.07
Crude fibre	16.96 ± 0.06	9.96± 0.06
Crude Protein	2.84 ± 0.05	2.15±0.01
Carbohydrate	50.12 ± 0.25	50.19 ± 0.45

Values are expressed as mean ±SD, n=3

TABLE 4  
Mineral compositions of *Bambusa vulgaris* and  
*Artocarpus altilis* leaves

Parameters mg/100g	<i>B. vulgaris</i>	<i>A. utilis</i>
Phosphorus	12.80±0.13	24.31±0.03
Calcium	32.48±0.02	20.08±0.01
Magnesium	8.09±0.03	5.76±0.01
Potassium	59.41±0.05	26.00±0.02
Sodium	5.65±0.01	7.20±0.02

Values are expressed as means ±SD, n=3

Mineral compositions of the leaves of the plants (Table 4) revealed high concentration of Potassium, Calcium and Phosphorus with moderate quantity of Magnesium and Sodium.

### Discussion

The phytochemical spectrum of *B. vulgaris* in this study is the same for *B. ventricosa* but differ with the absence of alkaloid as reported by Coffie *et al.* (2014). Three different classes of phytochemicals (alkaloids, glycosides and saponins) detected in *A. altilis* in the study are equally documented in the reports of Binumol and Sagitha (2013) for *A. heterophyllum* but differ with the presence of terpenoids. The protective and metabolic activity of alkaloids has been severally reported by many researchers. Alkaloids are one of the most efficient therapeutic bioactive substances in plants. Alkaloids are noted for their analgesic, antispasmodic and anti-bacterial properties (Okwu & Okwu, 2004). Saponins are known for their medicinal properties which includes anti- microbial effect (Kereem *et al.*, 2005), diuretic, analgesic as well as promoting wound healing (Arawande *et al.*, 2013).

The plant samples contain flavonoids which are phenolic compound that have health promoting effects such as anti-allergic, anti-viral, anti-cancer and anti-inflammatory (Morel, 2011). The presence of tannins in the two plant samples implies that they have astringent properties, quickens the healing of wound and inflamed mucous membrane (Farquar, 1996). Tannin is effective against indigestion and fever (Asekun *et al.*, 2013). They play an important role in prevention of different diseases. The presence of these secondary metabolites in the two plants investigated inferred that the plants have a therapeutic effect and their medicinal values could be due to their confirmation.

The proximate analyses of *B. vulgaris* and *A. altilis* leaves revealed appreciable high content of crude fibre (16.96%) in *B. vulgaris* and moderate amount of crude fibre (9.96%) in *A. altilis*. The crude fibre content reported in this study is lower when compared to what

was recorded for different species of *Bambusa* (25.88% to 33.19%) by Antiwi-Boasiako *et al.* (2011) but comparatively higher than 6.09% reported for *Artocarpus heterophyllum* seed cake (Ibironke & Raji, 2013). However, the value for *A. altilis* compared favourably with 9.09% reported by Okaranye and Ikewuchi (2009) for *Pennisetum purpureum*. The high crude fibre content of *B. vulgaris* may probably make ruminant animals to prefer it to common fodder plant such as *Pennisetum purpureum* (Okaranye & Ikewuchi, 2009). Fibre aids digestion by improving peristalsis. Besides, fibre lowers the body cholesterol level thereby reducing the risk of cardiovascular disease (Iheanacho & Udebuani, 2009).

The protein composition of the leaves of *B. vulgaris* (2.84%) and *A. altilis* (2.15%) were found to be relatively low compared to the values reported for *B. vulgaris* (22.38%) and *Azzeria africana* (29.85%) by Ikhimioya *et al.* (2007). The low crude protein composition of these two plants make them less nutritious foliage fodders for high protein demanding ruminant animals. The crude fat content of *B. vulgaris* and *A. altilis* was found to be 6.00% and 6.91% respectively which are much higher compared to value range from 1.38% to 1.58% reported for some Bamboo species (*Bambusa vulgaris vittata*, *B. vulgaris vulgaris* and *B. ventricosa*) by Antwi-Boasiako *et al.* (2011) but compared favourably with 6.50% with *Launaea taraxacifolia* (Adinrtey *et al.*, 2012), *Acalypha* species (6.15%, 6.30% and 6.60%) reported by Iniagbe *et al.* (2009). Crude fat should be consumed moderately as excess consumption may result in some complications such as cardiovascular disorders, atherosclerosis, cancer and ageing (Antia *et al.*, 2006). The percentage ash content, an index of inorganic mineral elements obtained in this study for *B. vulgaris* (11.82%) and *A.*

*altilis* (15.92%) are relatively high when compared with the values reported for *Ocimum viridis* (6.50%) and *Ocimum gratissimum* (2.0%) by Abdulraham *et al.* (2012). These values however compare favourably with 15.20% reported for *Cucurbita pepo* (Andzouana & Mombouli, 2012) and 10.61% for *B. vulgaris* (Ikhimioya *et al.*, 2007). The high ash content indicates that the leaves of the two plants are rich in mineral elements. The moisture content of *B. vulgaris* and *A. altilis* were relatively low when compared with the values obtained for *Ceiba petandra* (5.30%), *Manihot esculentus* (4.85%) and *Abelmoschus esculentus* (9.15%) as reported by Raimi *et al.* (2014). However, the values were higher than 10.88% moisture content recorded for *Securinega virosa* (Uzama *et al.*, 2012). The low moisture content may probably give the leaves long shelf life.

The carbohydrate content of *B. vulgaris* and *A. altilis* leaves were comparatively higher than some leafy vegetables such as *Launea taraxacifolia* (30.56%) reported by Adinortey *et al.* (2012), *Moringa oleifera* (43.88%) by Oduro *et al.* (2008), *Myrianthus arboreus* (7.20%) and (12.58%) *Spargonophorus sporgonophora* reported by Oyeyemi *et al.* (2014), but low when compared to 64.25% *Flueggea virosa* (Uzama *et al.*, 2012), 83.41% *Spondias mombin*, 85.64% *Azelia africana* and 72.13% *Landolphia hirsute* (Dike, 2010). The high carbohydrate content makes the two plants to be considered as rich carbohydrate plants and, hence, potentially good source of energy for feeding ruminants.

The phosphorus content of *B. vulgaris* (12.80 mg/100g) and *A. altilis* (24.31mg/100g) were low when compared with 67.89 mg/100g in *Launaea taraxacifolia* (Adinortey *et al.*, 2012) but relatively higher compared with 1.0 mg/100 g in *Diospyrus mesipiliformis* and 5.72 mg/100 g in *Mucuna flagellipes* (Hassan & Ngaski, 2007). Phospho-

rus plays a vital role in normal kidney functioning and transfer of nerve impulse.

The calcium concentration in the leaves of *B. vulgaris* and *A. altilis* was found to be 32.48 mg/100g and 20.08 mg/100g respectively. These values were high compared with the calcium content of 2.90 mg/100g reported by Uzama *et al.* (2012) for *Securinega virosa* leaves. The two plants contain high content of calcium which is necessary for bone and teeth development. Olayiwola *et al.* (2009) reported that calcium is also helpful in the formation of blood, intracellular and extra cellular fluids within and outside the cell of the body.

The magnesium content of the two plants *B. vulgaris* (8.09 mg/100g) and *A. altilis* (5.76 mg/100g) were lower than 249.92 mg/100g and 288.65 mg/100g reported for *Amaranthus hybridus* and *Telfaria occidentalis* respectively (Asaolu *et al.*, 2012). However, these values were comparably higher than that of *Amaranthus cruentus* (2.53mg/100g), *Talinum fruticosum* (2.22mg/100g) and *Celostia argentea* (1.41mg/100g) (Mensah *et al.*, 2008).

Magnesium is an important mineral element which acts as a cofactor of many enzymes (McDonald *et al.*, 1995). Higher values of potassium (59.41 mg/100 g and 26.00 mg/100 g) in *B. vulgaris* and *A. altilis* respectively were recorded in this study. These values are relatively high when compared with 3.67mg/100g reported for *Securinega virosa* (Uzama *et al.*, 2012). The observed values in this study are however low when compared with 70.62 mg/100 g for *Myrianthus arboreus* (Oyeyemi *et al.*, 2014) and 220.00 mg/100 g in *Cassia siamea* leaves (Hassan & Ngaski, 2007). The high value of potassium which is the most abundant element in the two plants is in agreement with the earlier report of Asekun *et al.* (1995) and Igile *et al.* (2013). Afolabi *et al.* (1995) reported that potassium is the abundant mineral in Nigeria



agricultural production. The concentration of sodium in the leaves was determined to be 5.65 mg/100 g and 7.20 mg/100g in *B. vulgaris* and *A. altilis* respectively.

The presence of sodium in moderate quantity is notable as it helps in osmotic pressure production between the cell and the surrounding tissues in the body and also regulating fluid exchange between the cell and the surrounding tissues in the body (Long, 2007).

### Conclusion

The phytochemical profile of the two plant leaves investigated contained active secondary metabolites which support their therapeutic potentials. The leaves are also rich in carbohydrates, crude fibre as well as essential minerals which can contribute to nutrient uptake of the animals that consume them. The good nutritional values coupled with their medicinal potential could make the leaves to be utilized as feed supplement for livestock.

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