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A review on medicinal plants of *Parkia Biglobosa* (Mimosaceae -Fabaceae) and *Pterocarpus Erinaceus* (Leguminosae – Papilionoidea)

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Abstract
The use of the medicinal plants constitutes a significant resource employed by communities for their daily healthcare. *Parkia biglobosa* and *Pterocarpus erinaceus* are two plants spread in West Africa and used in traditional medicine. This study was carried out in order to summarize current knowledge on medicinal uses of these plants. Data from this study showed that the plants possessed wide-reaching pharmacological actions, including anti - diarrhoea, antimicrobial, antihypertensive, anti-inflammatory, analgesic, antiplasmodial activity. All the parts of the plants are used for the care. Phytochemical investigations revealed that some compounds as alkaloids, tannins, saponins, flavonoids, steroids, phenols, glycoside and sugars are present.

Keywords: *Parkia biglobosa*, *Pterocarpus erinaceus*, ethnopharmacological, traditional medicine

1. Introduction
Plants have formed the basis of traditional medicine system [1] which has a rapidly growing economic importance [2]. Traditional medicine refers to health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral-based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat or to diagnose and prevent illnesses or maintain well-being [3]. It still remains the main recourse for a large majority of people for treating health problems. Approximately 80% of the population of the world depends according to the World Health Organization on traditional medicine, mostly herbal remedies, for their primary health care needs [4]. The African continent have a long history with the use of plants and in some African countries, up to 90% of the population rely on medicinal plants as a source of drugs [5]. This situation is justified by several reasons. Official medical attention is usually based on commercial drugs that have to be purchased with money, while a traditional medical consultancy has a much lower cost, including the consumption of the medicinal plants required [6]. The absence or inaccessibility of modern healthcare services, affordability, cultural acceptance and, under certain circumstances, effectiveness than their modern counterparts has caused a large percentage of the population to rely mostly on plant based traditional medicines for their primary health care needs [7]. These factors and a growing interest in the use of natural products and folk medicine have resulted to an increase in the demand for medicinal plants.
Like in many other developing countries, people in Bénin use medicinal plants to improve their state of health [7]. Bénin flora is too rich and various and plants are used to treat population diseases [8]. *Parkia biglobosa* Benth is a perennial deciduous tree from the savannah zone of West Africa and *Pterocarpus erinaceus* is a deciduous legume tree of African savannahs and dry forests. These plants belong to the flora of Bénin. They are important multipurpose trees and are well known in many African countries. Apart from providing building materials, wood, food, fodder, weapons and other commodities, these plants are especially important as traditional medicines. In Bénin, 47% of the various identified uses of *P. biglobosa* were medicinal [9].
The present study was set up to make the synthesis of the various uses of the two plants in traditional medicine and to support the possibility to use them like anthelminthic in the domestic ruminants to improve the productivity of the animals

2. Methods

In the present review, informations regarding medicinal properties, medicinal uses, botany and biochemical properties of *Parkia biglobosa* and *Pterocarpus erinaceus* were gathered via searching books and scientific databases including: published works on journals, PubMed, Elsevier, Google scholar, Science Direct, Springer, etc.

3. Observations and Results

3.1 Botany

Parkia biglobosa (sub-family Mimosoideae and family Fabaceae) popularly known as the African locust bean tree, is perennial tree legume. The tree grows in the savannah region of West Africa up to the southern edge of the Sahel zone 13° [10]. The fruit is slightly bent, brown indehiscent pod, 30 to 40 cm long and 2 to 3 cm wide producing up to 20 seeds.

Pterocarpus erinaceus Poir. (Leguminosae, subfamily Papilionoidea) is a small to medium-sized tree 12–15 m tall with a diameter of 1.2–1.8 m. Exceptionally tall trees reaching 35 m height have been reported [11]. The branches are light grey. The leaves are compound, imparipinnate, about 30 cm long composed of 10 to 15 alternate or sub-opposite leaflets. The young fruits are light green and turn light brown when dry.

3.2 Medicinal uses and pharmacology studies

Parkia biglobosa and *Pterocarpus erinaceus* are medicinal plants widely used in traditional African medicine particularly in Benin, Nigeria, Burkina Faso and Ivory Coast, Togo, Mali to treat a range of diseases. The use of the two plants for this purpose related especially to the bark, the leaves and the roots. The bark was the most used parts based on the high number of uses reported. The plants are mainly used against digestive disorders, wounds, hypertension and infections (table 1) and some studies are carried out to justify these uses (table 2).

Table 1: Uses of *P. biglobosa* and *P. erinaceus* in traditional medicine.

Scientific name and Family	Plant part used	Therapeutic indication	Medicinal Preparation (and administration mode)	References
Parkia biglobosa	Bark	Gastric and duodenal ulcer	Powder, maceration (oral)	[12]
Parkia biglobosa	Bark	Depurative, diuretic	Maceration (oral)	[8]
Parkia biglobosa	Leaves	Abscess	Grinding (local application)	[8]
Parkia biglobosa	Leaves	Liver diseases, hepatic deficiency	Decoction (oral, bath)	[13]
Parkia biglobosa	Leaves	Diabetes	Infusion (oral)	[14]
Parkia biglobosa	Leaves, pods, stem bark	Wounds	Powder, decoction (local application)	[15]
Parkia biglobosa	Root bark, trunk bark, leaves	Digestive, nervous, cutaneous and pregnancy-birth disorders, infection and infestation, poisoning	Decoction, calcinations, trituration and maceration (oral, bath, (application)	[16]
Parkia biglobosa	Bark, fruit pulp	High blood pressure, Yellow fever, Constipation	Bark and fruit are soaked and drunk (oral)	[17]
Parkia biglobosa	Stem bark, leaves	Wounds, pain, fungal infection	Decoction of bark in water (bath and/or to drink) The powder is usually dissolved in water (bath and/or to drink) or is thrown into fire (inhalation)	[18]
Parkia biglobosa	Roots	Coal disease	Decoction in salty water (oral)	[19]
Parkia biglobosa	Roots,stem bark	Diarrhoea, general weakness, abdominal pains	Powder, decoction (oral)	[20]
Parkia biglobosa	Seeds	Whitlow	Fermentation(local application)	[21]
Parkia biglobosa	Grains, barks	Anthelmintic	Grains and roots are ground, the grains are mixed with rock salt, the roots are soaked in water (oral)	[22]
Parkia biglobosa	Stem bark	Anti-inflammatory, antibacterial	Not reported	[23]
Parkia biglobosa	Seeds, leaves	Hypertension	Decoction (oral)	[24,23]
Parkia biglobosa	Trunk bark, pods	Diarrhoea, dysentery, cholera	Maceration (oral)	[25]
Parkia biglobosa	Bark, leaves, fruits	Snake or venomous animal bite	Not reported	[26]
Parkia biglobosa	bark	Diarrhoea and veneral diseases	Not reported	[27]
Parkia biglobosa	Seeds	Diabetes	Consumption in sauce (oral)	[24]
Parkia biglobosa	Bark	Toothaches	Fumigation	[28]
Parkia biglobosa	Bark	Smallpox, varicella, measles,tooth decay, toothaches, gingivitis	Infusion (oral),decoction (mouth bath)	[29]
Parkia biglobosa	Roots	Fever, malaria	Not reported	[30]
Parkia biglobosa	Fruits,barks leaves	Constipation, anorexia, rickets, icterus Mumps Haemorrhoid, ascariasis Burns	Fruits flour (oral); gargle, inhalation, fumigation of bark; maceration of fresh leaves,roast the young leaves (local application)	[31]
Parkia biglobosa	Stem bark	Wound, antiseptic, disinfectant, cicatrizing	Infusion (oral)	[32]
Parkia biglobosa	Bark	Fever, malaria	Maceration in water (oral)	[33]
Pterocarpus erinaceus	Bark	Nonsaanga or Saangpèlega of hen in moré language (Mossi)	Maceration in water (oral)	[19]
Pterocarpus erinaceus	Roots,leaves, stem bark	Diarrhoea, polyuria, rectum itching, vomiting, palpitations abdominal pains, general weakness, insomnia	Powder (oral);decoction (oral)	[20]
Pterocarpus erinaceus	Bark, fruit	Digestive and nervous disorders	Decoction, calcination (oral, massage, scarification)	[16]
Pterocarpus erinaceus	Stem bark	Eyediseases	Decoction is administered orally and used as eye drops	[34]

Table 2: pharmacological properties of *P. biglobosa* and *P. erinaceus*

Botanical Name	Biological Activity	Part Tested	Bioassay Models	Results	References
Parkia biglobosa	Antimicrobial Activities	ethyl acetate, ethanol and water extracts of leaves	The agar cup diffusion and dilution method	The extracts exhibited a concentration dependent antibacterial, inhibiting the growth of *S. aureus, B. cereus, E. coli, P. aeruginosa, A. niger and C. utilis*	[35]
		methanolic extract and aqueous fractions of the leaf, stem bark and root	agar – well diffusion method	*S. aureus, B. subtilis, E. coli P. aeruginosa* were inhibited by the extracts and their aqueous fractions at concentrations between 2.5 – 20 mg.	[36]
Parkia biglobosa	Antihypertensive effect	aqueous extract of bark of trunk	Ludwig manometer principle	The extracts decreased in a dose-depend manner the rabbit blood pressure and the effect was similar to that produced by propranolol	[37]
		Fermented seeds	Clinical, biochemical and anthropometrical, analyses in two types of people (consumption or no of seeds condiment)	Significantly decreased blood pressure and heart beat were detected in the group where the condiment is highly consumed region when compared to the non-consumption group	[38]
Parkia biglobosa	Anthelmintic effect	Aqueous extracts of seeds and leaves	Egg hatch assay	Produced a high hatching egg inhibition against *Haemonchus*, *Trichostrongylus, Oesophagostomum* and *Bunostomum* species	[39]
Parkia biglobosa	Antimicrobial Activities	Aqueous extract of leaves	WHO method *in vitro* micro test (Mark III)	There was a dose dependent inhibition of parasitemia in the *in vivo* tests, with maximum effect at 600 mg/kg and *in vitro* a weak and concentration-dependent activity against *P. falciparum.*	[40]
Parkia biglobosa	Analgesic and anti-inflammatory activities.	Hexane fraction of bark	The abdominal writhing test in mice and the hot-plate method	The extract has a marked analgesic activity when evaluated with the abdominal writhing test in mice, but, like paracetamol, was ineffective with the hot-plate method.	[41]
Parkia biglobosa	Anti-diabetic activity	aqueous and methanolic extracts of fermented seeds	Determination of fasting plasma glucose, total cholesterol, triglyceride, high-density lipoprotein and low-density lipoprotein	Extracts exert a hypoglycaemic effect and ameliorated the loss of bodyweight usually associated with diabetes.	[42]
Pterocarpus erinaceus	Antimicrobial activity	n-hexane, ethyl acetate and methanol extracts of stem bark	the cupplate method on gram positive and gram negative pathogens	The methanol fraction was the only extract that showed activity against *C. albicans, S. aureus, E. coli, B. subtilis* and *P. aeruginosa*	[43]
		aqueous acetone extracts	agar disc diffusion, micro-well dilution and Minimum Bactericidal Concentration assay	The extract exhibited antibacterial activity against *S. aureus* and *B. cereus*	[44]
Pterocarpus erinaceus	Antidiarrheal activity	Methanol leaf extract	castor oil-induced diarrhea, charcoal meal transit time and castor oil-induced enteropooling	The extract caused a significant decrease in the wet faeces, decreased the distance travelled by the charcoal meal and caused a reduction in the intraluminal fluid accumulation.	[45]
Pterocarpus erinaceus	Antiamaril activity	ethanolic leaves extracts	*in vitro* antimalarial tests were performed by light microscopy using Giemsa-stained smears	The extract has a moderate activity against *Plasmodium falciparum*	[46]
Pterocarpus erinaceus	Treatment of cognitive disorders	Aqueous bark extract	MTT colorimetric assay	Extract significantly decreased a production, displaying effects similar to those of DAPT on APP processing, but may act on another inhibition site.	[47]
Pterocarpus erinaceus	Anti-inflammatory effect	Methanol and dichloromethane stem bark extracts	Carrageenan induced paw edema test and croton oil induced-ear edema	Methanol extract reduced the carrageenan induced –hind paw edema. The extracts reduced the ear edema at different doses.	[48]
Pterocarpus erinaceus	Analgesic effect	Methanol stem bark extract	Acetic acid-induced writhing test	The extract showed an important analgesic effect against writhing induced by acetic acid injection	[48]
Pterocarpus erinaceus	Antioxidant potential	Aqueous, acetone leaves and barks extracts	Inhibition of free radical DPPH and Iron (III) to iron (II) reduction activity (FRAP).	The extract showed an antioxidant potential. It reduced capacity DPPH radicals which is determined by the decrease absorbance at517 nm.	[44]
Pterocarpus erinaceus	Haemostatic activity	Ethanolic stem bark extract	Bleeding and clotting times determination	Administration of the extract orally revealed a significant decrease in bleeding time compared to control.	[49]
Pterocarpus erinaceus	Antitrypanosomal activity	solvent soluble extracts of stem bark	*in vivo* screening for antitrypanosomal activity against *Trypanosoma brucei brucei*	The extracts showed only trypanostatic effects against *Trypanosoma brucei brucei* and could not clear the parasites completely.	[50]

3.3 Phytochemical components isolated from *Parkia biglobosa* and *Pterocarpus erinaceus*

The analysis of *P. biglobosa* leaves revealed the presence of saponins, tannins, flavonoids, terpenes, phenols, sterols, isoquinoline alkaloids, indole alkaloids, cardiac glycosides and reducing sugars [40,51]. However resins, volatile oil and anthraquinones were absent [40]. Ajaiyeoba (2002) indicated the presence of saponin, tannin, flavonoids and cardiac glycosides in the leaf root and stem bark. [52] showed that coumarins and anthocyanosides are present in both bark and leaf but in different concentrations. The bark and the pods contain parkine [53].

Phytochemical screening of the stem bark showed that *P. erinaceus* contains both condensed and hydrolysable tannins, saponins, flavonoids, terpenes, carbohydrate and phenols [43, 50]. The metabolites such as sterols, triterpenes, saponosides, anthocyanidins, coumarins and reducing compounds were isolated in stem bark and coumarins, anthocyanins, flavones and reducing compounds in the leaves by [54]. The presence of some isoflavonoids as prunetin, muningin, afromosin, tectorigenin, pseudobaptigenin is revealed in heartwood of [55].

3.4 Toxicity

The use of *P. biglobosa* as herbal medicaments in African countries and the reports on the toxicity of the plant further show that the plant is non-toxic to humans [51] but the bark and the pods of the same plant contain parkine and equally have piscicidal property [56]. The extracts of raw *P. biglobosa* seed exhibited termiticide activity [57]. No toxicity was reported for *P. erinaceus* [49, 58] showed that the supplementation of *A. guayanus* with tannin rich *P. erinaceus* or sole feeding of *P. erinaceus* did not pose any threat to the health of the animals under the conditions of the experiment.

4. Discussion

The results of this review of literature show that the populations of many countries (Bénin, Burkina-Faso, Nigeria, Ivory Coast, Togo, Mali etc.) use *P. erinaceus* and *P. biglobosa* to treat several diseases. The medicinal uses of the species were the most diversified. Particularly, the digestive system diseases (diarrhoea, dysentery, abdominal pain), diseases of the cardiovascular system, wounds, pains and burns, infectious diseases (malaria, abscesses, yellow fever, measles) are reported [28, 24, 33, 20, 16]. The scientific base of some uses of these plants was established by several studies which revealed that the plants have pharmacological properties such as antimicrobial, antihypertensive, antioxidant, anti-inflammatory, analgesic, anti- diabetic, antiplasmodial. The antimicrobial activity was determined using mainly agar diffusion method. Different extracts of both plants were prepared with different solvents. These studies showed that different extracts from leaves and stem bark in different concentrations significantly inhibited the growth of *S. aureus, B. cereus, B. subtilis, E. coli, P. aeruginosa, A. niger, C. albicans and C.utilis* [35, 36, 43, 44]. These activities may justify the use of these plants against infections, fungal skin deseases [16, 20, 27]. The anti-inflammatory and analgesic properties were investigated for the bark of *P. biglobosa* using the abdominal writhing test in mice and the hot-plate method and for the stem bark of *P. erinaceus* using the carrageenan induced paw edema test, croton oil induced-ear edema and acetic acid-induced writhing test. The results show that *P. biglobosa* possesses a marked analgesic activity when evaluated with the abdominal writhing test in mice but like paracetamol, was ineffective with the hot-plate method, a feature suggesting a peripheral mechanism of action [41]. *P. erinaceus* was able to reduce the carrageenan induced-hind paw edema, reduced the ear edema and showed an important analgesic effect against writhing induced by acetic acid injection [48]. These properties may explain the traditional use of *P. biglobosa* against ulcers, pains, toothaches [12, 18, 28]. The antihypertensive effect was evaluated for *P. biglobosa* using Ludwig manometer principle. The extract decreased the rabbit blood pressure [37]. Significantly decreased blood pressure and heart beat were detected in the group where the condiment is highly consumed region when compared to the non-consumption group [38]. These results justify the use of this plant by traditional healers in the high blood pressure treatment [24, 23]. *P. biglobosa* (grains, bark and leaves) is reported to be effective against the worms [22, 31, 39] showed *in vitro* the anthelmintic effect of aqueous extracts of seeds and leaveson bovine nematode eggs. The extracts produced a high hatching egg inhibition against *Haemonchus*, *Trichostrongylus, Oesophagostomum* and *Bunostomum* species. These results supported the anthelminthic use of this plant. The antimalariales activities are recognized by the traditional healers [33, 40] indicated that with *P. biglobosa*, there was *in vivo* a dose dependent inhibition of parasitaemia but the *in vitro* screening demonstrated a weak and concentration-dependent activity of the extract against *P. falciparum.* [46] showed that the leaves extracts have a moderate activity against *P. falciparum*. *P. biglobosa* and *P. erinaceus* are widely used in traditional medicine to treat a range of diseases. Their medicinal properties would undoubtedly be due to the various phytochemical components which they contain.

5. Conclusion

The synthesis of current knowledge on *P. biglobosa* and *P. erinaceus* shows that they are used in many countries in Africa to treat various affections like digestive disorders, hypertension, wounds, and aches. Several studies were carried out to validate some of their therapeutic uses. These plants are used especially to improve human health and very little for animal health then we can evaluate their anthelmintic properties against gastrointestinal parasites of small ruminants Djallonké.

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