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Comparative phytochemical and proximate analyses on *Ceiba pentandra* (L) Gaertn. and *Bombax buonopozense* (P) Beauv.

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Abstract
This research work reports the comparative Phytochemical and proximate analyses on two plants; *Ceiba pentandra* [L] Gaertn and *Bombax buonopozense* [P] Beauv both of the family Malvaceae formerly Bombacaceae. The study however, revealed the presence of phytochemical components such as Tannin, alkaloids, saponin, cyanogenic glycosides, steroids, flavonoids and phenols. In *Ceiba pentandra* the highest phytochemical compound was glycosides [18.71±2.0] present in the leaves and phenol was the lowest [0.04±0.01] present in the root, likewise in *Bombax buonopozense*, the highest phytochemical compound was glycosides [14.25±1.07] found in the leaves while the least was phenol [0.05±0.001] also found in the root. Moreover, their proximate values were also established, with both plants having carbohydrate as their highest proximate content [40.59±0.71] and [38.05±0.9] respectively found in their stems and the least was fat [0.69±0.02] and [0.62±0.015] found in the roots of the both plants. In addition, the work tried to establish the mineral content of the plants, minerals like potassium, sodium, phosphorus, magnesium and calcium were tested for, although found in minute quantities.

Keywords: *Ceiba pentandra*, *Bombax buonopozense*, Phytochemicals, Proximate Analysis.

1. Introduction
The roles of plants in maintaining human health is well documented [1]. In Nigeria and other parts of the world, many of these indigenous plants are used as species, food ornamentals or medicinal plants. Okwu DE *et al* [2] reported that many of these plants posses bioactive compounds that exhibit physiological activities against bacteria and other microorganisms. However, these plants are used in treatment of many diseases such as rheumatism, dysentery, cough, diabetes, tuberculosis, malaria and other ailments, [3, 4, 5]. Medicinal and aromatic plants have demonstrated its contribution to the treatment of disease such as HIV/AIDS, sickle-cell anemia, mental disorders [6, 7] and microbial infection [8].
It is generally assumed that the dietary constituents contributing to the protective effects of these plant materials are plant secondary metabolites in the form of phytochemicals, vitamins and minerals. Medicinal and aromatic plants contain biologically active chemical substances such as saponins, tannins, flavonoids, alkaloids, anthocyanin, steroids and other chemical compounds, [9, 10] which have curative properties.
Adding to these, [11] has reported that these plants also contain certain other compounds that moderate the effects of the active ingredients. Thus diets containing an abundance of fruits and vegetables give protection against a variety of diseases, particularly cardiovascular diseases [12]. Many rare and useful herbs occur in Nigeria, from which important drugs could be prepared or agents which may serve as starting materials for the partial synthesis of some useful drugs [10]. The usefulness of these plant materials medicinally is due to the presence of bioactive constituents such as phenols, flavonoids, tannins and alkaloids [13].
Phytochemicals are compounds formed during the plants normal metabolic processes. These chemicals are often referred to as “secondary metabolites” of which there are several classes including: Alkaloids, flavonoids, cumains, glycosides, tannins, steroids, phenols and others [9, 15]. Most of these phytochemical constituents are potent bioactive compounds found in medicinal plant parts which are precursors for the synthesis of useful drugs [10].
There are many families of phytochemicals and they help the body in a variety of ways. Research suggests that phytochemicals, working together with nutrients found in fruits, vegetables and nuts, may help slow the aging process and reduce the risk of many diseases, including cancer, heart disease, stroke, cataracts, osteoporosis and urinary tract infections.

They may also have complementary and overlapping mechanisms of action in the body, including antioxidant effects, modulation of detoxification enzymes, stimulation of the metabolism, antibacterial and antiviral [15].

Also, related studies revealed that flavonoids apart from their antioxidant protective effects, inhibits the initiation, promotion and progression of tumors [16, 15]. Tannins are known to inhibit pathogenic fungi [17]. Alkaloids play some metabolic role and control development in living system. Saponins prevent disease invasion of plants by parasitic fungi, [18] hence having antifungal properties.

***Ceiba pentandra* [L] Gaertn**

The genus ceiba consist of 10 species of large tropical trees in the family Malvaceae [formerly in the Bombacaceae], which also includes the "baobab" trees of Africa [genus *Adansonia*] [19] *Ceiba* trees are typically emergent, meaning their large umbrella-shaped canopies emerge above the forest canopy. They are thus among the tallest trees in the tropical forest reaching as high as 60 m in rainforests of the Amazon and West Africa. Their thick columnar trunks often have large buttresses [19].

However, young trunks and branches are armed with thick conical spines and are often green due to photosynthetic pigment [20]. The leaves are alternate and palmately compound, with 5-8 entire-margined leaflets. The radically symmetrical flowers can be rather small inconspicuous and showy. They are usually white, pinkish-white or red, and leathery. The flowers have 5 stamens fused into a tube at the base. *Ceiba* fruits are large ellipsoid capsules up to 20cm long, with 5 woody valves that split open to reveal abundant fluff, or kapok in which the many small black-brown seeds are embedded [20]. The kapok fibers are not attached to the seeds. The fibers are 1.5-3cm long and are covered with a waxy substance that aids in their water-repellency [19].

Tropicos [20] suggested that Ceiba tree may flower as little as once every 5 years, especially in wetter forest edges or in drier sites. The tree lose their leaves in the dry season, a condition termed "drought-deciduousness", [20] flowering and fruiting takes place when the tree in leafless and this is believed to be an adaptation that facilitates both mammal pollination and wind dispersal. This may explain how ceiba reached Africa from South America where the genus in believed to have originated.

The leaves of *C. pentandra* are eaten as vegetables and as livestock fodder. It is however, known by the 3 ethnic groups in Nigeria as:

Igbo : Owu-akpu

***Bombax buonopozense* [P] Beauv.**

Bombax buonopozense [P] Beauv on the other hand is of the family Malvaceae formerly Bombacaceae and is commonly known as Gold coast Bombax or red flowered silk cotton tree.

It is known by the following local names:

Igbo	-	Akpe
Yoruba	-	Ponpola
Hausa	-	Gurjuya, Kurya
Efik	-	Ukim and
Ijaw	-	Ido Undu

It is native primarily in West Africa where it is found in rainforests of Sierra Leone in the northwest, east Gabon, typically at elevations of 900 to 1200 meters [21]. It is a large tree and often reaches heights of 40 meters [130 feets] in diameter [20, 22]. The bark of younger trees is covered with spine but shedding the spines with age to some degree and large deep pink-to-red flowers emerge while the tree is leafless [22]. The branches are arranged in whorls. The leaves are compound and have 5 to 9 leaflets and 15 to 25 secondary veins [20]. In addition, their studies went further to explain that the leaves are set on long petioles that typically measure between 22 and 14 cm. The individual leaflets have entire margins and are also quite large, measuring 8 to 23cm in length by 3 to 7.5cm in width. The undersides of the leaflets may be either glabrous or puberulous. The buds are conical [20, 22].

The conspicuous flowers emerge while the tree is leafless and are either solitary or arranged in small axillary cymes. The truncate calyx that is the whorl of sepals is 1 to 1.6cm high and cupuliform, or cup shaped [22]. It is also deciduous, meaning persist on the fruit. The petals are deep pink or red in colour and are 5.5 to 9.5cm in length by 2.7 to 3.7 cm in width. The numerous stamens are arranged in bundles with two whorls. The fruits are oblong and fairly large being 8 to 18cm in length by 3.5 to 6cm in diameter [22]. They are glabrous, either rigged or angular, and loculicidal meaning that they open spontaneously at maturity along the capsule wall in between the sections of the locule [22]. More so, they contain many seeds that are 5 to 6mm in length, all of which have a woolly indument, which is a cotton-like fiber covering [22].

According to [21, 22] many parts of this plant is utilized for medicinal and traditional purposes.

2. Materials and Methods

2.1 Samples Collection

The fresh twigs, stems and roots of *Ceiba pentandra* and *Bombax buonopozense* were collected from the premises of Nnamdi Azikiwe University, Awka in the month of March, 2010. The plants were identified by Mr. P.O. Ugwuozor, a Taxonomist and herbarium curator of the department of Botany, Nnamdi Azikiwe University Awka and were authenticated by Prof. C. U. Okeke a taxonomist of the same department.

2.2 Preparation of Samples for Analyses

The fresh plants [leaves, stems and roots] were oven dried at the temperature of 65 ^{0}C for 24 hours. The dried samples were first mashed slightly with mortar and piston, then they were ground to a fine powder using Thomas-Willey milling machine. The dried powdered samples were however used for the various analyses.

2.3 Preliminary Phytochemical Investigation

Phytochemical tests were carried out first on the samples to establish the presence or otherwise of the chemical constituents using standard procedures [23], however, water and ethanol extracts were commonly used.

2.4 Quantitative Phytochemical Investigation

The Follins-Dennis spectrophotometric method [24] was used in all analysis.

2.5 Proximate Analysis

This was carried out mainly by using the method described by Association of Official Analytical Chemist [25]. It involves the determination of crude protein, dry matter, ash, crude fiber, ether extract [fat], moisture content and carbohydrate content.

2.6 Mineral Content Determination

The mineral content of the test samples were determined by the dry ash extraction method. 2.0g of the samples were burnt to ashes in a furnace [as in ash determination] the resulting ash was dissolved in 100 ml of dilute hydrochloric acid and then diluted to 100 ml in a volumetric flask using distilled water. The digest obtained was used for the various analyses.

3. Results

After the various analyses done in duplicates on the test samples, the following results were obtained, and compared to ensure competence in results.

Table 1: Qualitative Phytochemical Result of *Ceiba Pentandra*

Phytochemical component	Test	Observation	Inference		
			Leave	Stem	Root
Tannin	Ferric chlorides test	Greenish-black	+	+	+
Alkaloid	Mayer's and Wagner's test	Reddish brown precipitate	+	+	+
Saponin	Emulsion test	Presence of emulsion	+	+	+
Sterols	Salkowski test	Red colour at interface	+	+	+
Flavonoid	Ammonium test Ammonium chloride test	Yellow colour Yellow colour	+	+	+
Phenols	Ferric-chloride test	Greenish-brown precipitated	+	+	+

Table 1: shows that the leaves, stem and root of *C. pentandra* contained the following phytochemicals tested for Key + = Present - = Absent

Table 2: Qualitative Phytochemical Result of *Bombax Buonopozense*

Phytochemical component	Test	Observation	Inference		
			Leave	Stem	Root
Tannin	Ferric chlorides test	Greenish-black	+	+	+
Alkaloid	Mayer's and Wagner's test	Reddish brown precipitate	+	+	+
Saponin	Emulsion test	Presence of emulsion	+	+	+
Sterols	Salkowski test	Red colour at interface	+	+	+
Flavonoid	Ammonium test Ammonium chloride test	Yellow colour Yellow colour	+	+	+
Phenols	Ferric-chloride test	Greenish-brown precipitated	+	+	+

Table 2 shows that the leaves stem and root of *Bombax buonopozense* contained the following phytochemicals tested for. Key + = Present - = Absent

Table 3: Quantitative Phytochemical Result of *Ceiba Pentandra*

Phytochemical components in [%]	Leaves	Stem	Root
Tannin	2.62±0.02	0.83±0.01	1.22±0.02
Alkaloid	6.32±0.71	3.79±1.6	0.76±0.02
Saponin	3.75±0.7	2.43±0.7	1.25±0.71
Cyanogenic glycosides	18.71±2.0	4.31±1.0	16.74±5.0
Sterols	0.14±0.012	0.06±0.01	0.09±0.07
Flavonoid	1.26±0.015	1.14±0.02	0.83±0.02
Phenol	0.17±0.01	0.08±0.03	0.04±0.01

Table 3 shows that the leave contained the highest value of the chemical which is cyanogenic glycoside while the least is phenol contained in the root

Table 4: Quantitative Phytochemical Result of *Bombax Buonopozense*

Phytochemical components in [%]	Leaves	Stem	Root
Tannin	3.46±1.0	0.99±0.04	1.21±1.0
Alkaloid	5.77±2.55	3.63±2.5	0.71±0.02
Saponin	2.98±1.22	2.32±1.0	1.49±1.0
Cyanogenic glycosides	14.25±1.01	5.61±0.02	12.55±0.1
Sterols	0.14±1.6	0.08±0.002	0.12±0.02
Flavonoid	1.35±0.71	1.26±0.025	0.99±0.05
Phenol	0.18±0.02	0.08±0.01	0.05±0.001

Table 4 show that the highest value of phytochemical was cyanogenic glycoside found in leaves while the least was phenol found in the root.

Table 5: Proximate Analyses result of *Ceiba Pentandra*

Constituents [%]	Leaves	Stem	Root
Carbohydrate	40.59±0.71	31.85±1.0	35.06±0.130
Ash content	7.26±2.6	1.43±0.7	3.73±2.55
Moisture content	14.34±2.0	12.39±0.1	18.71±0.71
Crude fiber	18.64±1.9	19.75±1.0	23.64±1.6
Ether extract [Fat]	2.41±0.7	0.98±0.03	0.69±0.02
Crude protein	12.32±5.7	9.74±1.6	6.84±1.58

Table 5 shows that the highest proximate content was carbohydrate [40.59±0.71] present in the leave while the least is ether extract [fat] [0.69±0.02] present in the root.

Table 6: Proximate Analyses result of *Bombax Buonopozense*

Constituents [%]	Leaves	Stem	Root
Carbohydrate	38.05±0.9	32.79±2.55	31.42±0.71
Ash content	5.97±3.0	1.83±0.7	3.23±1.6
Moisture content	16.73±2.0	15.26±1.6	17.21±1.0
Ether extract[Fat]	2.18±1.6	0.73±0.71	0.62±0.015
Crude protein	13.18±2.0	8.94±1.6	6.93±2.5
Crude fiber	16.76±1.0	21.34±3.2	20.65±3.54

Table 6 shows that the highest proximate content was the carbohydrate [38.05±0.9] present in the leave while the least is fat [0.62±0.015] present in the root.

Table 7: Mineral composition result of *Ceiba Pentandra*

Minerals [%]	Leaves	Stem	Root
Potassium [k]	0.36±0.01	0.13±0.03	0.25±0.01
Sodium [Na]	0.24±0.08	0.14±0.009	0.20±0.02
Phosphorus [P]	0.22±0.02	0.08±0.01	0.17±0.01
Magnesium [Mg]	0.16±0.03	0.18±0.05	0.16±0.006
Calcium [Ca]	0.28±0.04	0.08±0.01	0.15±0.02

Table 7 shows that the highest mineral composition is the potassium [k] [0.36±0.01] found in the leave while the least are phosphorus and calcium [0.08±0.01] found in the stem.

Table 8: mineral composition of *Bombax buonopozense*

Minerals [%]	Leaves	Stem	Root
Potassium [k]	0.33±0.02	0.24±0.1	0.26±0.03
Sodium [Na]	0.24±0.2	0.16±0.4	0.25±0.05
Phosphorus [P]	0.29±0.004	0.06±0.01	0.23±0.5
Magnesium [Mg]	0.21±0.01	0.16±0.4	0.15±0.006
Calcium [Ca]	0.24±0.2	0.11±0.1	0.11±0.3

Table 8 shows that the highest mineral composition is potassium [K] [0.33±0.02] contained in the leave while the least is phosphorus [P] [0.06±0.01] contained in the stem.

4. Discussion

The result of the analyses revealed the presence of various phytochemicals and minerals such as alkaloids, tannins, flavonoids, saponins, sterols, glycosides and phenols; minerals like, calcium, sodium, phosphorus, potassium and magnesium although minerals are in minute quantities in the leaves, stem and roots of C*eiba pentandra* and *Bombax buonopozense*. These phytochemicals are known to have antimicrobial activities [26] and the minerals help plants and animals to live and be healthy.

The highest phytochemical compound in *Ceiba pentandra* is cyanogenic glycosides [18.71±2.0%] present in the leaves and the least being phenols [0.04±0.01%] present in the root, while in *Bombax buonopozense*, cyanogenic glycosides was also the highest phytochemical compound [14.25±1.01%] present in the leaves, with the least being phenols [0.05±0.001%] found in the root.

There are moderate amounts of alkaloids in the leaves and stems of *C. pentandra* and *B. buonopozense* respectively. Alkaloids are known to exhibit marked physiological activity when administered to animals [15]. However pure isolated plant alkaloids and their synthetic derivatives are used as basic medicinal agents for analgesics, antispasmodic and bacterial effects [27].

Tannins present in the two plants have been found to possess astringent properties which hasten the healing of wounds and inflamed mucus membranes [15, 28]. More so, tannins if ingested in excessive quantities inhibit the absorption of minerals leading to anemia [29].

The presence of flavonoid in the leaves, stem and root of both *C. pentandra* and *B. buonopozense* indicates their medicinal value. Hence, flavonoids are antioxidants and free radical scavengers which prevent oxidation; they have strong anticancer activity and also protect the cell against all stage of carcinogenesis [15, 30]. In addition, flavonoids in the intestinal tract lower the risk of heart disease [15].

C. pentandra and *B. buonopozense* are found to contain saponins. Saponin is useful in medicine and pharmaceutical industry due to its foaming ability that produces frothy effects in the food industry. Saponin is also used in the manufacture of shampoos, insecticides, various drug preparation and synthesis of steroidal hormone. However, some examples of such compounds include cortisone and the estrogenic contraceptive [31, 32].

Again, steroids are used in the treatment of some endocrine disorder, regulation of blood sugar, salt imbalance, and antimicrobial infections [31].

Glycosides found in enormous quantities in the two plants are constituent of many animal tissues, and are important in medicine because of their action on the heart [33].

Phenols, also present in the plants, although in traces, are germicidal and are used in formulating disinfectants [34]. Phenols are also used to make disinfectants and antiseptics that are used in mouthwash.

Relatively, the result also revealed the proximate content of the leaves, stems and roots of *Ceiba pentandra* and *Bombax buonopozense.* Carbohydrate [40.59±0.71] and [38.05±0.9] found in the stems of the both plants were the highest proximate content while the least proximate contents are ether extract [fat] [0.69±0.02] and [0.62±0.015] found in roots of both plants. Carbohydrates are hydrolyzed in the body to yield glucose, which can be utilized immediately or stored as glycogen in the muscles and liver for future use.

Proteins are body builders, they replace worn out tissues, and proteins are also immune booster and can help in cell division as well as growth [35].

Fats are important in energy production. Also, fats and oils help to regulate blood pressure of vital cell parts [36].

Moisture is a universal solvent. It dissolves other substances, carries nutrients and other materials round the body, creating the possibility for organs to perform their function effectively.

Fibers are parts of fruits, grains and vegetables which can

neither be digested nor absorbed by human system [37]. They reduce the levels of palm cholesterol and prevent colon cancer and cardiovascular disease [38].

5. Conclusion

From these analyses, the researcher observed that most phytochemical contents are higher in the leaves; and therefore recommend the leaves as the major source of these phytochemicals. However, *Ceiba pentandra* has higher content of most of these phytochemical components; therefore, it is suitable for industrial purposes like; in pharmaceutical industries and cosmetic industries. While *Bombax buonopozense* has moderate content of these components which may not be toxic or harmful to the human system and is therefore, recommended to be eaten as vegetable when it's cooked, so as to reduce its glycoside content as done by many tribes.

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