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Article

Acacia Bombax ceiba Linn. in Niger Delta, Nigeria: Proximate and Phytochemicals

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ABSTRACT

Bombax ceiba Linn. is a species of the Bombacaceae – Kapok tree family of Acacia, a wild tropical evergreen tree, and has immense potential as a medicinal source for man. This work studied the proximate, mineral, and bioactive components in *Acacia B. ceiba* Linn. Result showed 1.92% protein content, 22.9% carbohydrate, 3.44% ash, 7.25% fiber, 57.97% moisture, and 6.52% fat contents. Minerals analyzed were content 0.237% potassium, 0.011% iron, 1.654% calcium, 0.002% manganese, and 0.245% P. Minerals are vital for various body functions, such as muscle contraction, osmotic regulations, and other body signaling. The GC–MS analysis of the methanol extract of *Acacia B. ceiba* Linn. bark revealed the presence of 15 secondary metabolites. Each of the secondary metabolites had different retention times and area percentages. In the present study, the secondary metabolites whose percentages were <5% were considered to be insignificant. The secondary metabolites that had significant area percentage include 1-(4-Chlorophenoxy)-1-(1H-imidazol-1-yl)-3,3-dimethylbutan-2-one (8.558%), heptasiloxane (13.419%), and Benzo[b]fluoranthene (13.419%). The investigation also revealed that the bark of *Acacia B. ceiba* Linn. contains a high amount of Benzanthracene, a carcinogen.

Key words: Proximate, Mineral, Secondary metabolites, Phytochemicals

1. INTRODUCTION

A medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs [1]. This description makes it possible to distinguish between medicinal plants whose therapeutic properties and constituents have been established scientifically, and plants that are regarded as medicinal but which have not yet been subjected to a thorough scientific study. A number of plants have been used in traditional medicine for many years. Some do seem to work, although there may not be sufficient scientific data (double-blind trials, for example) to confirm their efficacy. Such plants should qualify as medicinal plants. The term "crude drugs of natural or biological origin" is used by pharmacists and pharmacologists to describe whole plants or parts of plants which have medicinal properties [2].

Acacia B. ceiba Linn. [Figure 1] is one of such plants that have been described as having medicinal properties. Acacia is a genus of about 160 species of trees and shrubs in the pea family (Fabaceae). It is a native to tropical and subtropical regions of the world, particularly Australia and Africa. Several *Acacia* species are important economically. Gum acacia (*Acacia senegal*), native to Sudan region in Africa, yields true gum Arabic, a substance used in adhesive, pharmaceuticals, inks, confections, and other products [3]. The bark of most acacia is rich in tannin, which is used in tanning and in dye inks, pharmaceuticals, and other products [4]. According to Rameshwar *et al*. [5], it is one of the important medicinal plants in tropical and subtropical India. It also occurs in Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, Java, Sumatra, and North Australia. It has a number of traditional uses and its medicinal usage has been reported in Indian traditional system of medicine such as Ayurveda, Siddha, and Unani [6].

In proximate analysis, environmental factors including temperature, soil fertility, soil water, lighting, and ozone may affect the concentration of elements in the plant from region to region [7]. Hoque *et al*. [8] reported that methanol and phenol extracts of *Acacia B. ceiba* L. roots showed mild-to-moderate *in vitro* antibacterial activity. Chauhan *et al*. [9] isolated tannin, saponin, alkanoids, glycosides, and phenolic compounds from *B. ceiba* seed powder. Zahan *et al*. [10] described in their study that the methanolic extract of root demonstrated dose-dependent reduction from Fe^{3+} to Fe^{2+} with highest absorbance of 1.11 at 500 µg/ml. Zengin *et al*. [11] attributed antioxidant activity of the extracts of *B. ceiba* L. to the reducing power of the plant.

Antibacterial activity study of *B. ceiba* stem bark methanolic extract showed good antibacterial activity against the bacterial strain [12]. Wang and Huang [13] found that *B. ceiba* root ethanolic extract has activity against *Helicobacter pylori*. Zahan *et al*. [10] while studying the methanolic extract of bark of *B. ceiba* demonstrated good DPPH radical scavenging activity having IC50 32.1 µg/ml. Jain *et al*. [14] described the methanolic extract of root demonstrated dose-dependent reduction from Fe^{3+} to Fe^{2+} with highest absorbance of 1.11 at 500 µg/ml. Zahan and others [10] reported that methanolic extract of bark of B. ceiba possesses adequate reducing activity.

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Although numerous functions of *B. ceiba* L. especially those relative to its medicinal and pharmacological functions have been reported, there is still limited information on the proximate analysis and biochemical profiles of the bark of *B. ceiba* L. in different regions of the world. Hence, this research is on proximate, mineral. and phytochemicals of samples of the bark of *Acacia Bombax ceiba* L. collected from a forest in Agalabiri community, Bayelsa State, Nigeria.

2. MATERIALS AND METHODS

2.1. Materials

All chemicals used were of analytical grades and obtained from BDH, Labtech Chemicals, Ken Light Laboratories, Kermel.

2.2. Methods

The bark of *Acacia B. ceiba* L. was collected from a forest in Angalabiri in Sagbama Local Government area, Bayelsa State, South Nigeria, and properly identified at the Department of Plant Science and Biotechnology, University of Port Harcourt, River state, Nigeria. The barks were cut into pieces and air dried for 10 days. The samples were later oven dried at 30°C for 3 days. The dried sample was ground into powder and stored in a desiccator before analysis.

2.2.1. Proximate analysis

Standard procedures as described by the Association of Official Analytical Chemists [15] were employed in the determination of moisture, fat, ash, crude fiber, crude protein, and carbohydrate content.

2.2.2. Mineral analysis

Standard procedures as described by the Association of Official Analytical Chemists [15] were used to determine manganese (Mn), iron (Fe), calcium (Ca), phosphorus (P), and potassium (K).

2.2.3. Bioactive chemicals

GC–MS analysis of methanol extract of the bark of *Acacia B. ceiba* L. was performed with GC (Agilent 6890) and MS (5973 MSD) equipped with Restek capillary column (30 m × 0.53 mm; film thickness 0.12 μm), using helium as the carrier gas with a flow rate of 1 mL/min.

3. RESULTS

Results of the various analyses carried out on the bark of *B. ceiba* L. are presented as follows:

4. DISCUSSION

Table 1 summarizes the results of proximate principles of the bark of *B. ceiba* Linn. Moisture content which influences the physical properties of a substance including weight, density, viscosity, conductivity, and others [16] of the bark of *Acacia B. ceiba* L. was 57.97%. This value was found to be a little higher compared to that obtained in the leaves of *Acacia modesta* (53.43%) and *Acacia nilotica* (44.78%) [17]. This difference could be as a result of the ability of the bark of a tree to retain water more than the leaves. The ash content of the bark of *Acacia B. ceiba* L. was 3.44%. The ash content is a measure of the total amount of minerals [18]. This result is smaller compared to the ash content of *Acacia ataxacantha* leaves which was reported to be 4.00% by Daben *et al*. [18]. The protein content of the bark of *Acacia B. ceiba* L. was 1.92%. This is relatively low compared to that of the leaf of *A. ataxacantha*, 6.56% [18] and also lower than the minimum requirement of 6% necessary for the maintenance of good animal's condition [19]. The fat content of the bark of *Acacia B. ceiba* L. was 6.52%. This was lower than that of *A. ataxacantha*, 13.24% [18]. The fiber content of the bark of *Acacia B. ceiba* L. was 7.25%. Plant fibers are elongated most commonly sclerenchyma supportive plant cells with thick cellulose walls with a well-organized structure [20]. This is relatively low compared to *A. nilotica*, 13.91%, and *A. ataxacantha* [18]. The carbohydrate content of the bark of *Acacia B. ceiba* L. was 22.9%. Carbohydrate is the primary source of energy in the body. This is also relatively low compared to that of the leaf of *A. ataxacantha* 51.75% [18].

Result of the analysis of mineral composition of the bark of *Acacia B. ceiba* L. is presented in Table 2. The concentration of potassium (K) in the bark of *Acacia B. ceiba* L was 0.237%. This is approximately the same with the concentration of potassium (K) in the leaves of *A. ataxacantha*, 0.2% [18], which is in the range for normal body functions. Fe is a mineral vital for the proper functioning of hemoglobin, a protein needed to transport oxygen in the blood. A shortage of Fe in the blood can lead to a range of serious health problems such as anemia [21]. Fe concentration in the bark of *Acacia B. ceiba* L. was 0.011%. The concentration is relatively smaller compared with the concentration of Fe in the leaves of *A. ataxacantha*, 0.2% [18], but still within the normal range for normal body functions. The concentration of Mn in the bark of *Acacia B. ceiba* L. was 0.002%. This was lower

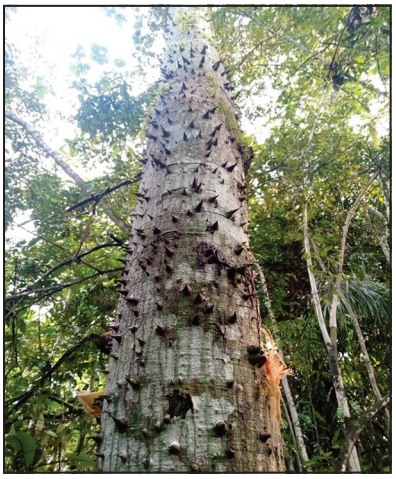

Figure 1: *Acacia Bombax ceiba* Linn. in Angalabiri Forest, Bayelsa State, Nigeria.

Table 1: Result of proximate analysis on the bark of *Bombax ceiba* L.

Proximate	Composition of dry sample (%)
Moisture	57.97
Ash	3.44
Protein	1.92
Fat	6.52
Fiber	7.25
Carbohydrate	22.9

Table 2: Result of mineral content on the bark of *Bombax ceiba* L.

Mineral composition	Composition of dry sample (%)
Potassium	0.237
Iron	0.011
Manganese	0.002
Calcium	1.654
Phosphorous	0.245

Table 3: Result of bioactive components analysis on the bark of *Acacia Bombax ceiba* L.

S. No.	Retention time	Name of compound	Molecular formula	Molecular weight	Peak area %
1.	0.644	Benzanthracene	$C_{18}H_{12}$	228	68.6
2.	1.896	Triphenylene	$C_{18}H_{12}$	228	14.3
3.	8.509	Performic acid	$C_4H_{10}O_3Si$	122	89.8
4.	8.646	Fluoroacetic acid	$C_6H_9FO_4$	163	0.89
5.	8.823	Squalene	$C_{30}H_{50}$	374	80.1
6.	12.075	1.1-Chloroheptacosane	$C_{27}H_{55}Cl$	414	90.1
7.	13.047	Octadecyl chloride	$C_{18}H_{37}Cl$	288	1.72
8.	13.275	(E)-2-bromobutyloxychalcone	$C_{19}H_{19}BrO_2$	358.9	97.0
9.	13.458	2-(n-Pentyl) oxybenzylidene acetophenone	$C_{20}H_{22}O_2$	294	0.97
10.	14.150	1.Methyl 2-[(1E)-4,4-dicyano-3-(methylanilino) -1,3-butadienyl]-2H-1,2,3-triazole-4-carboxylate	$C_{17}H_{14}N_6O_2$	334	98.4
11.	14.556	2-(E-4,4-Dicyano-1-N-methylanilino-1,3-butadien -1-yl)-4-(methoxycarbonyl)-1,2,3-triazole	$C_{17}H_{14}N_6O_2$	346	0.98
12.	15.213	1-(4-Chlorophenoxy)-1-(1H-imidazol-1-yl) -3,3-dimethylbutan-2-one	$C_{15}H_{17}ClN_2O_2$	292	92.0
13.	17.362	7-(4-Chlorophenyl)-1,6-diazabicyclo[4.1.0]heptane	$C_{11}H_{13}ClN_2$	208	0.92
14.	18.442	Eicosamethyl-cyclodecasiloxane	$C_{20}H_{60}O_{10}Si_{10}$	740	97.7
15.	19.322	Benzo[b] fluoranthene	$C_{20}H_{12}$	252	62.1

compared to the concentration of Mn in *A. ataxacantha* 0.03% [18]. Mn is useful for vitamins stabilization [18]. Ca is a mineral most often associated with healthy bones and teeth, although it also plays an important role in blood clothing, helps in muscles contraction, and regulating normal heart rhythms and nerve functions [22]. The concentration of Ca in the bark of *Acacia B. ceiba* L. was 1.654%. This is far higher compared with the Ca concentration in the leaf of *A. ataxacantha*, 0.03% [18]. The concentration of phosphorus (P) in the bark of *Acacia B. ceiba* L. was 0.245%. This is a little lower than the concentration of phosphorus in the leaves of *A. ataxacantha*, 0.30% [18].

The analysis of the gas chromatography—mass spectrometry (GC–MS) of the methanol extract of *Acacia B. ceiba* Linn. bark is presented in Table 3. The result shows the presence of fifteen (15) secondary metabolites with different retention times and peak area percentages. In the present study, the secondary metabolites whose percentages were <5% were considered to be insignificant. The secondary metabolites that had significant area percentage are benzanthracene (68.6%), triphenylene (14.3%), performic acid (89.8%), squalene (80.1%), 1-chloroheptacosane, (90.1%), (E)-2-bromobutyloxychalcone (97.0%), 1.Methyl 2-[(1E)-4,4-dicyano-3-(methylanilino)-1,3-butadienyl]-2H-1,2,3-triazole-4-carboxylate (98.4%), 1-(4-Chlorophenoxy)-1-(1H-imidazol-1-yl)-3,3-dimethylbutan-2-one (92.0%), eicosamethyl-cyclodecasiloxane (97.7%), and Benzo[b]fluoranthene (62.1%).

Performic acid HCOOH (PFA) is a wide-spectrum disinfectant. It inactivates viruses, bacteria and bacterial spores, mycobacteria, as well as microscopic fungi [23]. Squalene compound has anti-cancer, antioxidant, antitumor, chemopreventive, pesticidal, and sun screen properties [24] and many of the bioactive components have antibacterial, antifungal, antifouling, immunomodulatory, and antitumor properties justifying the folklore use of the bark of *Acacia B. ceiba* Linn. in traditional system as antivenin. Nevertheless, *Acacia Bombax ceiba* Linn. bark contains a high amount of benzanthracene which is carcinogenic and can affect the health once inhaled [25].

Thus, the results of GC–MS analysis of the methanol extract of *B. ceiba* L. demonstrate the presence of many secondary metabolites that possess a range of biological activities.

5. CONCLUSION

This research was focused on the proximate, minerals, and secondary metabolites in methanol extract of the bark of *Acacia B. ceiba* Linn. Proximate content was high compared to the mineral content in the bark of *Acacia B. ceiba* Linn. Gas chromatography–mass spectrometry (GC–MS) analysis of methanolic extract of the bark of the plant presented 15 secondary metabolites, affirming the medicinal properties of the bark of *Acacia B. ceiba* Linn. Benzanthracene, a carcinogen was found in significant amount in the bark of the plant. Optimistically, this research will provide important biochemical information of the bark of *Acacia B. ceiba* Linn. used locally to cure various ailments.

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