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Ethnobotanical Potentials: Phytochemical, Proximate, And Mineral Composition Of *Alchornea cordifolia*

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ABSTRACT

Alchornea cordifolia is a plant that have found wide range of medicinal and antioxidant activities due to their metabolites. Moreover, the use of plant-derived medicine is relatively safe compared to synthetic drugs. The leaves, stem and bark of *Alchornea cordifolia* was investigated for phytochemical, proximate and mineral properties following standard protocols. Results showed that the leaves had; Tannin (10.52 mg/g), Phenol (12.30 mg/g), Phytate (6.55 mg/g), Oxalate (3.64 mg/g), alkaloid (6.23 mg/g), saponin (7.98 mg/g), and flavonoid (2.32 mg/g). The bark had; Tannin (5.27 mg/g), Phenol (8.35 mg/g), Phytate (3.56 mg/g), and Oxalate (2.53 mg/g). The stem of the plant contained 3.51 mg/g of tannin, 5.50 mg/g of phenol, 4.25 mg/g of phytate, and 2.74 mg/g of oxalate. The leaves had 3.39 mg/l of potassium, followed by 1.38 mg/l of sodium, 0.81 mg/l of calcium, 0.59 mg/l of magnesium, and 0.013 mg/l of zinc. Lastly, the bark had 4.29 mg/l of potassium, 2.03 mg/l of sodium, 1.29 mg/l of calcium, 0.78 mg/l of magnesium, and 0.026 mg/l of zinc. Minerals in the stem were; potassium (4757.13), sodium (1700.74), calcium (973.89), magnesium (765.16), and zinc (21.31). Proximate analysis showed that the leaves had; moisture content (65.34%), crude protein (10.64%), fat content (5.28%), fibre content (6.33%), CHO value (0.11%). The bark had; Moisture content (69.05%), crude protein (9.35%), fat content (5.49%), fibre content (8.39%), and CHO value (1.57%). These findings confirmed that *Alchornea cordifolia* is rich in phytochemical, mineral and proximate values, which must have supported their wide range of medicinal and antioxidant properties.

Keywords*:* Phytochemicals, Stem-bark, *Alchornea cordifolia*, Extract, Plant

1.0 INTRODUCTION

Alchornea cordifolia, also known as the Christmas bush or Siam weed, is a small tree or shrub that is native to the tropical regions of West Africa. This plant is a member of the Euphorbiaceae family and can grow up to 10 meters in height. It is characterized by its heart-shaped leaves, which are glossy and dark green in color (Adeniyi *et al.*, 2022). *Alchornea cordifolia* is widely recognized for its medicinal properties and has been used in African traditional medicine for centuries to treat various illnesses such as malaria, diarrhea, fevers, and respiratory infections (Jain *et al.*, 2022). The plant contains bioactive compounds such as alkaloids, flavonoids, and tannins, which possess antimicrobial, anti-inflammatory, and antioxidant properties. These compounds are found in the leaves, bark, and roots of the plant (Jain *et al.*, 2022). Apart from its medicinal value, *Alchornea cordifolia* is also integrated into traditional African rituals and ceremonies.

The plant is considered sacred and is believed to possess spiritual properties that can help in healing and warding off evil spirits. Phytochemicals are naturally occurring compounds found in plants that have therapeutic applications in conventional and empirical medicine. These compounds protect plants from environmental stresses such as UV radiation, pests, and diseases. Several factors influence the antioxidant effectiveness of plants, including age, location, season, tolerance, plant part, and extraction solvent (Angaye, 2015). The age of the plant can affect the level of phytochemicals present in it. For instance, older plants tend to have higher levels of phytochemicals than younger ones. The location of the plant is also crucial, as plants growing in different environments can produce different levels and types of phytochemicals. Similarly, the season in which the plant is harvested can affect the phytochemical content, with some compounds being more abundant in certain seasons.

The extracts from the leaves, roots, and stem bark of A. cordifolia are commonly used in traditional medicine to treat respiratory, gastrointestinal, and urinary disorders (Essien *et al*., 2015). A mixture of the fruit is given to people with asthma and cough. The leaves are used internally for managing respiratory, gastrointestinal, and urinary tract infections and externally for treating wounds. A decoction made from the leaves is used as an eye lotion, while the powdered leaves and stem bark treat skin infections such as ringworms (Iwu, 1993). Scientific investigations have focused mainly on the leaf part of A. cordifolia, revealing its antimicrobial, antioxidant, and anticancer properties (Cai et al., 2004; Olaleye et al., 2007; Akpo C.O., Owhe-Ureghe, 2013). A study using gas chromatography-mass spectrometry (GC-MS) to analyze the volatile oil from new A. *cordifolia* leaves have also been published (Okoye et al., 2009). A. *cordifolia* has been shown to exhibit antibacterial activity against 21 different bacterial strains, with the highest activity observed against MRSA (Pesewu et al., 2005). Among the 24 other plant species studied, A. *cordifolia* showed the most potent antibacterial effects against MRSA.

Moreover, the plant part used for extraction can also influence the phytochemical content. For example, the leaves of some plants may have higher levels of certain compounds than the roots or flowers. Additionally, the solvent used for extraction can impact the phytochemical content, as some compounds may be more soluble in certain solvents than others. Overall, understanding the various factors that impact the phytochemical content in plants is essential for developing practical therapeutic applications in medicine. Plants possess many phytochemicals that comprise their genetic composition and are responsible for their diverse activities (Devappa *et al.*, 2010). These phytochemicals are intricate and varied, with over 10,000 alkaloids and 25,000 other compounds found in plants (Cheeke, 1998; Angaye, 2015). Recent studies have suggested that plant extracts are generally safer and preferred over synthetic agents for disease management (Okumu *et al.*, 2007; Dibua *et al.*, 2013; Angaye *et al.*, 2017a). Given plants' remarkable healing properties and phytochemicals, further research is necessary to uncover their mineral content, phytochemical composition, and overall makeup. This will help in developing new and effective treatments for various diseases.

2.0 MATERIALS AND METHOD

2.1 Study Area

The study area for our research was the Department of Biological Sciences research laboratory located at Niger Delta University on Wilberforce Island in Bayelsa State. The wet season in this region typically

spans from April to October and is characterized by high levels of precipitation, with an average annual rainfall of 2000mm. On the other hand, there is usually dry and dusty ranging from the month of November through March. The elevation of the study area is 45m above mean sea level (Angaye, 2015).

2.2 Plant sampling

The leaves and stem bark of the plant were carefully collected from bushes in the vicinity of Niger Delta University. These plant specimens were then transported to the Department of Biological Sciences Research Lab for thorough identification, extraction, and analysis. Before solvent extraction and proximate composition analysis, the plant parts were meticulously washed and air-dried. In order to ensure accurate results, the specimens were divided into three distinct portions.

2.3 Plant Extraction Procedure

Three hundred grams of the leaves and stem bark of the plant were weighed and pounded with mortar and pestle. Afterwards, the juice of the pounded leaves was squeezed and filtered into a clean conical flask using muslin cloth. Prior to the bioassay, the obtained juice of the plants was distinctly labelled and preserved at room temperature (Angaye *et al*., 2017a). Three hundred grams of the leaves and stem bark were macerated in 500 ml of ethanol for 3 days. Filtrates of the extractions were respectively extracted by concentrating in a rotary evaporator (60°C). After extraction the extract was fort the bioassay at room temperature.

2.4 Phytochemical analysis

2.4.1 Test for alkaloids

In order to detect alkaloids, it is recommended to extract 2g of plant material using 10 mL of ethanol. The filtrate can then be collected using filter paper, adding three drops of pyruvic acid to 2mL of the filtrate. Keep an eye out for light green colouration, as noted by Ojelere in 2014.

2.4.2 Test for flavonoid

The acid alkaline test was used to determine the presence of flavonoid. Few drops of concentrated ammonia (NH_4) was added to 2ml of the plant's aqueous extract. The yellow colouration will turn colourless with few drops of conc. hydrochloric (HCL) if flavonoid is present (Ojelere, 2014).

2.4.3 Test for saponin

Test for saponins was carried out using method described by Harborne. There are two different tests involved (froth test and emulsion test). The froth test, the mixture of 2 ml of the plant aqueous extract of the plant in a test tube with 5 ml of distilled water and agitated rapidly for froth formation which indicates the presence of saponin. The emulsion test involved the mixture of 3 drops of groundnut oil in a test tube with 5ml of distilled water and agitated, if emulsion is formed saponin is present (Ojelere, 2014).

2.4.4 Test for tannin

Test for tannin was investigated using method described by Harborne. A test tube with 3 ml of distilled water was prepared and 2 ml of the aqueous extract filtrate of the plant was added. About 0.1 ml ferric solution was added to the mixture, and the presence of tannin is confirmed with dark precipitate (Ojelere, 2014).

2.5 Proximate Composition Analysis

2.5.1 Moisture Content

The air oven method was used to determine the moisture content (AOAC, 2000). The test chamber was used to concentrate the sample to dryness as constant weight. Thus, the percentage of moisture content was determined using the formula below:

$$\%\ Moisture\ content = \left(1 - \frac{Weight\ dry\ sample}{Weght\ wet\ sample}\right)\ 100$$

2.5.2 Fat Content

The determination of fat content was carried out using the Soxtec method (SoxtecTM 2050 automated analyzer) as described by Noureddini and Byun (2010). Petroleum ether was the applied extracting solvent medium; the fat was content was calculated using the equation:

$$\%\ Fat\ content = \left(\frac{Weight\ (extraction\ cup + residue) - Weight\ (extraction\ cup)}{Weight\ sample} \right) X\ 100$$

2.5.3 Protein

The content of nitrogen from the sample was determined by the method of Ng Dunford (2008). Kjeltec TM 2200 was utilized as the Auto Distillation Unit. A nitrogen-to-protein converter was used with a 4.4 factor of conversion was used to determine the protein content of the sample (Ojelere 2014).

2.5.4. Ash Content

Determination of ash content was carried out using the dry ash method (AOAC 2000). A furnace was used for the incineration of the samples at a temperature of 550 °C. The inorganic residues were allowed to cool and weighed for further mineral determination. The preparation of the ash solution was done with 1 molar of HCL in 100ml.

2.5.5 Carbohydrate and Caloric Value

The differentials method was utilized to ascertain the carbohydrate percentage in the plant samples. To determine the percentage caloric value, the sum of carbohydrates and proteins was computed, and then multiplied by a factor of 4 kcal/g. The fat's calorie count was determined by multiplying the fat content by 9 kcal per gram.

2.5.6 Mineral Analyses

The FAA spectrometric method, employing an air-acetylene cathode lamp, was utilized to determine the degree of absorption. The mineral elements were then detected using the lamp current and wavelengths. The concentrations of minerals were expressed in milligrams per kilogram (mg/kg) as per Ooi (2012).

2.4 Statistical Analysis

The version 23 of SPSS was used for the statistical analysis. Data was expressed as Mean±Standard deviation. The mean was separated using analysis of variance (ANOVA), while Duncan was used to test the degree of significance.

3.0 RESULT AND DISCUSSION

3.1 Qualitative Assessment of Phytochemical Contents

Table 1 presents the results of the qualitative assessment of the phytochemical contents of the plant. Phytochemical analysis of the plant showed the presence of alkaloids in the in the leaves and stem, with the bark not having alkaloids (Table 1). Tannin, phlobatannin and Terpenoid were present in the bark, leaves and stem of the plant, while saponin and steroid was only present in the leaves (Table 1). Results also showed that the leaves and the stem of the plant had flavonoid and cardiac glycoside, while bark showed no presence of flavonoid and cardiac glycoside (Table 1).

Table 1: Results of Phytochemical Analysis

	Bark	Leaves	Stem
Alkaloids	-	+	+
Tannin	+	+	+
Saponin	-	+	-
Steroid	-	+	-
Phlobatannin	+	+	+
Terpenoid	+	+	+
Flavonoid	-	+	+
Cardic glycoside	-	+	+

The presence of these phytochemicals has confirmed their medicinal applications. With the exception of phlobatannin, these phytochemicals reported in this current study were in tandem with phytochemicals previously (Osuagwu & Ihenwosu 2014). Also, the study of Boniface *et al*., (2016), reported the presence

of similar phytochemical element as reported in this study, they included; terpenoids, flavonoids, phenolic acids, alkaloids.

Table 2: Quantitative Analysis of Phytochemicals

	Bark (mg/g)	Leaves (mg/g)	Stem (mg/g)
Tannin	5.27±0.025d	10.52±0.015f	3.51±0.020b
Phenol	8.35±0.015e	12.30±0.025g	5.50±0.020d
Phytate	3.56±0.015c	6.55±0.015d	4.25±00.002c
Oxalate	2.53±0.025b	3.64±0.037b	2.74±00.004a
Alkaloid	00.00±00.00a	6.23±0.015c	00.00±00.00a
Saponin	00.00±00.00a	7.98±0.193e	00.00±00.00
Flavonoid	00.00±00.00a	2.32±0.020a	00.00±00.00a

Essien *et al*. (2015) found that *A. cordifolia* fruit oil contains 52.9% oxygenated monoterpenoids, 26.5% aromatic esters, 17.2% monoterpene, and 14.6% sesquiterpene hydrocarbons. Furthermore, the oil contains trace amounts of aliphatic alcohol and aldehyde (3.7%). This sample's main constituents are methyl salicylate (25.3%), citronellol (21.4%), -phellandrene (7.4%), terpinolene (5.7%), and 1,8-cineole (5.5%). Other trace components found in significant amounts include p-cymene (3.6%), -humulene (3.0%), -caryophyllene (2.8%), (E)--damascenone (2.0%), and 1-octen-3-ol (2.0%). Djimeli et al. (2017) discovered many phytochemicals in *A. cordifolia extract*, including phenols, tannins, triterpenes, flavonoids, alkaloids, anthraquinones, anthocyanins, saponins, and coumarins. Their research also revealed that the plant was acutely toxic to male mice, with LD50 values of 8.6 g/kg and 3.8 g/kg, respectively. Furthermore, in vivo experiments revealed that oral extract administration reduced the bacterial load dose-dependently. Specifically, doses of 232, 112, and 58 g/kg of the extract were shown to eliminate the infection after 9, 11, and 13 days of therapy, respectively.

3.2 Quantitative Assessment of Phytochemical Contents

Results of the quantitative assessments of phytochemical contents of the plant is presented in Table 2. The concentration of Taninn was significantly highest in the leaves (10.52 mg/g), followed by the bark (5.27 mg/g), and lowest in the stem with 3.51 mg/g ($p<0.05$). Similarly, phenol was highest in the leaves (12.30 mg/g), and followed by the bark and stem which were 8.35 mg/g and 5.50 mg/g respectively (Table 2). Phytate contents of the plant was 6.55 mg/g for the leaves, 4.25 mg/g for the stem, and 3.56 for the bark ($p<0.05$). Meanwhile, Oxalate was 3.64 mg/g in the leaves, 2.74 mg/g in the stem and 2.53 mg/g in the bark ($p<0.05$).

It was noteworthy that only the leaves of the plant had alkaloid (6.23 mg/g), saponin (7.98 mg/g), and flavonoid (2.32 mg/g), as the stem and bark of the plant detected none of these three phytochemicals. Compared to the current study, the quantification of metabolites in the leaves extract of *A. cordifolia* was assessed by Adeshina *et al*., (2012), results showed that tannin content was 6.80 mg/g, while alkaloid was 5.90 mg/g. Also, previous study on the quantification of phytochemicals in the leaves of the plant showed lower contents of Alkaloid (8.77 mg/g), Flavonoid (5.33 mg/g), Phenol (1.12 mg/g), Steroid (0.99 mg/g), Tannin (0.67 mg/g), and saponin which was not detected (Osuagwu & Ihenwosu, 2014).

3.3 Mineral Assessment of the Plant

Results of the quantitative assessment of mineral element of the plant are presented in Table 3. Results showed that the bark of the plant was highest in potassium (4.29 mg/l), followed by sodium (2.03 mg/l), calcium (1.28 mg/l), magnesium (0.78 mg/l) and with Zinc as the least (0.026 mg/l). Mineral elements of the plant showed that potassium was highest (4757.13), followed by sodium (1.70 mg/l), calcium (0.97 mg/l), magnesium (0.77 mg/l), with the stem having zinc as 0.021 mg/l (Table 3). Furthermore, the leaves were highest in potassium (3.34 mg/l), followed by sodium (1.38 mg/l), calcium (0.81 mg/l), magnesium (0.58 mg/l), and zinc (0.013 mg/l) which was the least mineral element in the leaves (Table 4).

Table 3: Mineral Composition of the Plant

	Bark (mg/l)	Stem (mg/l)	Leaves (mg/l)
Sodium	2029.91±0.091d	1700.74±0.638d	1379.05±0.020d
Potassium	4298.53±0.020e	4757.13±0.020e	3338.75±0.035e
Calcium	1288.81±0.015c	973.89±00.003c	808.50±0.025c
Magnesium	775.22±0.020b	765.16±0.021b	583.95±0.015b
Zinc	26.07±0.104a	21.31±0.021a	12.76±00.001a

3.4 Proximate Analysis of the Plant

The proximate analysis of the plant has yielded significant results, which are presented in Table 4. The ash content of the plant was analyzed, and the findings indicate that the leaves and stems had the highest ash content of 12.31% and 12.12%, respectively, with no significant difference ($p>0.05$) between them. In contrast, the bark had the lowest ash content at 11.21%. These results are of great importance, as ash content is an indicator of the mineral content of the plant and can provide valuable insights into its nutritional value. The presented data can be used for further research and analysis of the plant's properties in various industries, including agriculture and pharmaceuticals. As presented in Table 4, the Moisture content (MC) value was highest in the stem (72.78%), followed by the bark (69.05%), and lowest in the leaves (65.34%).

The crude protein value of the plant was highest in the leaves (10.64%), and lowest in the stem (4.22%), while the crude protein value of the bark was 9.53% (Table 4). Results also showed no significant difference in the fat content of the bark (5.49%) and leaves (5.28%), but significantly different with contents of the stem (3.03%), which was the lowest (Table 4).

Table 4: Proximate Analysis of the Plant

	Bark (%)	Leaves (%)	Stem (%)
Ash	5.97±0.025c	12.31±0.020e	12.12±0.020e
Moisture Content	69.05±0.020f	65.34±0.010f	72.28±0.015f
Crude Protein	9.53±0.015e	10.64±0.040d	4.22±0.025c
Fat	5.49±0.021b	5.28±0.003b	3.03±0.150b
Fiber	8.39±0.383d	6.33±0.003c	7.31±0.015d
Carbohydrate	1.57±0.429a	0.11±0.076a	1.03±0.016a

The fibre content of the bark was highest with value of 8.39, which was not significantly different from the stem (7.31), but statistically different from the leaves which had values of 6.33. The leaves had the lowest carbohydrate (CHO) value (0.11), followed by the stem (1.03), and the bark had the highest, with a value of 1.57 (Table 4).

The comparative proximate analysis the leaf and bark of *Alchornea Cordifolia* was carried out by Ngaha *et al*. (2016b), the leaf had of Crude Protein (13.19%), Crude Fiber (33.58%), moisture (8.72%), dry matter (91.27%) and Organic matter (96.36%); while the bark had crude protein (5.61%), of Crude Fiber (31.37%), moisture (10.06%), dry matter (89.93%), and organic matter (89.65 %).

CONCLUSION

The purpose of this study was to investigate the chemical and nutritional composition of the different extracts obtained from the leaves, stems, and bark of the *Alchornea cordifolia* plant, using well-established analytical methods. The results of the analysis revealed that the plant extracts contained a wide range of phytochemicals and proximate compositions, indicating its potential therapeutic and antioxidant properties. Additionally, the proximate composition analysis showed that the plant is rich in phytochemicals that contribute to its therapeutic characteristics.

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