

Qualitative and Quantitative Phytochemical Analysis of the Leaf, Stem Bark and Root of *Bombax Ceiba* (Red Silk Cotton Tree) in North Central Nigeria

C.U. Aguoru¹✍, K. Akombor¹, J.O. Olasan¹

¹Department of Biological Sciences, University of Agriculture, Makurdi, Nigeria

Abstract: Qualitative and quantitative phytochemical studies were carried out on the leaf, stem and root of *Bombax ceiba*. Aqueous and ethanolic extractions methods were adopted following standard procedures. Bioactive compounds were tested using standard methods of screening while quantification was done using gravimetric and spectroscopic approach. Result indicated the presence of saponin, tannins, flavonoids and alkaloids in the leaf. The leaf organ lacked reducing sugar, anthraquinone, steroids and glycosides in the ethanolic extract. The major active principles present in the leaf were absent in the stem except flavonoid and phlobatannins. The roots however contained only reducing sugar and saponins among the constituents screened. The leaf was made up of 5.04% saponins, 0.18% steroids and 3.1% flavonoids. The saponin content of the root was 1.37% and 1.04% respectively. The stem bark had 1.52% alkaloids. Based on this finding, the leaf is the most important organ of medicinal importance in terms of quality and quantity of bioactive compounds present. The diverse array of phytochemicals present in the plant thus suggests its therapeutic potentials which may be explored in drug manufacturing industry as well as in traditional medicine.

Keywords: *Bombax ceiba*, Phytochemical, Leaf, Stem, Root, Quality, Quantity

Introduction

Medicinal plants have been identified and used throughout human history (Lichterman, 2004). Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions, and to defend against attacks from predators such as insects, fungi and herbivorous mammals (Tapsell *et al.*, 2006). Medicinal plant is any plant which one or more of its organs contain substances that can be used for therapeutic purposes or which is a precursor for the synthesis of useful drugs (Aguoru *et al.*, 2014). Generally, the goals of using plants as sources of therapeutic agents are: to isolate bioactive compounds for direct use as drugs and to produce bioactive compounds of novel structures as lead compounds for semisynthesis.

Herbal medicine is among the most respected of the ancient natural therapies and it has stood the test of time despite the introduction of modern medical science (Vijendra *et al.*, 2010). Fossil records date

human use of plants as medicines at least to the middle Palaeolithic age some 60,000 years ago (Farnsworth, 1966).

Bombax ceiba is commonly known as red silk cotton tree. It belongs to the family Malvaceae which contains about 26 genera and nearly 150 species. It is widely distributed in temperate Asia, tropical Asia, Africa and Australia. In India it can be found at altitudes between sea level and up to 1500m elevation. The red silk cotton has a medium growth rate and grows up to 100 feet tall. The trunk and branches are usually covered with conical thorns especially when young (Faizi and Ali (1999). The plant has been scrutinized for its pharmacology in various parts of the world mainly used by various tribal communities and forest dwellers for the treatment of ailments or disease. The plant is popularly called "genge" among the Tiv speaking people of Nigeria and its dried sepal has become a preferred choice as their local soup which is believed to last long without spoilage. This therefore suggests

This article is published under the terms of the Creative Commons Attribution License 4.0

Author(s) retain the copyright of this article. Publication rights with Alkhaer Publications.

Published at: <http://www.ijsciences.com/pub/issue/2015-05/>

Article Number: V4201505713; Online ISSN: 2305-3925; Print ISSN: 2410-4477



C. U. Aguoru (Correspondence)

celeaguoru@yahoo.com

+

its antimicrobial activities. Different parts of the plant has been shown to possess many biological properties predominantly antioxidant, antimicrobial, anti-inflammatory, analgesic, anabolic, hypotensive and hypoglycemic activities (Jain *et al.*, 2011).

Phytochemical processes have been aided enormously by the development of rapid and accurate methods of screening plants for particular chemicals usually employing chromatographic techniques (Sneader, 2000). Quantification usually employs the use of gravimetric and spectroscopic methods with several advanced approaches now available (Aguoru *et al.*, 2014). Extensive effort have now been channelled towards screening of plants for more active and effective new drugs to eliminate ailments which have strains of pathogenic organism that resist the effect of drug in use today (Sneader, 2000). Based on the numerous ethnomedicinal values of this plant, it is becomes imperative to determine the active ingredients present in different parts of the plant as well as their composition. The aim of this work was to determine the quality (types) and quantity (amount) of bioactive compounds in the leaf, stem and roots of *B. ceiba* in the North Central part of Nigeria.

Materials and method

The plant (*Bombax ceiba*) was identified by plant taxonomists in the Botany Unit of the Department of Biological Sciences, University of Agriculture, Makurdi, Nigeria. All qualitative and quantitative studies were carried out in the Advanced Biology Laboratory of the same school. Plant parts (leaf, stem and root) were collected from three villages in the North Central part of Nigeria. The dried and powdered form of each part was processed for phytochemical extraction. Aqueous and ethanolic extractions were carried out on each plant organ. Qualitative biochemical tests were conducted following standard protocols of phytochemical screening. Thirty (30) qualitative tests (10 on each plant organ) were conducted using aqueous solvent and another thirty (30) tests were conducted using ethanolic solvent. The screened compounds which appeared in the three plant organs were quantified using gravimetric and spectroscopic methods. All data were graphically analysed.

Results and Discussion

Phytochemicals screening of aqueous extract showed the presence of saponnin, tannin, reducing sugar, anthraquinone, steroids and flavonoid in the leaf. Only three bioactive compounds (saponin, phlobatannin and alkaloid) were present in the root while the root contained two (phlobatannin and alkaloid) (Table 1).

Result from ethanolic extracts indicated the presence of fewer numbers of bioactive compounds than aqueous solvent. Saponnin, tannin, flavonoids and alkaloids were found in the leaf while only flavoid was present in the stem. The root contained only reducing sugar as well (Table 2). Quantitative analysis showed that the leaf contained high amount of saponnin (5.04%) and flavonoid (3.1%) but low amount of steroid (0.18%). Moderate quantity of saponnin (1.37%) and alkaloid (1.04%) were recorded in the root. The stem bark also contained moderate amount of alkaloid only (1.52%) (Table 3). This report has clearly shown the potency of aqueous extraction method which yielded more bioactive compounds in the three plant parts investigated.

It has been clearly revealed that the leaf of *B.ceiba* is the most important organ that may be explored for its active principles both in quality (types) and quantity (figure 1). This is confirmed by radial plot where flavonoid and saponnin are concentrated in the leaf. Saponnin and alkaloid are moderately concentrated in the root (Figure 2). This reports is in agreement with the findings of Faizi and Ali (1999) who reported new Shamimin as a new flavonoid present in the leaf of *B.ceiba*.

Among the four quantified phytochemicals, saponnin shared 61% in the leaf followed by flavonoid (37%) (Figure 3). The root is shared by saponnin (57%) and alkaloid (43%) as shown in figure 4. The stem is largely composed of alkaloid (100%) (Figure 5). Despite the variation recorded in the quality and quantity of phytochemicals, this finding aligns with the view of Aguoru *et al.*(2014) that complete information on plant phytoconstituents could be achieved when different parts are investigated.

Table 1: Qualitative screening using aqueous extraction method

Bioactive compounds	Leaf	Root	Stem bark
Saponnins	+	+	-
Tannins	+	-	-
Reducing sugar	+	-	-
Phlobatannins	-	+	+
Anthraquinone	+	-	-
Steroids	+	-	-
Flavonoids	+	-	-
Glycosides	-	-	-
Alkaloids	-	+	+

Legend: (+)= present (-)= absent

Table 2: Qualitative screening using ethanolic extraction method

Bioactive compounds	Leaf	Stem bark	Roots
Saponnins	+	-	-
Tannins	+	-	-
Reducing sugar	-	-	+
Phlobatannins	-	-	-
Anthraquinone	-	-	-
Steroids	-	-	-
Flavonoids	+	+	-
Glycoside	-	-	-
Alkaloids	+	-	-

Legend: (+)= present (-)= absent

Table 3: Quantified phytochemicals in the plant organs

Bioactive compounds	Leaf (%)	Root (%)	Stem bark (%)
Saponnins	5.04	1.37	0.00
Steroids	0.18	0.00	0.00
Flavonoids	3.1	0.00	0.00
Alkaloids	0.00	1.04	1.52

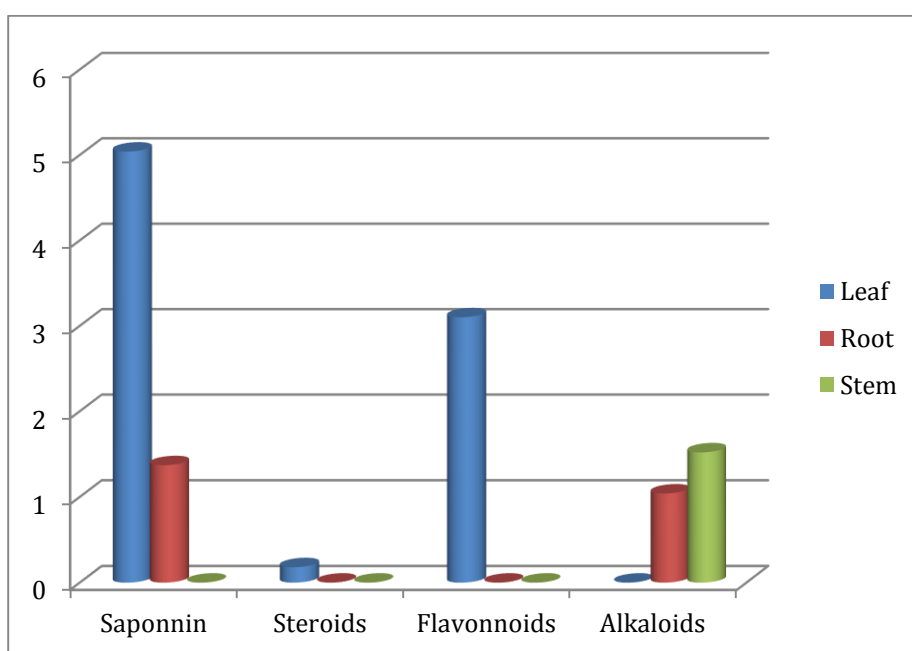


Fig1: Percentages of phytochemicals in the three plant parts

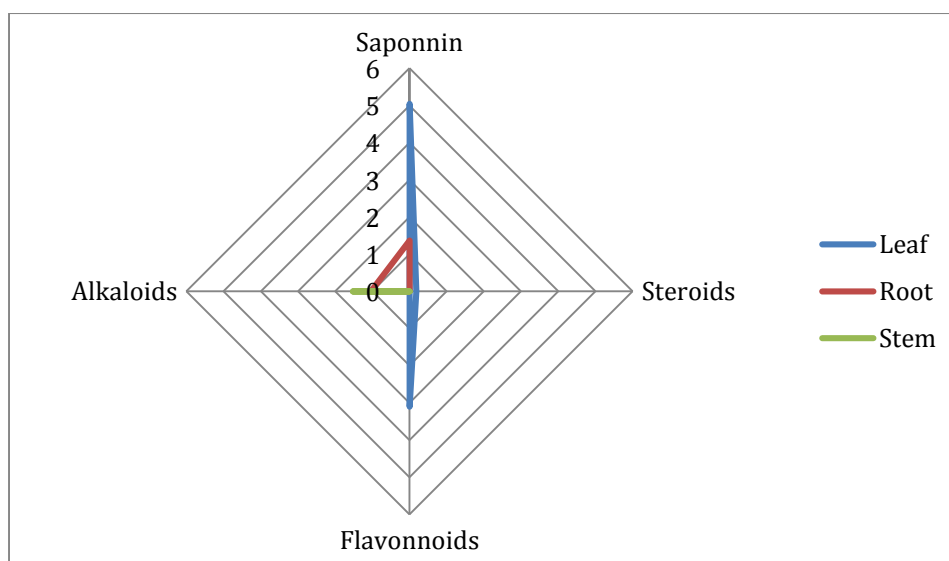


Fig 2: Concentration of phytochemical in each plant part by radar plot

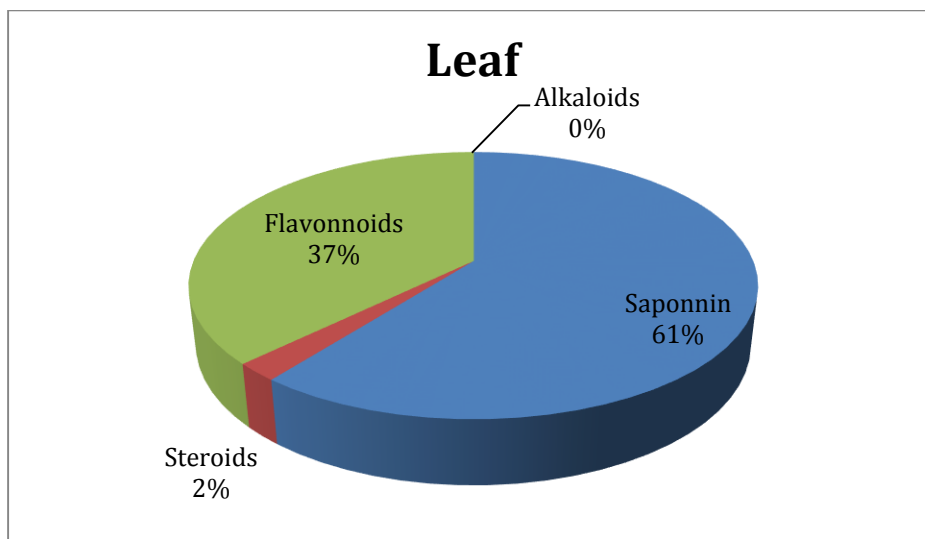


Figure 3: Relative proportion of four phytochemicals in the leaf

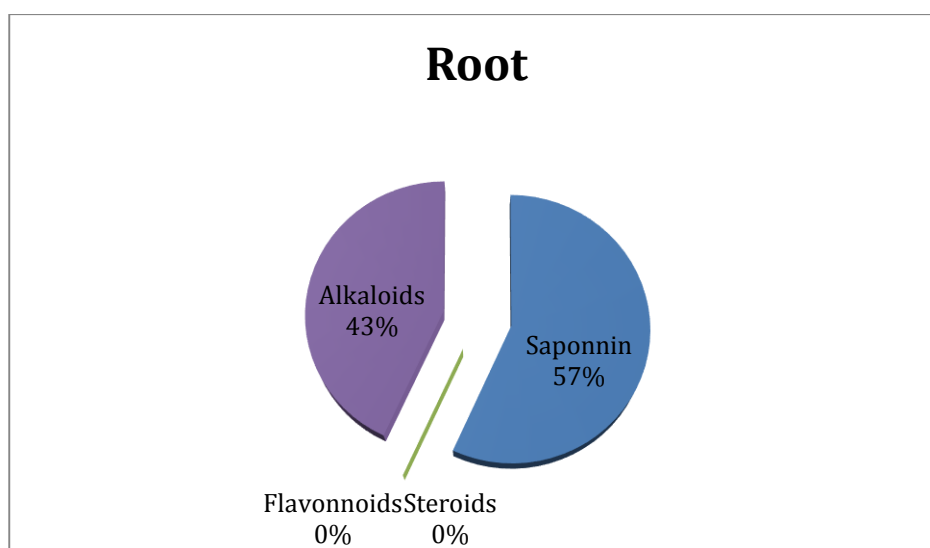


Figure 4: Relative proportion of four phytochemicals in the root

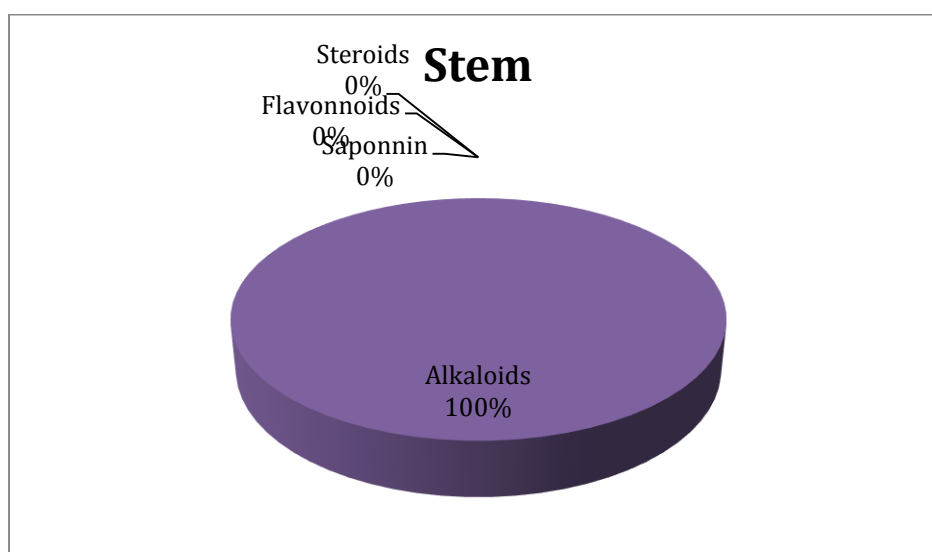


Figure 5: Relative proportion of four phytochemicals in the stem

In the last decade, *Bombax ceiba* has attracted scientific attention that resulted in exploration of many novel chemical compounds as well as validation of its traditional uses in many diseases of man (Jain *et al.*, 2011). For instance, aspirin drug was discovered and synthesized from the bark of this plant (Sneader, 2000) and from this study; the bark contains phlobatannin, flavonoid and alkaloid. The stem bark has been confirmed to possess hypotensive properties (Rubeena *et al.*, 2003). According to Vijendra *et al.* (2010) almost all the parts of the plant are documented to be medically useful. Saleem (1999) reported the hypotensive, hypoglycemic and toxicological effect of *B. ceiba*. The root is used against diarrhoea, dysentery, boils and burns, diabetes, snake bite, urinary troubles and hepatic diseases (Ravi *et al.*, 2010). The stem bark may also help solve kidney related problems, headache, snake bite, asthma, piles and diarrhoea. The leaf is used against dysentery, anemia and infertility. The vast array of phytochemicals qualitatively screened in this research has established the views of authors that *B.ceiba* is endowed with strong capacity to fight against microorganisms such as bacteria, fungi and viral attacks. Each part possesses antimicrobial activity as has been demonstrated in various in vitro experiment studies (Jain *et al.*, 2011).

In conclusion, *B.ceiba* has been revealed to contain diverse types of active principles of medicinal potentials which may account for its numerous medicinal uses most especially in treating many life threatening ailments in many parts of the world. The leaf, stem and root would therefore be of importance in drug manufacturing industry. The leaf as the most valuable medicinal organ may also play important roles in traditional medicine. However, other parts of this plant such as the seed, fruit and flower may be studied in terms of phytochemical compositions. It is also recommended that extracts from all parts of the

plant should be tested for their activity in biological systems.

Reference

- 1) Aguru, C.U., Ameh, S. J. and Olasan, O. (2014). Comparative Phytochemical Studies on the presence and quantification of various bioactive compounds in the three major organs of Okoko plant (*Cissus Popunea* Guill & Perr) in Benue State, North Central Nigeria, West Africa. *European Journal of Advanced Research in Biological and Life Sciences*, 2 (2): 16-22
- 2) Faizi, S. and Ali, M. (1999). Shamimin: A new Flavonol C – glycoside from leaves of *Bombax ceiba*. *Planta Med*, 65: 383–385. <http://dx.doi.org/10.1055/s-2006-960796>
- 3) Farnsworth, N.R. (1966). Biological and phytochemical screening of plants. *Journal of Pharmaceutical Science*, 55:225–276. <http://dx.doi.org/10.1002/jps.2600550302>
- 4) Jain, S.K., Verma, S.S., Katewa, S., Anandjiwala, B. (2011). Singh Free Radical Scavenging Property of *Bombax ceiba* Linn. Root. *Research Journal of Medicinal Plant* , 5(4): 462-470. <http://dx.doi.org/10.3923/rjmp.2011.462.470>
- 5) Lichterman, B. L (2004). "Aspirin: The Story of a Wonder Drug". *British Medical Journal* **329** (7479): 1408. doi:10.1136/bmj.329.7479.1408 <http://dx.doi.org/10.1136/bmj.329.7479.1408>
- 6) Ravi, V., Patel, S.S., Verma, N.K., Dutta, D., Saleem, T.S.M. (2010). Hepatoprotective activity of *Bombax ceiba* Linn against isoniazid and rifampicininduced toxicity in experimentalrats. *Int J Appl Res Nat Prod.*, 3(3): 19-26.
- 7) Rubeena, S., Ahmad, S.I., Ahmed, M., Faizi, Z., Zikr-ur-Rahman, S. and Ali, M. (2003). Hypotensive Activity and Toxicology of Constituents from *Bombax ceiba* Stem Bark. *Biological and Pharmaceutical Bulletin*, 26(1): 41-46. <http://dx.doi.org/10.1248/bpb.26.41>
- 8) Saleem, R., Ahmad, M., Hussain, S.A., Qazi, A.M. and Ahmad, S.I. (1999). Hypotensive, hypoglycemic and toxicology studies on the flavonol C-glycoside shamimin from *Bombax ceiba*. *Planta Med.*, 65(4):331-34 <http://dx.doi.org/10.1055/s-1999-14060>
- 9) Sneader, W. (2000). "The discovery of aspirin: A reappraisal". *BMJ (Clinical research ed.)* **321** (7276): 1591–1594. <http://dx.doi.org/10.1136/bmj.321.7276.1591>
- 10) Tapsell, L.C., Hemphill, I. and Cobiac, L. (2006). "Health benefits of herbs and spices: the past, the present, the future". *Med. J. Aust.* **185** (4): 14–24.
- 11) Vijendra, V., Jalalpure, S.S., Amit Sahu, L. K., Bhadwal, Y. (2010). *Bombax ceiba* Linn: pharmacognostical, phytochemistry, ethnobotany, and pharmacological studies. *Research in Natural Products*, 3 (3):19-26.