

Original Research Article

Phytochemical and nutrient composition of *Pterocarpus erinaceus* stem bark

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 ± 0.05 % and 31.22 ± 0.32 % respectively. The extract also contains 8.70 ± 1.10 % protein and 0.45 ± 0.50 % fat. *Pterocarpus erinaceus* stem bark is a rich source of vitamin A (75.87 ± 0.12 IU/100g) and B₉ (71.25 ± 1.23 mcg/100g). 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: Proximate analysis, anaemia, antioxidant, *Pterocarpus erinaceus*, heavy metals.

22 **Introduction**

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

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

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

37 *Pterocarpus erinaceous* is a deciduous legume tree of African savannas and dry forest. It
38 produces one of the finest wood in its native region. Foliage and immature pods are sometimes
39 cut down at the end of the dry season to fatten sheep, goats, cattle and horses. The leaves are
40 used in abortifacient mixtures and as a febrifuge. The bark is used for treatment of infections of
41 the scalp due to ringworm, for chronic ulcers, blennorrhagia and in a gargle for tooth and mouth
42 troubles. The bark and resin is used for urethral discharge and as an astringent for severe diarrhea
43 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].

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*.

Methodology

Collection and preparation of plant material

The stem bark of *Pterocarpus erinaceus* were collected in the month of January, 2013 at Vakuna village in Maiha 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.

Phytochemical screening

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

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 4hours until constant weight of ash is obtained. Crude fibre was determined using the method of [17]. The carbohydrate content was obtained by difference.

67

68 **Determination of vitamins**

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

70

71 **Mineral analysis**

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

74 **Results**

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

79 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	-	-

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

83 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

84 Results are mean ± SEM (n=3)

85

86 Table 3 shows that *P.erinaceus* contains high amount of vitamin B₉ (Folic acid) and vitamin A.
 87 Vitamin C and K is present in very low amount ;2.18 ± 0.99mg/100g and 3.76 ± 1.00mg/100g
 88 respectively.

89 Table 3: Vitamins content of *Pterocarpus erinaceus*

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

90 Results are mean ± SEM (n=3)

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

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

Element	mg/100g
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

94 Results are expressed as mean $\pm$ SEM of three determinations.

95 Discussion

96 The phytochemicals found in *P.erinaceus* stem bark have been reported to be beneficial in
 97 treatment of various diseases.. Alkaloids and their synthetic derivatives exhibit antispasmodium,
 98 antibacterial and analgesics properties [19]. Steroids and triterpenoids also exhibit analgesic
 99 properties [20][21]. This may justify its use in the treatment of fever. Saponins lowers blood
 100 cholesterol, stimulates immune system [22]. It also have antitumor, anti mutagenic and
 101 antihypoglycemic property [23]. Tannin is used in the treatment of Diarrhea [24] and may be the
 102 justification for its use in the treatment of diarrhea. Flavonoids are free radical scavengers, they
 103 prevent oxidative damage and have strong anticancer activity [23] they also function to protect
 104 against allergies, inflammation, ulcer and tumor [25]. The presence of these phytochemicals in
 105 *P.erinaceus* stem bark makes the plant a potential in the treatment of a wide array of disease. The
 106 absence of anthraquinone in aqueous extract observed in this work was also reported by [26]

107 *P.erinaceus* stem bark is a good source of carbohydrate and fibre and may serve as animal feed.
 108 Vitamin B₉ is necessary for rapid cell division and growth. In combination with vitamin B₁₂, it is
 109 essential for the productions of red blood cells. It is necessary for efficient neural tube
 110 development during pregnancy. Vitamin A stimulates the production and activity of white blood
 111 cells for normal immune function. *Pterocarpus erinaceus* is a rich source of vitamins A and B₉,
 112 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 ($2.18 \pm 0.99\text{mg}/100\text{g}$). 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 *P.erinaceus* 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 [27]. Zinc is essential for the production of insulin [28] and helps prevent and manage diarrhea. Vitamin A and E metabolism and bioactivity are dependent on zinc status [29]. It is also necessary for fertility [30], for wound healing and plays vital role in protein synthesis and digestion. [31]: [32]. Copper is a constituent of enzymes like cytochrome c oxidase, catalase, ascorbic acid oxidase etc, it plays a role in iron absorption [33], and incorporation in heamoglobin [32]. It is thus, neccessary for the heamatological and neurological systems [34]. Iron is a part of the heam of heamoglobin, myoglobimn and the cytochromes [33]. It is required for making heamoglobin [35].

Conclusion

This study reveals that *Pterocarpus erinaceus* stem bark is a rich source of vital vitamins and minerals such as vitamins A, B₉, 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

135 **Abbreviations**

136 ND- not detectable. P.erinaceus – Ptericarpus erinaceus.

137 **Declaration**

138 The authors declare that the work is an original work and has not been published in any journal.

139 **References**

- 140 1. Rahim, G.R., Qureshi, R., Arshad, M and Gulfram, M. (2013). Phytochemical analysis
141 and antioxidant properties of teucrium stocksianum flowers from Malakand Division,
142 Pakistan. Int. J. Agric. Biol. 15: 377-381
- 143 2. Agbor , R.B., Ekpo, I.A. and Ekanem, B.E. (2012). Antimicrobial properties and
144 nutritional composition of *Aspilia Africana* C.D. Adams. International Journal of Applied
145 Science and Technology. 2(7) : 94-102.
- 146 3. Zafar, F., Jahan, J.N., Rahman, K., Zafar, w., Aslam, S. (2014). COMPARATIVE
147 Evaluation of Phytochemical, mineral and vitamin contents of Gemmomodified extracts
148 and leaves of 2 indigenous Medicinal plants. Int.J. Agorc. Biol. 16(5): 911-9916
- 149 4. Aslam, M.F., Anwar, R., Nadeem, U., Rashid, T.,Kazi, G. and Nadeem, M. (2005).
150 Mineral composition of *Moringa oleifera* leaves and pods from different regions of
151 Punjab, Pakistan. Asian J. Plant Sci. 4: 417-421
- 152 5. Anjorin, T.S., Ikokoh, P., Okolona, S. (2010). Mineral composition of *Moringa olefeira*
153 leaves, pods an seed from two regions inAbuja, Nigeria. Int. J. Agric. Biol. 12:431-434
- 154 6. Smith, K.T. (1988). Trace minerls in foods. Marcel. Delker. New York.
- 155 7. Prasad, A.S. (1993). Essential and toxic elements in Human Health and Diseases, an
156 update. Wiley-Iss, New York.

- 157 8. Bender, D.A. (2003) Nutritional Biochemistry of the vitamins. Cambridge, U.K.
158 Cambridge University PRESS.
- 159 9. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2002). Biochemistry. 5th edn. W.H. Freeman.
160 New York.
- 161 10. Orwa C, A Mutua, Kindt R, Jamnadass R, S Anthony. 2009 Agroforestry Database: a tree
162 reference and selection guide version 4.0
163 (<http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp>)
- 164 11. Bonkounu G.E, Djimde, M., Ayuk, E.T., Zoungrana, I., Tchoundjeu, Z. (1998). Taking
165 stock of agroforestry in the Sahel, harvesting results for the future. ICRAF, Nairobi,
166 Kenya.
- 167 12. Nadro, M.S., and Modibbo, A.A. (2014). Effects of *Pterocarpus erinaceus* stem Bark
168 aqueous extract on Anemic rats. Sci. Res. J. Vol II, Issue 4: 1-4
- 169 13. Sofowora, A. Medicinal plants and traditional medicine in Africa. 2nd edtn. Spectrum
170 Books Limited. Ibadan. Nigeria.
- 171 14. Harbone, J.B., 1993. Phytochemicals Methods. In; A guide to modern techniques of
172 plant analysis (ed J.B. Harbone) p 182
- 173 15. Trease, G. E., Evans, W.C. 1989. A textbook of pharmacognosy, 13th edtn. Barliere
174 Indian Limited. P.19-21
- 175 16. AOAC (1995). Official methods of analysis (16th edn) Association of Official Analytical
176 Chemists. Arlington, V. A. USA
- 177 17. Saura-Calixto F, Canellas J, Soler L (1983). Dietary fibre components of the nitrogen free
178 extract of almond kernels. J. Sci. Food Agric 36: 1419-1422.

18. Nwakpa, M.E., Abgor, R.B., Amadi, B.A. and Ikepe, E.V. (2015). Vitamin and mineral content of *Ageratum conyzoides* (goat weed). *Nature and Science*. 13 (4). 1-5
19. Stray, F. (1998). *The natural guide to medicinal herbs and plants*. Tiger Books International, London. Pp 12-16
20. Snehel, S.P., and Jignasha, K.S., (2015). Systematic review of plant steroids as potential anti-inflammatory agents: current status and future propectives. *The Journal of Phytopharmacology*. 4(2): 121-125.
21. Lea Herrlala R., Anne, W., Tianarilalaina, T., Solofoniaina, G.A. *et al*, (2014). Triterpenes and steroids from the stem bark of *Gambaya boiviniana Pierre*. *Journal of Pharmacognosy and Phytochemistry*. 3(1); 68-72.
22. Adeolu, A.T. and Enesi, D.O. (2013). Assessment of proximate, mineral, vitamins and phytochemical compositions of plantain (*Musa paradisiac ca*) bract –an agricultural waste. *International Research Journal of Plant Science*. Vol 4(7). Pp192-197
23. Nafiu, M.O., Akanji, M., Adewunmi, Y. Toyin, M. (2011). Phytochemical and mineral constituents of *Cochlospermum planchonii* (Hook Ef. X. Planch) Root Biores. *Bull* 5: 51-56
24. Delazar, A., Babaei, H. and Rezaxadeh, H. (2003). 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*; 11: 1-6
25. Okwu, D.E. and Okwu, M.E (2004) Chemical composition of *spondias mombim linn*, plnt parts. *Journal of sustainable Agric and Environment*. 6: 140- 147

26. Gabriel, A.F. and Onigbanjo, H.O. (2010). Phytochemical and Antimicrobial screening of the Stem Bark extracts of *Pterocarpus erinaceus* (Poir). Nig. J. of Basic and Applied Science. 18(1) 1-5
27. Hays, V.W., Swerson, M.J. (1985). Minerals and Body In: Dukes, physiology of Domestic Animals. Tenth Editn. Pp: 449-466
28. Okwu, D.E. and Morah, F.N(2004). Mineral and nutritive values of *Dennrtha tripetala* fruits. 59; 437- 442
29. Szabo, G., Chavan, S., Mandrekar, P., Catalano, D., (1999). Acute alcoholic consumption allenuates IL-8 and MCP-1 induction in response to ex-vivo stimulation. J.Clin. Immunol. 19: 67-76
30. Merk, V.M. (1986). THE Merk vertinary manual. 6th edition. A handbook of diagnosis, therapy and disease prevention and control for the verterian. Published by Merk and Co Inc. Rahwa, New Jersey. USA.
31. Malhotra, V.K. (1998). Biochenistry for Students. 10th edition. Jaypee Brothers Medical Publishers (P). Ltd. New Delhi. India.
- 32.** Murray, R.K., Granner, D.K., Mayes, P.A., Rodwell, V.W. (2001) Harpers Biochemistry. 25TH Editio. McGraw-Hill Health Profession Division. U.S/A
33. Chandra, R.K. (1990). Micronutrients and immune functions: An overview. Annal New York Acad. Sci. 587: 9-16
34. Tan, J.C., Burns, D.L., Jones, H.R. (2006).Severe ataxia, myelopathy and peripheral neuropathy due to acquired copper deficiency in a patient with history of gastrectomy. J. Parenteral Nutition. 30: 446-450

222 **35.** Galan, P., Viteri, F., Bertrais, S., Gernichow, S., Faurell. (2005). Serum concentration of
 223 beta-carotene, vitamin C and E, Zinc and Selenium are influenced by sex, age, diet,
 224 smoking status, alcohol consumption and corpulence in a general French adult population.
 225 Eur. J. Clin. Nutri. 59: 1181-1190