ABSTRACT

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P. biglobosa (Jacq.) R.Br. ex G. Don (family fabaceae) popularly called the African locust bean tree have been used traditionally as food and medicine and are of high commercial value in the West African region. The plant is reported to contain carbohydrates, proteins, fats, minerals, vitamins, tannins and flavonoids. P. biglobosa possesses antimalarial, antihelminthic, antibacterial, antivenom, antidiabetic, and anti hypertensive and antioxidant properties. The article covers its phytochemical and pharmacological properties.

Key words: Parkia biglobosa, African locust bean tree, Phytochemistry, Pharmacology, Toxicity.

INTRODUCTION

Parkia biglobosa tree is deciduous with a very broad crown that may reach a height of 20 m. The species grows under a wide range of conditions, where annual rainfall ranges from 600 to 1500 mm and the dry season lasts 5–7 months. It occurs in natural and semi-natural habitats such as savannahs and woodlands, sometimes on rocky slopes, stony ridges and sandstone hills. It is able to withstand drought because of its deep taproot. Together with the shea butter tree (*Vittelaria paradoxa*), African locust bean is one of the main components of agroforestry parklands in West Africa. [1]

Parkia biglobosa belongs to the genus *Parkia* which belongs to the tribe Parkieae. It consists of about 35 species with a pantropical distribution but there are five well recognized species besides African locust bean: *P. filicoida*, *P. bicolor*, *P. roxburghii*, *P. biglandulosa* and *P. madagascariensis*. [2]
Geographical Distribution

*P. biglobosa* has a wide distribution across the Sudan and Guinea savanna ecological zones. The range extends from the western coast of Africa in Senegal across to Sudan. *P. biglobosa* is found in nineteen African countries: Senegal, Gambia, Guinea Bissau, Guinea, Sierra Leone, Mali, Côte d’Ivoire, Burkina Faso, Ghana, Togo, Benin, Niger, Nigeria, Cameroon, Chad, Central African Republic, Zaire, Sudan, and Uganda. In Nigeria, *P. biglobosa* is found everywhere.

![Distribution range of P. biglobosa](image)

**Fig. 1: Distribution range of P. biglobosa**

Botanical Description

*P. biglobosa* belongs to the family Fabaceae. It is a perennial deciduous tree occurring in a belt between 5° N and 15° N 7 to 20 m tall, and in some cases it can reach up to 30 m. The fruit is a slightly curved, brown indehiscent pod, 30 to 40 cm long and 2 to 3 cm wide producing up to 20 seeds. *P. biglobosa* seeds number 5 - 20 per pod. The individual brown, smooth seeds are oval, 0.9 –1.5 cm long by 0.8 – 1.1 cm wide and weigh 0.25 grams each. Each seed consists of 30% testa and 70% green cotyledons. The seeds constitute 22% of the fruit, while the pod case is 42% and the pulp is 36%. Taproot often present, lateral roots up to 10–20 m spreading from bole; bole usually straight and robust, cylindrical, up to 130 cm in diameter, often branching low. Barks are distinctly longitudinally fissured, often with more or less regular scales between the fissures, thick, ash-grey to greyish-brown, slash fibrous and reddish-brown, exuding an amber gum; crown dense, wide spreading and umbrella-shaped, consisting of heavy branches. Leaves are alternate, dark green and
bipinnate (doubly compound). They are up to 30 cm long and consist of up to 17 pairs of pinnae, with 13–60 pairs of leaflets on each. [1]

**Traditional Uses**

The traditional uses for *P. biglobosa* can be defined as non timber forest products (NTFP), which include wood energy (fuel wood and charcoal) and all other tangible products other than timber. [9] Non-timber forest products derived from *P. biglobosa* are food, medicine, animal fodder, soil amendments, charcoal, and firewood. The most significant product from *P. biglobosa* is food. The food products collected from *P. biglobosa* are especially important due to the seasonality of fruit maturation and food availability. The seeds are used in preparation of dawadawa, a protein and fat rich food. The yellow starchy pulp that surrounds the seed is an important food supplement rich in Vitamin C and carbohydrates. The dried powder is often mixed with water to produce a drink called dozim. [1, 4]

**Table 1: Uses of different parts of *P. biglobosa* [1]**

<table>
<thead>
<tr>
<th>Uses</th>
<th>Parts of plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>Flowers, fruits, pods, pulp, seed</td>
</tr>
<tr>
<td>Fodder</td>
<td>Fruits, leaves</td>
</tr>
<tr>
<td>Fuel wood or wood production</td>
<td>Branches, stems</td>
</tr>
<tr>
<td>Soil production</td>
<td>Whole tree</td>
</tr>
<tr>
<td>Medicines</td>
<td>Flowers, fruits, leaves, barks, roots</td>
</tr>
</tbody>
</table>

**Medicinal Uses**

Several authors have reported on the medicinal uses and treatments summarized in Table 1 [3, 4, 10-15]

**Table 2: Medicinal uses of *P. biglobosa***

<table>
<thead>
<tr>
<th>Parts</th>
<th>Vernacular name</th>
<th>Preparation</th>
<th>Medicinal uses</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem bark</td>
<td><em>Dorowa, nèrè, dona</em> (Bariba)</td>
<td>Decoction, powder</td>
<td>Malaria, wounds, dysentery, rheumatism, headache, cough, pain, fungal infection, tonic, anti-diarrhoea, female sterility, skin infection, leprosy, blennorrhoea, <em>Schistosoma</em> infection, sores, ulcers, mumps, enema, antiemetic, severe colic and snake bites.</td>
<td>Nigeria, Senegal, Ivory coast, Burkina Faso, Mali.</td>
</tr>
</tbody>
</table>
Leaves | Iru, nèrè | Decoction, poultices | Malaria, pain, diabetes, palpitiation eye lotion, toothache, burns, fever, hemorrhoids, constipation, anorexia, bronchitis, whooping cough, amenorrhoea, snake bites. | Nigeria, Senegal, Niger, Gambia, Mali, Togo, Burkina Faso.
---|---|---|---|---
Fruits | Dowa (lobi, wale) | Maceration | Skin eruption, abscess, stomach ache, yellow fever, conjunctivitis, snake bites. | Ghana, Benin, Mali.
Pulp | Nere (Malinke)neri | Sedative, diuretic, purgative, Malaria | Guinea Conakry.
Seeds | Irugba, dorowa, orgiri | Tension, wounds, mouth ulcers, wasp, bee sting. | Nigeria, Mali.
Pods | Dòó (Dagomba), porgu, yulo | Pounded with salt, fermented | Stomach ache. | Ghana.
Roots | | Decoction | Bronchitis, pneumonia, dysentery, diarrhoea. | Senegal.

**Phytochemistry**

The stem bark is reported to contain flavonoids, tannins, terpenes, saponins, sterols, phenols and reducing sugars. \([16, 17]\) Elemental analysis showed the presence of magnesium, calcium, iron, zinc, potassium, sodium and copper \([16]\). Leaf of African locust bean tree contains flavonoids, tannins, saponins, cardiac glycosides, alkaloids and reducing sugars. \([18-20]\). Long-chain ester of trans-ferulic acid, a mixture of long-chain cis-ferulates and different kinds of catechins (catechins and ferulates) were identified in the stem bark of *P. biglobosa*. \([21]\)

Phytochemical results indicated that the root bark of the plant contained a lot of glycosides and tannins, appreciable amounts of saponins and traces of alkaloids. \([17]\) Also saponins, carbohydrates, tannins and flavonoids were detected in the root of *P. biglobosa*. \([17]\)

The chemical composition of the African plant *Parkia biglobosa* (Fabaceae) roots and barks by Liquid Chromatography - Electrospray Ionization and Direct Injection Tandem Mass Spectrometry analysis was also investigated. \([22]\) Mass spectral data indicated that B-type oligomers are present, namely procyanidins and prodelphinidins, with their gallate and glucuronide derivatives, some of them in different isomeric forms.
The yellowish fruit pulp is very rich in carbohydrate (60%), 10-20% of which is sucrose, 291mg Vitamin C. The seeds contain 35% proteins, 29% lipids, 16% carbohydrates, calcium and have good organoleptic properties. A non-toxic oil of variable composition is also present. Some sources indicate arachidic acid as the most abundant fatty acid, accompanied by behenic, stearic, palmitic and linoleic acids. The proximate analysis of the nutritive contents of *P. biglobosa* seeds indicated the presence of high amount of lipid, crude protein, pureprotein, carbohydrates, total soluble sugar and starch.

**Pharmacology**

**Antiplasmodial and antipyretic activity**

The antiplasmodial activities of the methanol extract and methanol fraction of the stem bark of African locust bean tree were evaluated against malaria model *Plasmodium berghei berghei* and clinical isolates of *Plasmodium falciparum*. The crude extract and methanol fraction exhibited dose dependent reduction of parasitaemia at the different doses administered. Methanol fraction showed higher reduction of parasitaemia. Antipyretic properties of the crude extract and methanol fractions were studied; reduction in yeast-induced hyperpyrexia was produced by the extract and the fractions. The methanol fraction exhibited a significant reduction in yeast induced elevated temperature.

The antiplasmodial activity of the leaves of *P. biglobosa* was evaluated *in vivo* and *in vitro* against *Plasmodium berghei berghei* and clinical isolates of *Plasmodium falciparum* respectively. There was a dose dependent inhibition of parasitaemia in the *in vivo* antiplasmodial tests. The *in vitro* screening demonstrated a weak and concentration-dependent activity of the extract against *P. falciparum*.

**Analgesic and anti-inflammatory activity**

The hexane extract from the bark of *P. biglobosa* had some analgesic and anti-inflammatory effects. Intraperitoneal administration of the methanolic extracts of *P. biglobosa* stalk significantly antagonized the formation of croton pellet granuloma in a dose-dependent manner. The extract also showed a dose-dependent inhibition of the croton oil ear inflammation in test animals, there was also appreciable inhibition of carrageenin-induced rat paw oedema compared with controls. The extracts of *P. biglobosa* further inhibited the arachidonic acid induced paw oedema in a dose-dependent manner comparable to the dual-blocker, phenidone. Thus, suggesting that the observed anti-inflammatory activities may be
produced by the inhibition of the lipo-oxygenase pathways, the cyclooxygenase pathways or both which are involved in metabolism of arachidonic acid. [26]

Antisnake venom
A water-methanol extract of P. biglobosa stem bark had been shown to possess antisnake venom activity. This extract also reduced the loss of responses to acetylcholine (Ach), carbachol and KCl, which are normally blocked by N. nigricollis venom, and significantly reduced the contractures of the preparation induced by venom. [27]

Anti-diarrhoeal
Research showed that P. biglobosa had anti-diarrhoeal properties in mice. [28] Anti-diarrhoeal activities of the aqueous stem bark extract of P. biglobosa and its fractions designated PF1-PF4 investigated in mice indicated that the extract and its column chromatographic fraction F3 significantly (p < 0.05) and dose-dependently reduced frequency of stooling in castor-oil-induced diarrhoea, castor-oil-induced intestinal fluid accumulation and intestinal transit. [29]

Anti-bacterial
The anti bacterial activity of the stem bark and leaves of P. biglobosa has been conducted on four strains of Staphylococcus aureus isolated from patients in the National Hospital Yalgado Ouagadougou, Burkina Faso. [30] Also Antibacterial evaluation of the methanolic extract and aqueous fractions of the leaf, stem bark and root of the African locust bean tree, Parkia biglobosa was carried out using the agar- well diffusion method. The extracts and their fractions were tested against two gram positive organisms – Staphylococcus aureus and Bacillus subtilis and two gram negative organisms–Escherichia coli and Pseudomonas aeruginosa. Results obtained confirmed a broad spectrum of activity as all the organisms used were inhibited by the extracts and their aqueous fractions. [31]

Anti-microbial
Ethanolic extract of the P. biglobosa exhibited antimicrobial activities against the multi-drug resistant isolates. [32] The antimicrobial screening of the leaves P. biglobosa was done using standard strains of microorganisms. The extracts exhibited a concentration dependent antibacterial, inhibiting the growth of the gram – positive bacteria used in the study. [20] Anti-microbial activities of the aqueous stem bark extract of P. biglobosa and its fractions designated PF1-PF4 were investigated in against selected diarrhoea-causing micro-
organisms, the crude extract as well as fractions F3 and F4 strongly inhibited growth of selected microorganisms.\textsuperscript{[29]}

Antioxidant
Antioxidant activities of the leaves and stem barks were determined by the means of 1, 1-diphenyl-2-picrylhydrazyl (DPPH) assay.\textsuperscript{[33]} The result of the antioxidant activities of the methanol extract and methanol fraction indicated that the sensitivity of the antioxidant activity of the methanol fraction is higher than that of crude un-fractionated methanol extract.\textsuperscript{[16]} Study on the antioxidant properties of the stem bark of \textit{P. biglobosa} showed that the radical-scavenging potential of \textit{P. biglobosa} was dose-dependent; this activity was higher than that of standards (rutin, ascorbic acid, butylated hydro-anisole (BHA) and alphatocopherol).\textsuperscript{[20]} The stalk of \textit{P. biglobosa} also showed \textit{in vitro} anti-oxidant activities using the DPPH.\textsuperscript{[26]}

Anti-diabetic
The hypoglycaemic effect of fermented seeds of \textit{Parkia biglobosa}, a natural nutritional condiment that features frequently in some African diets as a spice, was investigated in alloxan-induced diabetic rats.\textsuperscript{[34]}

Hypotension
An alcoholic extract of crude seeds of \textit{P. biglobosa} showed anti-hypertensive activity and contractile effect on smooth muscles of the intestine, and increased the tonus and mobility of the uterus. Ichthyotoxic and molluscicidal activities have been recorded for the seeds due to the presence of saponins.\textsuperscript{[35]}

Hypolipidemia
The hypolipidemic effect and the improvement in serum lipid profile of triton-induced hyperlipidemic rats by \textit{Parkia biglobosa} saponins were investigated. The result indicated that \textit{P. biglobosa}-mediated therapeutic effects may be associated with its hypolipidemic components.\textsuperscript{[36]}

The cardioprotective effect of \textit{P. biglobosa} stem bark used on isoproterenol (ISO) induced myocardial infarction in rats was evaluated. \textit{P. biglobosa} ameliorated positively biochemical alterations, prevented oxidative stress and histological and morphological changes induced by isoproterenol.\textsuperscript{[37]}
Toxicity

The acute and sub acute toxicity profile of the water and alcohol extracts of the stem bark of *P. biglobosa* was investigated. The result of this study showed that the lethal dose (LD<sub>50</sub>) was greater than 5000 mg/kg per oral (p.o) for both extracts and the toxicity characteristics of the methanol and water extracts of the stem bark *P. biglobosa* in short time treatment with the extracts. [38]

The result of acute toxicity study of the stem, leaf and root of *P. biglobosa* indicated that LD<sub>50</sub> fell within the range of 500 – 5000 mg/kg body weight confirming them to be only slightly toxic and hence not potentially dangerous. [39] The toxicity of aqueous and ethanolic extracts of *Parkia biglobosa* pods on *Clarias gariepinus* was investigated. It was concluded that aqueous and ethanol extracts of *P. biglobosa* pods are toxic to *C. geriepinus* juveniles with the ethanol extract being more toxic, which shows that apart from the bark of *P. biglobosa*, the pods has piscicidal property and can be put into use in the control and management of fish ponds to eradicate predators by farmers. [39,40]

REFERENCES


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