



## **Phytochemical and Nutrient Composition of *Pterocarpus erinaceus* Stem Bark**

**Maryam U. Ahmed<sup>1\*</sup>, Abdullahi A. Modibbo<sup>2</sup>, Moses Z. Zaruwa<sup>1</sup>  
and Ismaila Y. Sudi<sup>1</sup>**

<sup>1</sup>Department of Biochemistry, Faculty of Sciences, Adamawa State University, Mubi, Adamawa State, Nigeria.

<sup>2</sup>Biochemistry Unit, Department of Chemical Science Technology, Federal Polytechnic, Mubi, Adamawa State, Nigeria.

### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author MUA designed the study and wrote the first draft of the manuscript. Author AAM carried out the laboratory work performed the statistical analysis and wrote the protocol. Authors MZZ and IYS managed the analyses of the study. Authors MUA and AAM managed the literature searches. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/IJBCRR/2017/36546

#### Editor(s):

- (1) Nidhi Sahni, Biochemical Chemical Division, R&D II, Sardar Swaran Singh National Institute of Bio-Energy (An Autonomous Institution of Ministry of New and Renewable Energy, GOI), India  
(2) Shadaan Abid, Department of Internal Medicine, UT Southwestern Medical Center, Dallas, Texas, USA.

#### Reviewers:

- (1) Dinithi Peiris, University of Sri Jayewardenepura, Sri Lanka.  
(2) Okon Okon Godwin, University of Uyo, Nigeria.

Complete Peer review History: <http://www.sciencedomain.org/review-history/21268>

**Original Research Article**

**Received 31<sup>st</sup> August 2017**  
**Accepted 26<sup>th</sup> September 2017**  
**Published 6<sup>th</sup> October 2017**

### **ABSTRACT**

The use of plants for medicine is gaining more acceptability worldwide due to its availability, affordability, efficiency and considerable safety. This study sought to gather information on the phytochemical and nutrient composition of *Pterocarpus erinaceus* stem bark. This will be a guide to the importance of the plant healthwise. Phytochemical, proximate, mineral and vitamin analysis was done using standard procedures. Alkaloids, saponins, tannins, flavonoids, steroids were present in both aqueous and ethanolic stem bark extracts of *Pterocarpus erinaceus*. Anthraquinone was present only in the ethanolic extract. Proximate analysis shows high carbohydrate and fibre content  $39.33 \pm 0.05\%$  and  $31.22 \pm 0.32\%$  respectively. The extract also contains  $8.70 \pm 1.10\%$  protein and  $0.45 \pm 0.50\%$  fat. *Pterocarpus erinaceus* stem bark is a rich source of vitamin A (75.87

\*Corresponding author: E-mail: [mariam\\_usman@yahoo.com](mailto:mariam_usman@yahoo.com);

$\pm 0.12$  IU/100 g) and B<sub>9</sub> (71.25  $\pm$  1.23 mcg/100 g). Heavy metals (Cd, Pb and Ni) were not detected in this study. Phosphorus and iron were detected in high amount. This therefore justifies the use of this plant for the treatment of diseases such as anaemia and diarrhea. Research should be carried out on this stem bark to explore more potentials of this plant.

**Keywords:** Anaemia; antioxidant; heavy metals proximate analysis; *Pterocarpus erinaceus*.

## ABBREVIATIONS

ND : Not Detectable

*P. erinaceus* : *Ptericarpus erinaceus*

## 1. INTRODUCTION

Medicinal plants play an important role in maintenance of human and animal health. A wide array of diseases including life threatening diseases such as cancer, diabetes, hypertension etc. are being treated successfully with medicinal plants. These plants are widely consumed not only for medicinal purposes but also as food. These role played by plants are due to the presence of phytochemicals and nutrients. Phytochemicals which include tannins, flavonoids, saponins, terpenoids, and alkaloids play key role in defense against numerous diseases [1].

Reports on the role of minerals (elements) present in plants have been on the increase in recent years [2]. Minerals are essentially required for tissue functioning, [3], osmotic adjustment and to activate enzymes [4]. Humans do not synthesize it and so, obtain it from their diet [5]. Major minerals such as Ca, Mg, Cl, Na, S, K, P serve as structural components of tissues, function in cell metabolism and acid-base balance [6]. Many trace elements play vital roles in prevention and treatment of diseases [7].

Vitamins have diverse biochemical role which include antioxidation [8], precursors for enzyme cofactors and hormones [9].

*Pterocarpus erinaceus* (family: Leguminosae-papilionoideae) is a deciduous legume tree of African savannas and dry forest. The tree grows to about 12-15 m tall and 1.2 m in diameter. The stem bark is dark grey and scaly, The leaves are compound and imparipinnate, upto 30 cm long. It has yellow flowers. The fruits present winged outgrowth [10,11]. The seed is kidney shaped to oblong and usually narrowed and curved near the minute hilum [10]. It is commonly known as African rosewood. The leaves and seeds are edible after proper cooking [10]. It produces one

of the finest wood in its native region. Foliage and immature pods are sometimes cut down at the end of the dry season to fatten sheep, goats, cattle and horses. The leaves are used in abortifacient mixtures and as a febrifuge. The bark is used for treatment of scalp infections due to ringworm, for chronic ulcers, blennorrhagia and is gargled for tooth and mouth troubles. The bark and resin is used for urethral discharge and as an astringent for severe diarrhea and dysentery. The grated root is mixed with tobacco and smoked in a pipe as a cough remedy [10]. The trunk and root bark are used in malnutrition, debility, pregnancy and anaemia [11,12].



**Fig. 1. *Pterocarpus erinaceus* plant**

Despite its popular use in traditional medicine, little has been reported about its nutritional and phytochemical constituents. This study was therefore conducted to provide information on the phytochemical, proximate, element and vitamins composition of *Pterocarpus erinaceus*.

## 2. METHODOLOGY

### 2.1 Collection and Preparation of Plant Material

The stem bark of *Pterocarpus erinaceus* were collected in the month of January, 2016 at Vakuna village in Maiha (coordinates: 9° 59' 44"N 13° 13' 5"E) local government area of Adamawa state, Nigeria. The plant was

taxonomically identified and authenticated in Biological Science Department of Modibbo Adama University of Technology, Yola. The stem bark was air-dried. It was then reduced to powdered form by grinding in pestle and mortar.

## 2.2 Phytochemical Screening

Qualitative analysis was carried out on the extracts to identify the constituents using standard procedures as described by [13,14,15].

## 2.3 Proximate Composition

The proximate composition of the sample was determined using the standard methods of analysis of Association of Official Analytical Chemists [16]. Moisture content of the samples was determined by air oven (Gallenkamp) method at 105°C. The crude protein of the sample was determined using micro-Kjeldahl method. Crude lipid was determined by Soxhlet extraction method using petroleum ether as extracting solvent. The ash content was determined using a muffle furnace set at 550°C for 4 hours until constant weight of ash is obtained. Crude fibre was determined using the method of [17]. The carbohydrate content was obtained by taking the difference.

## 2.4 Determination of Vitamins

Vitamins A, B and C content of the vegetable were determined using [16].

## 2.5 Mineral Analysis

Mineral content was determined using atomic absorption spectrophotometric analysis as described by [18].

## 3. RESULTS

Phytochemical screening shows the presence of alkaloids, flavonoids, glycosides, phlobatannins, saponins, steroids and tannins in both aqueous and ethanolic extract of the plant. Anthraquinone was present in the ethanolic extract but absent in the aqueous extract of *P. erinaceus* as shown in Table 1.

Results of proximate analysis of *Pterocarpus erinaceus* stem bark shows that it has high carbohydrate content (39.33%). It also contains fibre (31.22%), proteins (8.70%) and moisture content of 1.85% as shown in Table 2.

Table 3 shows that *P. erinaceus* contains high amount of vitamin B<sub>9</sub> (Folic acid) and vitamin A.

Vitamin C and K is present in very low amount;  $2.18 \pm 0.99$  mg/100 g and  $3.76 \pm 1.00$  mg/100 g respectively.

**Table 1. Phytochemical analysis of aqueous and ethanolic extracts of *P. erinaceus***

Phytochemical	Aqueous extract <i>P. erinaceus</i>	Ethanolic extract <i>P. erinaceus</i>
Alkaloids	+	+
Anthraquinones	-	+
Flavonoids	+	+
Glycosides	+	+
Phlobatannins	+	+
Saponins	+	+
Steroids	+	+
Tannins	+	+
Terpenoids	-	-

**Table 2. Proximate analysis of *Pterocarpus erinaceus* stem bark**

Constituents	%
Ash	18.40 ± 0.12
Carbohydrate	39.33 ± 0.05
Fibre	31.22 ± 0.32
Fats	0.45 ± 0.50
Moisture content	1.85 ± 0.26
Proteins	8.70 ± 1.10

Results are mean ± SEM (n=3)

**Table 3. Vitamins content of *Pterocarpus erinaceus***

Vitamin	Amount
A	75 ± 0.12 IU/100 g
B <sub>9</sub> (Folic acid)	71.25 ± 1.23 mcg/100 g
B <sub>12</sub>	0.89 ± 0.08 mcg/100 g
C	2.18 ± 0.99 mg/100 g
E	0.12 ± 0.07 mcg/100 g
K	3.76 ± 1.00 mcg/100 g

Results are mean ± SEM (n=3)

Table 4 shows that the stem bark of *P. erinaceus* contains high amount of Phosphorus, copper and iron. Lead, cadmium and nickel were not detected.

## 4. DISCUSSION

Phytochemical screening shows the presence of alkaloids, flavonoids, glycosides, saponins, steroids and tannins. The presence of these phytochemicals in *P. erinaceus* stem bark was also reported by [19,20]. The absence of anthraquinone in aqueous extract observed in this work was also reported by [21]. [19,20] reported the presence of terpenoids in the

aqueous and methanolic stem bark extracts of *P. erinaceus*. Differences in phytochemical components of plants arise due to genetic variations and environmental conditions [22].

**Table 4. Mineral/element contents of *P. erinaceus* stem bark**

Element	mg/100 g
Cadmium	ND
Copper	10.88 ± 0.78
Iron	18.65 ± 0.89
Lead	ND
Manganese	0.93 ± 0.97
Nickel	ND
Phosphorus	27.30 ± 0.68
Zinc	0.42 ± 0.85

Results are expressed as mean ± SEM of three determinations

The phytochemicals found in *P. erinaceus* stem bark have been reported to be beneficial in treatment of various diseases. Alkaloids and their synthetic derivatives exhibit antispasmodium, antibacterial and analgesics properties [23]. Steroids and triterpenoids also exhibit analgesic properties [24,25]. This may justify its use in the treatment of fever. Saponins lowers blood cholesterol and stimulates immune system [26]. It also have antitumor, anti mutagenic and antihypoglycemic property [27]. Tannin is used in the treatment of diarrhea [28] and may be the justification for its use in the treatment of diarrhea. Flavonoids are free radical scavengers, they prevent oxidative damage and have strong anticancer activity [27] they also function to protect against allergies, inflammation, ulcer and tumor [29]. The presence of these phytochemicals in *P. erinaceus* stem bark makes the plant a potential in the treatment of a wide array of disease.

*P. erinaceus* stem bark is a good source of carbohydrate and fibre and may serve as animal feed.

Vitamin B<sub>9</sub> is necessary for rapid cell division and growth. In combination with vitamin B<sub>12</sub>, it is essential for the productions of red blood cells. It is necessary for efficient neural tube development during pregnancy. Vitamin A stimulates the production and activity of white blood cells for normal immune function. *Pterocarpus erinaceus* is a rich source of vitamins A and B<sub>9</sub>. This may be the justification for the use of this plant during pregnancy and in anemic conditions. It also contains slight

amount of Vitamin C (2.18 ± 0.99 mg/100 g). Vitamin C serves as an antioxidant [3], and can prevent the body from free radicals that can cause cancer.

The results of the mineral composition (Table 4) show that stem bark is rich in sources of copper, iron and phosphorus. Heavy metal such as lead, cadmium and nickel were not detected. Copper, iron and zinc are essential micro nutrients while others such as cadmium and lead have no biochemical or physiological importance and are considered toxic pollutant [18]. Phosphorus is involved in many metabolic processes including those involved in many metabolic processes including those involving the buffers in body fluids [30]. Zinc is essential for the production of insulin [31] and helps prevent and manage diarrhea. Vitamin A and E metabolism and bioactivity are dependent on zinc status [32]. It is also necessary for fertility [33], for wound healing and plays vital role in protein synthesis and digestion [34,35]. Copper is a constituent of enzymes like cytochrome c oxidase, catalase, ascorbic acid oxidase etc, it plays a role in iron absorption [36], and incorporation in heamoglobin [35]. It is thus, neccessary for the heamatological and neurological systems [37]. Iron is a part of the heam of heamoglobin, myoglobin and the cytochromes [36]. It is required for making heamoglobin [38].

## 5. CONCLUSION

This study reveals that *Pterocarpus erinaceus* stem bark is a rich source of vital vitamins and minerals such as vitamins A, B<sub>9</sub>, Phosphorus and iron. It also contains useful phytochemicals such as alkaloids, flavonoids, tannin and saponin. The presence of these substances makes it a potential for the treatment of a wide array of diseases such as aneamia, cancer, diarrhea, diabetes, etc. Further studies should be carried out to reveal and ascertain these potential.

## ACKNOWLEDGEMENT

Authors wish to acknowledge Mr. Raji of Department of Biochemistry Laboratory, Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria for his contribution during the laboratory work.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

- Rahim GR, Qureshi R, Arshad M, Gulfram M. Phytochemical analysis and antioxidant properties of teucrium stocksianum flowers from Malakand Division, Pakistan. *Int. J. Agric. Biol.* 2013;15:377-381.
- Agbor RB, Ekpo IA, Ekanem BE. Antimicrobial properties and nutritional composition of *Aspilia africana* C.D. Adams. *International Journal of Applied Science and Technology.* 2012;2(7):94-102.
- Zafar F, Jahan JN, Rahman K, Zafar W, Aslam S. Comparative evaluation of phytochemical, mineral and vitamin contents of gemmomodified extracts and leaves of 2 indigenous medicinal plants. *Int. J. Agorc. Biol.* 2014;16(5):911-916.
- Aslam MF, Anwar R, Nadeem U, Rashid T, Kazi G, Nadeem M. Mineral composition of *Moringa oleifera* leaves and pods from different regions of Punjab, Pakistan. *Asian J. Plant Sci.* 2005;4:417-421.
- Anjorin TS, Ikokoh P, Okolona S. Mineral composition of *Moringa oleifera* leaves, pods and seed from two regions in Abuja, Nigeria. *Int. J. Agric. Biol.* 2010;12:431-434.
- Smith KT. Trace minerals in foods. Marcel. Delker. New York; 1988.
- Prasad AS. Essential and toxic elements in human health and diseases, an update. Wiley-Iss, New York; 1993.
- Bender DA. Nutritional biochemistry of the vitamins. Cambridge, U.K. Cambridge University PRESS; 2003.
- Berg JM, Tymoczko JL, Stryer L. *Biochemistry.* 5<sup>th</sup> Edn. W.H. Freeman. New York; 2002.
- Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S. *Agroforestry database: A tree reference and selection guide version 4.0; 2009*  
Available: <http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp>
- Bonkounou GE, Djimde M, Ayuk ET, Zougrana I, Tchoundjeu Z. Taking stock of agroforestry in the Sahel, harvesting results for the future. ICRAF, Nairobi, Kenya; 1998.
- Nadro MS, Modibbo AA. Effects of *Pterocarpus erinaceus* stem Bark aqueous extract on anemic rats. *Sci. Res. J.* 2014;2(4):1-4.
- Sofowora A. Medicinal plants and traditional medicine in Africa. 2<sup>nd</sup> edn. Spectrum Books Limited. Ibadan. Nigeria.
- Harbone JB. Phytochemicals methods. In: A guide to modern techniques of plant analysis (Ed J.B. Harbone). 1993;182.
- Trease GE, Evans WC. A textbook of pharmacognosy, 13<sup>th</sup> edn. Barliere Indian Limited. 1989;19-21.
- AOAC. Official methods of analysis (16th edn) association of official analytical chemists. Arlington, V. A. USA; 1995.
- Saura-Calixto F, Canellas J, Soler L. Dietary fibre components of the nitrogen free extract of almond kernels. *J. Sci. Food Agric.* 1983;36:1419-1422.
- Nwakpa ME, Abgor RB, Amadi BA, Ikepe EV. Vitamin and mineral content of *Ageratum conyzoides* (goat weed). *Nature and Science.* 2015;13(4):1-5.
- Patrick AT, Sampson FP, Jalo K, Tagriki D, Umaru HA, Madusolumo MA. Antioxidant activity and phytochemical evaluation of aqueous and methanolic stem bark extracts of *Pterocarpus erinaceus*. *World Journal of Pharmaceutical Research.* 2016;5(4):134-151.
- Salawu AO, Aliyu M, Tijanni AY. Hematological studies on the ethanolic stem bark extract of *Pterocarpus erinaceus* (Fabaceae). *African Journal of Biotechnology.* 2008;7(9):1212-1215.
- Nafiu MO, Akanji M, Adewunmi Y, Toyin M. Phytochemical and mineral constituents of *Cochlospermum planchonii* (Hook Ef. X. Planch) Root Biores. *Bull.* 2011;5:51-56.
- Wadood A, Ghufuran M, Jamal BS, Naeem M, Khan A, Ghaffar R. Phytochemical analysis of medicinal plants occurring in local area of Marden. *Biochemistry and Analytical Biochemistry.* 2013;2:144.
- Stray F. *The natural guide to medicinal herbs and plants.* Tiger Books International, London. 1998;12-16.
- Snehel SP, Jignasha KS. Systematic review of plant steroids as potential anti-inflammatory agents: Current status and future perspectives. *The Journal of Phytopharmacology.* 2015;4(2):121-125.
- Lea Herrlala R, Anne W, Tianarilalaina T, Solofoniaina GA, et al. Triterpenes and steroids from the stem bark of *Gambaya boiviniana* Pierre. *Journal of Pharmacognosy and Phytochemistry.* 2014;3(1):68-72.

26. Adeolu AT, Enesi DO. Assessment of proximate, mineral, vitamins and phytochemical compositions of plantain (*Musa paradisiaca*) bract –an agricultural waste. International Research Journal of Plant Science. 2013;4(7):192-197.
27. Delazar A, Babaei H, Rezaxadeh H. Inhibitory effect of tannic acid from nutgall on iron-dextran augmented 7,12-dimethyl benz (A) anthracene-initiated and croton oil promoted skin carcinogenesis. DARU. 2003;11:1-6.
28. Okwu DE, Okwu ME. Chemical composition of *spondias mombim* Linn, plant parts. Journal of sustainable Agric and Environment. 2004;6:140-147.
29. Gabriel AF, Onigbanjo HO. Phytochemical and Antimicrobial screening of the Stem Bark extracts of *Pterocarpus erinaceus* (Poir). Nig. J. of Basic and Applied Science. 2010;18(1):1-5.
30. Hays VW, Swerson MJ. Minerals and body in: Dukes, physiology of domestic animals. Tenth Editn. 1985;449-466.
31. Okwu DE, Morah FN. Mineral and nutritive values of *Dennrtha tripetala* fruits. 2004; 59:437-442.
32. Szabo G, Chavan S, Mandrekar P, Catalano D. Acute alcoholic consumption allenuates IL-8 and MCP-1 induction in response to *ex-vivo* stimulation. J. Clin. Immunol. 1999;19:67-76.
33. Merk VM. THE Merk veterinary manual. 6<sup>th</sup> edition. A handbook of diagnosis, therapy and disease prevention and control for the verterian. Published by Merk and Co Inc. Rahwa, New Jersey. USA; 1986.
34. Malhotra VK. Biochenistry for students. 10<sup>th</sup> edition. Jaypee Brothers Medical Publishers (P). Ltd. New Delhi. India; 1998.
35. Murray RK, Granner DK, Mayes PA, Rodwell VW. Harpers biochemistry. 25<sup>th</sup> Editio. McGraw-Hill Health Profession Division. U.S.A; 2001.
36. Chandra RK. Micronutrients and immune functions: An overview. Annal New York Acad. Sci. 1990;587:9-16.
37. Tan JC, Burns DL, Jones HR. Severe ataxia, myelopathy and peripheral neuropathy due to acquired copper deficiency in a patient with history of gastrectomy. J. Parenteral Nutition. 2006; 30:446-450.
38. Galan P, Viteri F, Bertrais S, Gernichow S, Faurell. Serum concentration of beta-carotene, vitamn C and E, Zinc and Selenium are influenced by sex, age, diet, smoking status, alcohol consumption and corpulence I a general French adult population. Eur. J. Clin. Nutri. 2005;59: 1181-1190.

© 2017 Ahmed et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*

*The peer review history for this paper can be accessed here:*  
<http://sciencedomain.org/review-history/21268>