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A review of cardio-metabolic properties of *Parkia biglobosa* seeds

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ABSTRACT

Management of chronic diseases such as hypertension and type 2 diabetes is based on pharmacological treatment combined with non-pharmacological measures, including regular physical activity and diet rich in fruit and legumes. This includes *Parkia biglobosa*, a plant of *Fabaceae* family. While several preclinical data on medicinal effects of *Parkia biglobosa* seeds are available in literature, studies in humans are scarce. The objective of this review was to present and synthesize recent scientific data on the cardio-metabolic properties of *Parkia biglobosa* seeds. We conducted a review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines by consulted and retrieved usual search sites. The 24 studies that met the inclusion criteria were thoroughly analyzed. Cardio-metabolic medicinal properties of *Parkia biglobosa* seeds are thought to be linked to the action of various chemical substances contained in the seed on cardiac and vascular smooth muscle, carbohydrate-lipid and electrolyte metabolism. A synthesis of ethnobotanical, pharmacological, and nutritional data reveals that *Parkia biglobosa* seeds—particularly in fermented form—offer multiple cardiometabolic benefits: antihypertensive effects via vasodilation and calcium channel inhibition, improved lipid and glycemic profiles, and favorable modulation of electrolyte metabolism. © 2026 International Formule Group. All rights reserved.

Keywords : *Parkia biglobosa* seeds, Ethnomedicine, Cardio-metabolic activities.

INTRODUCTION

The management of chronic diseases such as hypertension and type 2 diabetes remains a significant challenge in sub-Saharan

Africa. This is largely due to socioeconomic barriers including widespread poverty, limited access to healthcare services, and the lack of robust health insurance systems (Ebrahim et

al., 2013 ; Atun et al., 2015). As a result, a substantial proportion of the population relies on traditional medicine, which includes the use of various medicinal plants. One such plant, *Parkia biglobosa* (Jacq.) G. Don, commonly known as the African locust bean, is widely used in West Africa for both nutritional and medicinal purposes (Koura et al., 2013; Adébayo-Tayo et al., 2021; Adeniyi et al., 2022).

The fruit of *Parkia biglobosa* contains a sweet, floury pulp, but it is the seeds—often fermented—that are most valued. These fermented seeds, known regionally as "soubala" or "iru," are widely used as a flavor-enhancing condiment and a source of plant-based protein (Camara et al., 2016 ; Coulibaly-Diakité et al., 2020). Nutritionally, they are rich in proteins, unsaturated fatty acids, carbohydrates, vitamins (particularly B-complex), essential minerals, and polyphenols, conferring both nutritional and potential therapeutic benefits (Ajaiyeoba et al., 2002 ; Ogunyinka et al., 2019).

Numerous preclinical studies have explored the bioactive properties of *Parkia biglobosa*, especially its seeds, leaves, and bark, reporting antioxidant, antihypertensive, antidiabetic, and lipid-lowering effects in animal models (Odetola et al., 2006 ; Tokoudagba et al., 2009 ; Dedehou et al., 2016 ; Ogunyinka et al., 2019 ; Coulibaly et al., 2022). These pharmacological effects have been attributed to the plant's polyphenolic compounds and other secondary metabolites. Moreover, it is often claimed that plant-based therapies such as *Parkia biglobosa* are associated with fewer side effects than synthetic pharmaceuticals (Ekor, 2014; Olayemi et al., 2022). However, despite the abundance of promising preclinical data, clinical studies validating these therapeutic effects in humans remain scarce (Ognatan et al., 2011). This review aims to present and synthesize recent scientific data on the cardio-metabolic properties of *Parkia biglobosa*

seeds, with an emphasis on their potential role in managing hypertension, diabetes, and obesity.

DATA ORIGIN

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). A comprehensive literature search was performed to identify relevant studies on the medicinal and cardio-metabolic properties of *Parkia biglobosa* seeds.

Data Sources and Search Strategy

Electronic databases including PubMed, Google Scholar, ScienceDirect, and African Journals Online (AJOL) were searched for articles published between January 2000 and April 2024. The search terms used included combinations of the following keywords: "*Parkia biglobosa*", "*Parkia biglobosa* seeds", "*Parkia biglobosa* and medicine", "traditional medicine *Parkia biglobosa*", and "cardio-metabolic effects of *Parkia biglobosa*". Boolean operators (AND/OR) were applied to optimize retrieval.

Eligibility Criteria

Studies were included if they met the following criteria:

1. Study type: Experimental (in vitro or in vivo), preclinical, or clinical studies.
2. Focus: Investigating the pharmacological or therapeutic effects of *Parkia biglobosa* seeds, particularly on metabolic or cardiovascular parameters.
3. Language: Articles published in English or French.
4. Accessibility: Full-text availability.

Exclusion criteria included review articles, studies not involving *Parkia biglobosa* seeds specifically, or those that investigated unrelated outcomes.

Data Extraction and Synthesis

Titles and abstracts were screened independently by two reviewers. Full texts of potentially eligible studies were retrieved and assessed for inclusion. Extracted data included study design, sample characteristics, type of extract used, outcome measures, and key findings related to cardio-metabolic health. Due to the heterogeneity of study designs and outcomes, a narrative synthesis was performed rather than a quantitative meta-analysis.

ETHNOBOTANICAL DATA AND VERNACULAR NOMENCLATURE

Parkia biglobosa is a key multipurpose tree species native to the Sudano-Guinean savannas, with a broad distribution extending from the West African coastline to Sudan, spanning at least nineteen countries (Cissé et al., 2021). This wide geographical range overlaps with significant linguistic and cultural diversity, which explains the numerous vernacular names associated with the species, such as *nééré*, *ahwa*, *ewé*, *igba*, *igiougha*, and *ogba*, depending on the ethnic groups and regions (Tokoudagba et al., 2010). Notably, the fermented seeds are designated by different names including *iru* (Yoruba, Nigeria), *dawadawa* (Hausa, Nigeria), *soumbala* or *soumara* (Mandingue populations in Guinea, Burkina Faso, and Côte d'Ivoire), *kpalugu* (Kusasi and Dagomba ethnic groups, Ghana), and *netetu* in Wolof (Senegal) (Parkouda et al., 2009; Coulibaly-Diakité et al., 2020). All parts of the tree—pods, bark, leaves, and roots—are traditionally utilized for food, crafts, and especially medicinal purposes, underscoring the socio-cultural significance of this species in sub-Saharan Africa (Koura et al., 2011).

CARDIO-METABOLIC PROPERTIES

Cardiovascular Effects

Both observational and experimental studies have highlighted the antihypertensive effects of *Parkia biglobosa* seeds, particularly when fermented. In Togo, Ognatan et al. (2011)

reported significantly lower blood pressure levels among a population consuming fermented seeds regularly, compared to a non-consuming group ($P < 0.001$). These findings are supported by pharmacological studies showing that hydroalcoholic seed extracts exhibit dose-dependent hypotensive effects in animal models by reducing cardiac inotropy and chronotropy, suggestive of a cholinergic-like action (Coulibaly et al., 2017).

Further mechanistic insights were provided by Ouédraogo et al. (2012), who demonstrated that aqueous extracts of fermented or roasted seeds induced dose-dependent vasorelaxation in isolated rat aortic rings, even in the absence of endothelium, suggesting multiple underlying pathways. The effective concentrations (EC_{50}) of these aqueous extracts, with and without endothelium, were respectively 5.37 ± 0.12 and 4.19 ± 1.02 mg/ml for fermented seeds and 5.39 ± 1.12 and 5.93 ± 0.95 mg/ml for roasted seeds. Chemical analyses revealed the presence of bioactive compounds such as cardiac glycosides, alkaloids, saponins, polyphenols, flavonoids, tannins and triterpenes. The latter, present in many plants, are thought to have anti-hypertensive properties (Ajaiyeoba et al., 2002; Alabi et al., 2005; Takashi 2005; Odetola et al., 2006; Ouédraogo et al., 2012 ; Olaleye et al., 2013, Coulibaly et al., 2017). They act directly on vascular smooth muscle and via the endothelium, generating vasodilator prostaglandins²² (Ouédraogo et al., 2012). These compounds are known to possess cardioprotective properties through angiotensin-converting enzyme (ACE) inhibition, nitric oxide bioavailability enhancement, and oxidative stress reduction (Aroua et al., 2023). Phenolic inhibition of angiotensin-converting enzyme is linked to chelates that form complexes in active center of the enzyme, inactivating it (Guerrero et al., 2012). Polyphenol-dependent vasodilation is thought to be mediated by stimulation of Src/PI3-kinase/Akt pathway, which enhances

endothelial NO synthase activity (Anselm et al., 2009).

Preclinical work by Ogunyinka et al. (2019) found that a purified protein isolate from the seeds—*Parkia biglobosa* Protein Isolate (PBPI)—ameliorated cardiac oxidative stress in streptozotocin-induced diabetic rats, by upregulating endogenous antioxidant systems and reducing reactive oxygen species (ROS). Coulibaly et al. (2017) further confirmed the antihypertensive effect of both aqueous and ethanolic extracts of fermented seeds in adrenaline-induced 0.36 mg/kg body weight (bw) hypertensive rats [systolic blood pressure (SBP) 181.2 ± 2.21 mmHg, diastolic blood pressure (DBP) 144.7 ± 2.03 mmHg and heart rate (HR) 250.3 ± 3.39 beats per minute], showing significant ($p < 0.01$) reductions in systolic and diastolic blood pressure and heart rate. Greater reduction in SBP (32.45%), DBP (27.02%) and HR (18.59%) were observed with ethanolic extract at 1500 mg/kg bw, with effects comparable to those of nifedipine, a calcium channel blocker. This suggests a possible mechanism involving calcium channel inhibition and smooth muscle relaxation. Indeed, calcium is involved in vascular smooth muscle contraction. Inhibition of its entry into the smooth muscle cell leads to vasodilation via relaxation of the vascular smooth muscle fibre (Marieb et al., 2010). *Parkia biglobosa* extracts would have acted using the same mechanism of action as Nifedipine.

Metabolic Effects

Metabolically, Ognatan et al. (2011) also observed that regular consumption of fermented seeds by Bogou population was associated with improved glycemic and lipid profiles: lower fasting glucose (67.80 ± 16.3 vs. 76.40 ± 15.3 mg/dL; $p < 0.001$), total cholesterol (ChT) (175.7 ± 3.2 vs. 180.8 ± 3.3 mg/dL; $p = 0.225$), low-density lipoprotein cholesterol (LDLc) (90.9 ± 35.7 vs. 110.3 ± 44.8 mg/dL; $p = 0.01$), triglycerides (110.7 ± 5.93 vs. 129.1 ± 5.8 mg/dL; 0.028), along with

increased high-density lipoprotein cholesterol (HDLc) (62.6 ± 1.6 vs. 48.3 ± 2.7 mg/dL; $p < 0.001$) levels in Bogou population compared with Goumou-Kope.

These clinical observations are in line with animal studies showing hypoglycemic and hypolipidemic effects of seed extracts in diabetic and hyperlipidemic models (Odetola et al., 2006; Fred-Jaiyesimi et al., 2009; Airaodion et al., 2019).

The glucose-lowering effect of certain fractions (especially chloroform-soluble ones) was comparable or superior to glibenclamide, suggesting potential insulinotropic or glucose absorption-modulating activities. Secondary metabolites such as glycosides, alkaloids, and flavonoids are likely responsible for these effects. Additionally, hypolipidemic actions appear to be mediated by modulation of lipid metabolism, as evidenced by improved HDL/LDL ratios—an important marker of cardiovascular protection (Ayo-Lawal et al., 2014 ; Ogunyinka et al., 2019). These findings suggest that the regular intake of fermented seeds may play a preventive role in cardiometabolic risk reduction across sub-Saharan African populations.

The exact mechanism of action and secondary metabolite group involved in anti-diabetic activity of fermented *Parkia biglobosa* seeds is not known. It would appear that metabolic effects of *Parkia biglobosa* involve multiple mechanisms. However, further research is needed to identify the active molecules and understand their specific roles in these effects (Fred-Jaiyesimi et al., 2009).

Electrolyte Metabolism and Blood Pressure Regulation

Findings regarding electrolyte metabolism remain variable. Ognatan et al. (2011) observed significantly lower serum sodium levels in individuals regularly consuming fermented seeds (143.1 vs 149.2 mmol/L; $p < 0.001$). Indeed, Sodium is an electrolyte required to maintain osmotic

pressure, plasma and interstitial volumes and cardiovascular system's response to endogenous vasopressors (Chatelanat et al., 2019). When absorbed in excess, it causes the kidneys to retain water in order to maintain plasma osmolarity. This increase in extracellular volume leads to a rise cardiac output, which can increase blood pressure (Guyton et al., 2021). High sodium consumption can induce vasoconstriction by increasing the reactivity of blood vessels to catecholamines. This contributes to an increase in vascular resistance and therefore blood pressure (Farquhar et al., 2015). Excess sodium can impair endothelial function by reducing the bioavailability of NO, a strong vasodilator with a corollary decrease in vasodilation and increase in blood pressure (Laffer et al., 2016). Reduction in plasma sodium in individuals regularly consuming fermented seeds may contribute to blood pressure lowering via decreased extracellular fluid volume and reduced vascular reactivity to catecholamines (Marieb et al., 2010; Farquhar et al., 2015). Moreover, the high potassium and magnesium content of the fermented seeds, as reported by Cissé et al. (2021), enhances their antihypertensive potential, given that both electrolytes promote vasodilation and reduce sodium retention. It's recognized that a diet rich in potassium improves blood pressure levels (Akita et al., 2003) through various mechanisms. Potassium's said to have a natriuretic action (Akita et al., 2003). Potassium's also thought to act directly on arterial wall, inducing vasodilation controlled in part by hyperpolarization of smooth muscle cells (Marieb et al., 2010; Guyton et al., 2021). Magnesium acts on the cardiovascular system via variety of mechanisms. Magnesium interacts physiologically with calcium and therefore acts as an anti-calcium agent (Berthelot et al., 2004). It regulates flow of calcium across the cell membrane. This electrolyte's said to have vasodilatory properties, stimulating endothelial NO and

prostacyclin production and inhibiting endothelin production (Berthelot et al., 2004). However, a contrasting report by Epkerikpe et al. (2019) found an increase in serum sodium among diabetic rats treated with aqueous extracts of *Parkia biglobosa*, highlighting the need for further studies to clarify these effects under different pathophysiological conditions.

TOXICITY OF *PARKIA BIGLOBOSA* SEEDS

Ouédraogo et al. (2012) showed in three-month-old rat weighing between 20 and 40 g, that the median lethal dose (LD₅₀) by intraperitoneal route of aqueous extract was estimated at 1800 mg/kg for toasted seeds and 1600 mg/kg for fermented seeds, classifying them as slightly toxic according to the scales of the World Health Organization (WHO) (WHO, 2002). However, no mortality was observed up to 3000 mg/kg orally. According to WHO scale (WHO, 2002), *Parkia biglobosa* seeds are well tolerated orally (Ouédraogo et al., 2012).

OTHER PROPERTIES AND USES OF *PARKIA BIGLOBOSA* SEEDS

Antioxidant properties

Antioxidant property of a substance depends on its iron reduction capacity (Wasiu et al., 2018). Fermented *Parkia biglobosa* seeds have been reported to have a high capacity to reduce ferric iron (Fe³⁺) to ferrous iron (Fe²⁺) (Obboh et al. 2008). Fermented seeds are also reported to have a high free radical scavenging capacity, suggesting that they could be used as a source of dietary antioxidant. Similar found was reported by Badu et al. in their study of the reducing capacities of methanolic and ethanolic/aqueous extracts of *Parkia biglobosa* seeds (Badu et al., 2012). The high antioxidant activity of fermented *Parkia biglobosa* seeds is linked in particular to their richness in phenolic compounds (Obboh et al. 2008). Fermented seeds are reported to have higher polyphenol

contents and antioxidant activities *in vitro* than unfermented seeds (Arouna et al., 2023).

Antimicrobial properties

Eboma et al. demonstrated antibacterial and antifungal properties of oily and aqueous extracts of fermented *Parkia biglobosa* seeds. At concentrations ranging from 2.5 to 10 mg/mL, extracts induced inhibitory effects on growth of *Klebsiella spp.*, *Aeromonas hydrophilia*, *Citrobacter braakii*, *Enterobacter aerogenes*, *Shigella dysenteriae*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Escherichia coli*, *Methicillin-Resistant, Staphylococcus aureus* (MRSA), *Aspergillus spp.* and *Candida albican* (Eboma et al., 2021). Similar bactericidal and fungicidal effects were found by Ajiboye et al. with aqueous and acetone extracts of fermented *Parkia biglobosa* seeds on *Parkia. aeruginosa*, *E. coli* and *C. albicans* (Ajiboye et al., 2020).

Analgesic, anti-inflammatory and anticancer properties

Lectins isolated from raw *Parkia biglobosa* seeds are reported to have analgesic and anti-inflammatory activity *in vitro* (Silva et al., 2013). In a study designed to compare antinociceptive activity of lectin isolated from raw *Parkia. biglobosa* and *Parkia Platycephala* seeds, it was reported that at a dose of 1 mg/kg, the inhibitory effect of *Parkia biglobosa* lectin on acetic acid-induced aches and pains on rat was 58%, while that of *Parkia Platycephala* was 74% (Bari et al. 2016). This would mean that *Parkia biglobosa* seeds would have analgesic properties (Bari et al., 2016). Furthermore, extracts of fermented *Parkia biglobosa* seeds are reported to contain bioactive peptides that induce selective cytotoxicity and apoptosis of cancer cells (Ayo-Lawal et al., 2020; 2021).

Other medicinal uses

Other scientifically undocumented properties are attributed to *Parkia biglobosa*

seeds by many consumers in the West African sub-region. *Parkia biglobosa* seeds are said to be used in ethnomedicine to treat certain visual disorders, diarrhea, leprosy and to accelerate wound healing (Wasiu et al., 2018).

Conclusion

A synthesis of ethnobotanical, pharmacological, and nutritional data reveals that *Parkia biglobosa* seeds—particularly in fermented form—offer multiple cardiometabolic benefits: antihypertensive effects via vasodilation and calcium channel inhibition, improved lipid and glycemic profiles, and favorable modulation of electrolyte metabolism. These findings align with the plant's traditional use and support its potential in developing culturally appropriate nutritional or phytotherapeutic interventions for sub-Saharan African populations. Nonetheless, precise molecular mechanisms and active metabolites require further investigation, alongside well-designed clinical trials to validate these effects in humans.

COMPETING INTERESTS

Authors declare no competing interests related to this study.

AUTHORS CONTRIBUTIONS

BAK initiated the project described in this manuscript. BAK, NMK, CK and MD wrote the manuscript. BAK and MD translated it into English. TAY, CK, BMK, contributed to the literature search. All co-authors contributed to the proofreading and finalization of the manuscript.

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