Research Article

Comparative Analysis of Medicinal Properties of the Bark and Leaves of *Tectona grandis*

Oke, David Gbenga* and Ogunjimi, Babatunde Emmanuel

Department of Chemistry and Industrial Chemistry, Bowen University, Nigeria

Abstract

This study was carried out to compare the proximate and phytochemical properties of leaves and back of tectona *grandis*. Ethanolic extract of both the bark and leaves were subjected to both phytochemical and proximate analysis. The stem barks were positive for the following phytochemicals: flavonoids, terpenoids, saponins, tanins, steroids, alkaloids, and glycosides. The leaves were also positive for all except alkaloids and glycosides. Proximate analysis of the stem bark revealed the following: 13.0% moisture, 25.0% ash, 28.8% fibre, 20.0% lipid, 12.0% protein, 1.2% carbohydrate and 1.9% nitrogen. While the leaves contained: 10.0% moisture, 25.0% ash, 12.0% fibre, 11.1% lipid, 23.1% protein, 15.1% carbohydrate and 3.7% nitrogen. The comparison of the two showed that the stem bark is richer in phytochemicals than the root while the proximate analysis revealed that the bark is higher in moisture, ash, fibre and lipid but lower in protein, nitrogen and carbohydrate.

Keywords: *Tectona grandis*, proximate and phytochemicals

***Correspondence**

Oke, David Gbenga

Email: okedg25@gmail.com

Introduction

Tectona grandis (Teak) is a hardwood tree that is common in tropical areas and is placed in the family Lamiaceae. It is a deciduous tree that is large and dominant in mixed hardwood forests. It is mostly small tree with fragrant white flowers and leaves that are papery and often hairy on the lower surface. It is normally called 'Burmese Teak' and the Yorubas called it "Igi Gedu". Teak wood has a leather smells particularly, when it is freshly milled. Teak timber is particularly valued for its durability and water resistance, and is used for a number of things among which are: boat building, exterior construction, veneer, furniture, carving, turnings, and other small wood projects [1].

It was reported that the flowers of tectona *grandis* are normally pollinated by insect (entomophilous), but sometimes are pollinated by wind [2]. It was found in its native range in Thailand, that the major pollinators were species in the *Ceratina* genus of bees [3].

Teak's natural oils make it useful in exposed locations, and make the timber, termite and pest resistant. Teak is durable even when not treated with oil or varnish. Timber cut from old teak trees was once believed to be more durable and harder than plantation grown teak. Studies have shown that plantation teak performs on par with old-growth teak in erosion rate, dimensional stability, warping, and surface checking, but is more susceptible to colour change from UV exposure [4]. *Hyblaea puera*, a moth native to Southeast Asia, is a teak pest whose caterpillar feeds on teak and other species of trees common in the region [5].

Teak is often an effective material for the construction of both indoor and outdoor furniture. Teak's high oil content, high tensile strength and tight grain makes it particularly suitable for outdoor furniture applications, boat decks, and other articles where weather resistance is desired. It is also used for cutting boards, indoor flooring, and countertops and as a veneer for indoor furnishings [5].

The leaves are used as haemostatic, depurative, anti-inflammatory, cooling and vulnerary, [6]. The wood is used as acrid, cooling, laxative, and sedative to gravid uterus, useful in the treatment of piles, leucoderma and dysentery. Oil extracted from wood is best for headache, biliousness and burning pains. The flowers are used as acrid, for bitter drying and cures bronchitis, biliousness, useful in scabies.

The Proximate chemical composition of teak leaves has been reported by Ocheja and the result shows 39.45% dry matter (carbohydrate and fat), 10.13% crude protein, 10.97% crude fibre, 68.13% nitrogen free extract and 19.17% ash content [7] compared to 10.3% of the same leaves by Adekola [8] and 19.4% of Satya[9].

The department of pharmacology, college of pharmacy India worked on the phytochemical analysis of the stem and bark. They obtained a proximate moisture content of 14.6% compared to 15.82% [9], gotten from the leaves.

The research done by [9] revealed that the ethanol extract of the bark of teak were positive for carbohydrate, protein, amino acids, glucosides, saponins, flavonoids and tannins but negative for steroids and alkaloids.

This study furthers aims at comparing both the proximate and phytochemical properties of tectona *grandis* (leaves and plant) from the same tree.

Experimental

Collection, Identification and Preparation of Plant Material:

The leaves and barks of the plant were harvested at Bowen University, Iwo. They were identified and authenticated at the herbarium section of the Department of Biological Science, Bowen University. The materials were thoroughly washed in water to remove dirt and unwanted particles. The washed materials were oven dried using a hot air oven at 105^0C for 5 days, pounded, grinded with a blender (i.e. pulverization) and sieved with a mesh size of 0.5 mm to obtain a fine dry powder. The prepared sample was then kept in air-tight polythene bags to prevent exposure to air and moisture.

Proximate and Phytochemical Analysis:

Proximate composition of the materials was carried out by the official standard method [10]. The analysis carried out includes: moisture content, ash content, crude fibre, crude lipid, crude protein, nitrogen contents and carbohydrates.
The samples for the phytochemical analysis were prepared by soaking 200 g of the powdered sample in 600 ml of distilled ethanol for 72 hours. The extracts were concentrated ready for analysis. Chemical tests were then carried out on the alcoholic extracts and on the powdered samples to identify the constituents using standard procedures [11].

Results and Discussion

Table 1 The result of proximate analysis carried out on bark and leaves of teak plant

Food Content	Moisture Content	Ash Content	Crude Fibre	Crude Lipid/Fat	Crude Protein	Carbohydrate	Nitrogen Content
Bark	13.0	25.0	28.8	20.0	12.0	1.2	1.9
Leaves	10.0	25.0	12.0	11.1	23.1	15.1	3.7

Table 2 The result of phytochemical screening carried out on bark and leaves of teak plant

Phytochemicals	Alkaloids	Steroids	Flavonoids	Saponins	Terpenoids	Tannins	Glycosides
Bark	+	+	+	+	+	+	+
Leaves	-	+	+	+	+	+	-

Key: + = Present; - = Absent

Proximate Analysis

Table 1 presents the proximate results of both the bark and leaves of tectona *grandis* respectively. The proximate analysis results shown for both the leaves and bark are comparable. The moisture content was 13.0% for the bark and 10.0% for the leaves which imply that the leaves have a longer shelf- life than the bark and they are both comparable to 12.0% - 13.0% reported earlier [11]. They both have percentage ash contents to be 25.0% which is a bit high, implying a high deposit of mineral elements in the plant [12] and important in the evaluation of purity of drugs [14]. The nitrogen content of 1.9% for the bark and 3.7% for the leaves as well as protein content of 12.0% for the bark and 23.1% for the leave are approximately doubled, though comparable to [11]. This implies that the leaves definitely has more protein content than the bark and is preferable when protein is needed in the body.

The crude fibre content and crude fat content are 28.8% and 20.0% respectively for the bark and is roughly half for the leaves which are 12.0% and 11.1% respectively but comparable to 30% and 21.75% [12] on termite attack and heart-rot on thinned *Acacia mangium* trees. The high ash contents of 25% (same for both bark and leaves) and moderate moisture contents of 13% and 10% respectively are typical of normal forest trees and desirable to remain fresh for longer period to meet market demand [13]. High crude fibre and fat may be helpful in preventing infections from bacteria and feasting of termites. The moderate moisture and high crude fibre and fat account for the heavy weight of the tree bark. It possesses adequate minerals from its high ash content. The less carbohydrate provides instant energy that is easily burnt off when concoction is made from the bark.

Table 2 shows the results of phytochemical screening carried out on bark and leaves of the teak plant. These results indicate the strong occurrence of polyphenolic compounds such as tannins, steroids, terpenoids, saponins, flavonoids, glycosides and alkaloids. Most of the medicinal properties may be due to their phytochemical contents. Alkaloid extract invoke a bitter taste on the tree bark, makes the bark and even the tree wood toxic to predating organisms. The phytochemical results were very much comparable in that all the phytochemicals tested for were all positive for both except for alkaloids and glycosides that were negative for the leaves.

Tannin extract is responsible for the bitter taste of the tree bark and it binds to and precipitates amino acids and alkaloids; it protects the tree bark from predators like termites and also as pesticides, and in plant growth regulation [15]. Saponin extract protect the tree bark and even the wood against microbes and fungi. Saponins are often bitter to taste, and so reduce plant palatability (e.g. in livestock feeds), or even imbue them with life threatening animal toxicity [16].

Flavonoid extract have been shown to have wide range of biological and pharmacological activities in in vitro and in vivo studies which include anti-allergic, anti-inflammatory, antioxidant, anti-microbial, anti-cancer, anti-diarrheal activities [17]. Steroid extracts function as components of cell membranes and decrease membrane fluidity [18]. Terpenoid extract are responsible for their aromatic qualities in the tree bark. It plays a role in traditional herbal remedies and is under investigation for pharmaceutical functions. Terpenoid contribute to the colour of the tree flowers [19]. Glycoside extract are used as medications for some illnesses [20].

Conclusion

The proximate and phytochemical analysis of the bark and leaves of *Tectona grandis* have revealed the major phytochemicals, food and energy contents present in the plant. The various phytochemical constituents determined have shown the medicinal properties. The comparism revealed that the stem bark is richer in phytochemicals than the root while the proximate results revealed that the stem bark is higher in moisture, ash, fibre and lipid but lower in

protein, nitrogen, and carbohydrates. This could mean that the bark is likely to be more efficacious in drug preparation than the leaves.

Acknowledgement

The authors wish to acknowledgement the contribution of Dr. G.O Olutona of the department of Chemistry and Industrial Chemistry, Bowen University, Iwo, Nigeria for his efforts and advice on this paper.

References

[1] United States Department of Agriculture, 2007
[2] K. Bryndum, T. Hedegart, *Pollination of teak. Silv. Genet* 1969, 18: 77-80.
[3] J. N. Owen, *Distil receptivity and Pollen growth of Tectona grandis Linn.* Floral biology 1996.
[4] R.S. Williams, R. Miller, *Wood and Fiber Science* 2001, 33 (4). Pp. 618-626.
[5] D. Herbison-Evans, *University of Technology Sydney*, 2007. Archived from the original on 2008-07-24. Retrieved 2008-03-12.
[6] P. S. Varier, *Int. J Green Pharm*. **2008**, 2:118-21.
[7] J.O. Ocheja, Performance of weaner rams fed with varying proportions of a mixture of Bambara nut waste and rice offal as supplement to natural pasture, of *4th International Conference of the Nigerian Society of Indigenous Knowledge and Development*, Kogi State University. 2008, p. 76-82.
[8] O.F. Adekola, *Chemical characterization and potential mineralization of selected tree leaves in the guinea savannah belt of Nigeria*, 2008.
[9] M. Sataya, *International Journal of Engineering Research and Application.* ISSN 2248-9672, Vol. 4, Issue 3, pages 553-559.
[10] Association of Official Analytical Chemists (A. O. A. C.), *Official Methods of Analysis*, (Washington, DC: Association of Official Analytical Chemists) 15th edt. 1990.
[11] J.B. Harborne, *Phytochemical methods*, (London: Chapman and Hall, Ltd) **1973**, 49-188.
[12] K.T. Chew, *Assessment of termite attack and heart-rot on thinned Acacia mangium trees*. Forest Department, Kuala Lumpur. Malaysia, 1987, 2 p.
[13] Bureau of Indian Standards (BIS). *Indian Standard methods of testing small clear specimens of timber*. IS: 1708-1986, Bureau of Indian Standards, New Delhi; 1986; 40 p.
[14] B. S. Antia, E. J. Akpan, P. A. Okon, I. U. Umoren, *Pakistan J. Nutr*. **2006**; 5 (2): 166-168
[15] E.F. Katie, R.W. Thorington, *Squirrels: the animal answer guide*, Baltimore: Johns Hopkins University Press, 2006, p. 91.
[16] H. Foerster, "*MetaCyc Pathway: saponin biosynthesis*". 2006, Retrieved 23 February 2009.
[17] Y. Yamamoto, R.B. Gaynor, *Journal of Clinical Investigation.* **2001**, 107(2): 135-42.
[18] D.Sadava, D.M Hillis, H.M. Heller, M.R. Berenbaum, *Life: The Science of Biology*, 9th Edition, San Francisco: Freeman; 2001; p.105-114.
[19] M. Specter, "*A Life of its Own*". September 28, 2009.
[20] R. Boutron-Charlard, *Annales de chimie et de physique*; 1830; 44: 352-382.

Publication History
Received 21st Dec 2015
Revised 14th Jan 2016
Accepted 23rd Jan 2016
Online 30th Mar 2016