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Neocarya macrophylla (Sabine) Plant: A Brief Review of its Phytochemical Properties and Pharmacology

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Authors' contributions

This work was carried out in collaboration among all authors. Authors DK and etFAD conceptualized and Validated the study. Authors SA and DSIM performed the methodology. Authors KD and MAI edited the manuscript. Authors DW and etFAD contributed to supervised the study. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Background: The medicinal plant *Neocarya macrophylla* (Sabine) (Chrysobalanaceae) is widely used in traditional African medicine to treat a variety of conditions, including to relieve respiratory problems, diabetes, high blood pressure and eye inflammation. Its seeds and oil also have antioxidant properties; Because it is widely used in traditional medicine.
Methodology: A documentary search was conducted using data from Google Scholar, PubMed, Elsevier, ScienceDirect, and Scifinder to examine published scientific reports on its composition and pharmacological properties.
Results: The presence of flavonoids, tannins, terpenes, anthracenes, saponosides, cardiotonic heterosides and alkaloids. Other active compounds have been identified, including chlorogenic acid, hyperoside, procyanidin B2 and other procyanidins has been demonstrated by chemistry

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studies. It has been shown that this plant's extracts and the pure compounds that were isolated from it had antiveninic, antimicrobial, analgesic, anti-inflammatory, antimycobacterial, anthelmintic, antidiabetic and antioxidant properties, among others. Acute toxicity studies conducted have confirmed the plant to be toxic.
Conclusion: This review serves as a reference for research and development on *N. macrophylla* by offering an overview of all current advancements in the fields of pharmacology, phytochemistry, ethnopharmacology and toxicity.

Keywords: Traditional uses; phytochemistry; pharmacology; Neocarya macrophylla (Sabine).

1. INTRODUCTION

"Oilseed plants are widespread throughout the world. They are very diverse, with more than two thousand species listed worldwide" [1]. In Senegal, there are many plants with exceptional virtues. However, the lack of scientific knowledge about the composition of their fruits and seeds limits their value-adding potential. In fact, the way in which a fruit or oilseed is used depends very much on knowledge of its composition and its physico-chemical, pharmacology and biochemical characteristics.

Neocarya macrophylla (Sabine) Prance is a wild fruit tree of the Chrysobalanaceae family [2]. "This woody tree, formerly known as Parinari macrophylla of the Rosaceae family, extends in Africa from the Guineo -Congolese region to the Sudano-Zambezian region, especially in the coastal savannahs of Senegal, Liberia, in the woodland of Southern Mali, Southern Niger and North Nigeria. The species grows on Sudanian and Guinean fringes, on forest and lowland areas and on sandy soils" [3].

"It is a tree that produces fruits locally known as Gamsa, consumed and whose trade brings a substantial income to the local population " [4] and possesses oleaginous properties [5].

"Neocarya macrophylla sabine is a woody species for food use that is purely West African [6]. As well as its highly prized fruit, its leaves and bark are used medicinally as an antiodontal agent to relieve respiratory problems, diabetes and high blood pressure, and to relieve eye inflammation" [6, 7]. Its seeds and oil also have antioxidant properties [8, 9].

Our bibliographic sources indicate that, despite a number of chemical and pharmacological investigations into *N. macrophylla*, no comprehensive study has been done on the plant's components and pharmacological characteristics. Therefore, the aim of this study was to investigate the chemical components and pharmacological activity of *N. macrophylla* by a literature search in the databases Scifinder, Elsevier, PubMed, Google Scholar, ScienceDomain and ScienceDirect.

2. DESCRIPTION AND USES

2.1 Common Names

French: Pommier du Cayor
English: Gingerbread plum
Wolof: Néw in, Néoudi in
Pulaar: Newdi
Hausa: Gawasa or Farar rura
Fulfulde: Naawdi
Synonym: *Parinari macrophylla* Sabine

2.2 Plant Taxonomy

According to Yusuf *et al.,* 2021, *Neocarya macrophylla* belongs to the Chrysobalanaceae family [10]. Here is the systematic classification of this species.

Kingdom: Plantae
Clade: Angiosperms
Clade: Eudicotyledons
Clade: Rosaceae
Order: Malpighiales
Family: Chrysobalanaceae
Genus: *Neocarya*
Species: *Neocarya macrophylla*

2.3 Morphology

N. macrophylla is a tiny tree or shrub that can reach a height of 6 to 10 meters (Fig. 1). It typically has an open crown and a bole with small, twisted branches [11]. The fruit (Fig. 2) has a hard stone imbedded in a thick pulp and is ellipsoid, glabrous, yellowish-brown, and has grey warts on its surface. It is 4 to 5 cm in length and 2.5 to 3.5 cm in diameter. The thick, brittle bark has red and blackish slashes and is rough or fissured. The russet-brown stems are heavily pubescent. Stipules on the plant are linear and located in the leaf axils.

The alternating, elliptic or ovate leaves (Fig. 3) are coriaceous and downy underneath, measuring 10 to 25 cm in length and 5 to 15 cm in diameter. There is a blade with a cordate or rounded base and a rounded, occasionally acuminate, apex [12]. "*N. macrophylla* nerves have 13–20 pairs of conspicuous lateral nerves that fuse close to the apex. They are pinnate, midrib brown, and downy on both surfaces. The thick, brown, tomentose petiole is 3–7 mm long and has two tiny glands at the top that can reach a length of 30 cm. Except for the five white to pink petals, which range in diameter from 12 to 20 mm, the flowers are tomentose" [11, 12].

2.4 Distribution and Habitat

In the lowlands of Guinea and Sudan, NM grows on sandy soils in fringe forests and forest edges. Additionally, the trees can be found growing in arid and semiarid areas of Central America and western Africa [13]. The plant is found in coastal savannahs from Senegal to Liberia, as well as in wooded savannahs in southern Mali, Niger, and northern Nigeria [13].

2.5 Traditional Uses

Additionally, the nuts are eaten as snacks or added to food, and occasionally some are processed to produce cooking oil [14, 15]. Strong fruit juices are made from the fruits by making aromatic syrups [13]. The fruits are a common delicacy in northern Nigeria, Senegal, and Sierra Leone, where they are offered for sale in local marketplaces. The rind of the fresh fruits is used to give ointments a nice aroma, while the flesh of the fruits is soft and yellowish when fresh and has a unique flavour [16]. The stem bark is used to treat snake bites [15], cancer, respiratory issues [2], discomfort, dental decay, and conjunctivitis. Additionally, the leaves are chewed and administered topically to alleviate discomfort [13, 15]. Burning gingerbread plum trees and inhaling the smoke as a treatment for snakebite in Senegal [17]. " The roots are used to treat wounds and circumcision, as well as as antivenom and haemostatic agents " [11]. The fruit is used to treat diarrhoea in Nigerian traditional medicine, and the seeds are employed as anthelminthic and purgative agents [5, 11]. "The fruits of *N. macrophylla* are used as soap, ointments, and vermifuges. They are also occasionally planted, let to grow, or preferred in fields. The fruits of *N. macrophylla* have a variety of magico-religious purposes, including talismans, spells, and sacerdotal ornaments. Additionally, *N. macrophylla* roots are believed to ward off demons and curses. The plant's firm brown wood is used to make charcoal, fuel, pirogues, and buildings" [11]. The tree is used by the locals as fuel, termite repellents (in the Gambia), dye, glue, soap, feed, and construction materials [16]. It is possible to make soap from the seed oil of gingerbread plums [18].

2.6 Phytochemistry

"Many investigations have been conducted on the chemical makeup of *N. macrophylla*. Every plant part has been examined. phytochemical analysis of *N. macrophylla* leaf, root, stem, bark, and gall extracts revealed the presence of free fatty acid (0.18 and 0.20%), acid value (0.35 and 0.39 mgKOHg-1), peroxide value (34.65 and 48.87 mgO2.kg^{-1}), iodine value (31.08 and 34.59 gI2.100g-1) and saponification value (157.18 and 168.48 mgKOHg^{-1}) [19]; the oil contained α-tocopherol (88.39 and 54.29%), β-tocopherol (3.17 and 34.49%) and δ-tocopherol (8.44 and 11.22%)" [19]. *N. macrophylla* seed cake have been reported to have moisture content (12.32 %), ash content (6.53%), carbohydrate content (13.19%), crude protein (56.04), crude fat (4.51%), crude fibre (7.41%), dry matter (87.68%) and calorific energy value of 317.48 kcal/100g [20].

Niger and Guinean gingerbread plum kernel oil had monounsaturated (51.41 and 49.47%), polyunsaturated (33.06 and 35.29%), and saturated (15.57 and 15.29%) fatty acids. [16]. In a different investigation, the Niger and Guinean kernels had α-tocopherol, β-tocopherol, and δ-tocopherol in addition to saturated fatty acids (15.90 and 17.18%), monounsaturated (48.31 and 42.51%), and polyunsaturated fatty acids (35.08 and 40.40%) [21]. A bright yellow gingerbread plum seed oil had the following values: iodine (32.07 I2/100g), saponification (153.30), peroxide (meq H_2O_2) of 45.48, free fatty acid (15.10% oleic), and acid value (12.97 mg KOH/g) [18]. Additionally, the oil had 40% oleic acid, 31% eleostearic acid, 15% linoleic acid, 12% palmitic acid, and 2% stearic acid in addition to sterol A and B [22]. " The flour and paste of gingerbread plums from Niger and Guinea were also found to contain essential amino acids (like histidine, threonine, valine, methionine, phenylalanine, isoleucine, leucine, and tryptophan) and nonessential amino acids (like tyrosine, cysteines, aspartic acid, glutamic acid, serine, glycine, arginine, alanine, and proline)" [21].

Fig. 1. *N. macrophylla* tree

Fig. 2. *N. macrophylla* fruit

Fig. 3. *N. macrophylla* Leaves

"In terms of mineral elements, the paste and flour of gingerbread plum were shown to predominantly contain calcium, phosphorus, magnesium, sodium, potassium, iron, copper, zinc and manganese, which varied between locations" [23]. "Gingerbread plum seed had a good solubility profile between pH 4 and pH 10, with an amino acid score of 65.53% and a protein efficiency ratio of 2.35%. It measured 145 mL/100 mL and 110 mL/100 mL for forming capacity and stability, and 3.01 and 3.12 g/g for water holding capacity" [24]. "Its bulk density was 0.30 g/mL and its emulsifying capacity was 29% [24]. It has been demonstrated that, in addition to proteins, lipids, vitamin C, and other mineral ingredients, the pulp of N. macrophylla contains about 60% water" [25]. The bioactive constituents of the plant which contribute to its pharmacological or therapeutic actions are mainly steroids, flavonoids and glycosides (Fig. 4). Other active compounds have been identified, such as chlorogenic acid, hyperoside, procyanidin B2 and other procyanidins [6].

The majority of Nm is made up of simple or dimeric polyphenolic compounds of the flavanol class. According to Cook *et al.,* [26], the plant contains a flavonoid glycoside. While quercetin [27] was recovered from the leaves of Nm, bis-(5, 7-diacetyl-catechin-4'-α rhamnopyranoside) [15], epicatechin [28], (+)-catechin-3-O-rhamnopyranoside [29], and catechin [30] were extracted from the ethylacetate soluble fraction of the plant's methanol stem bark extract. The root bark of the plant has been reported to contain tannins, flavonoids, steroids, alkaloids, cardiac glycosides and anthraquinones [4]. The ethanol leaf extract of *N. macrophylla* indicated the presence of flavonoids, steroids, palmitoleic acid, alpha tocopherol, beta tocopherol, tannins and glycosides [31]. The methanol stem bark extract of *N. macrophylla* was found to include carbohydrates, alkaloids, flavonoids, anthraquinones, tannins, saponins, glycosides, steroids, and triterpenes [32].

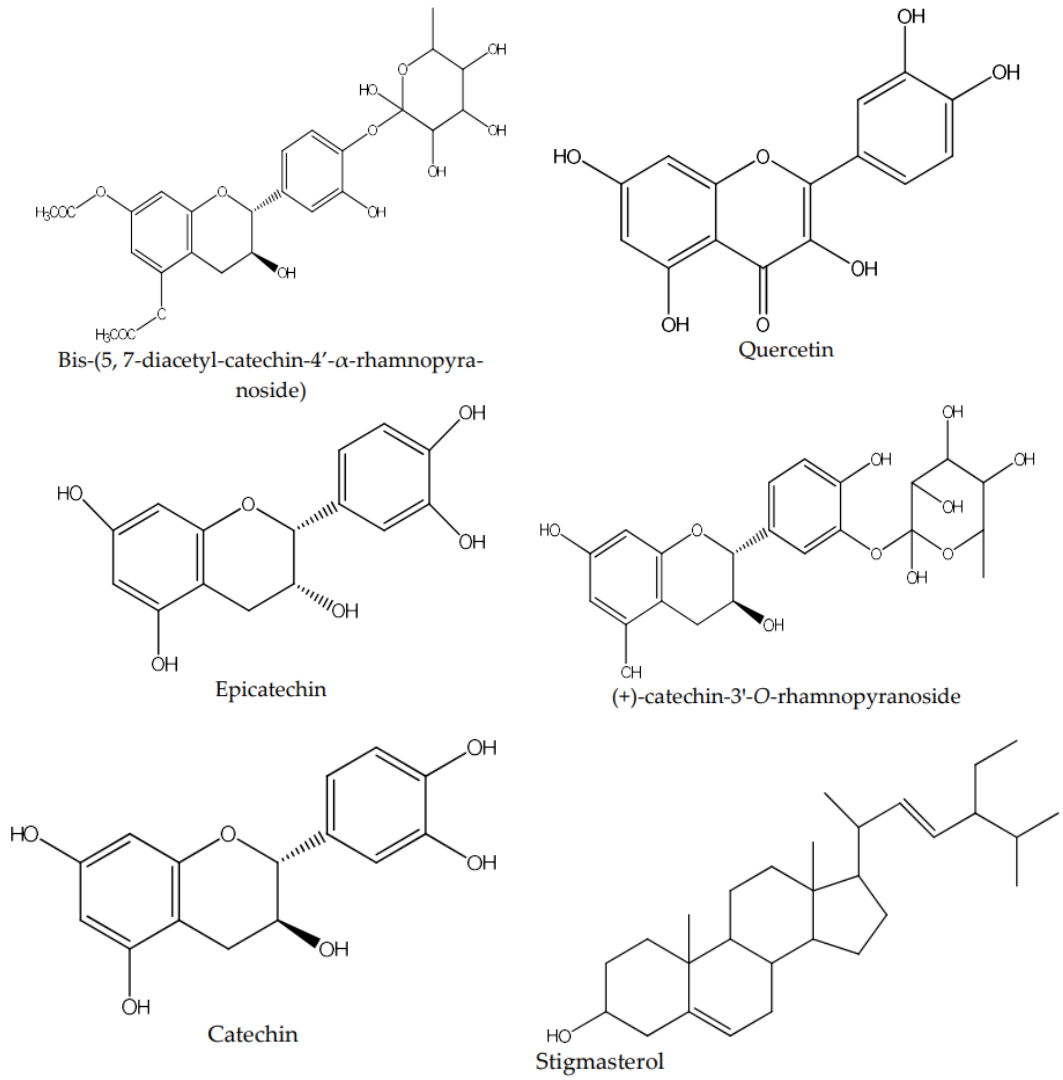

Fig. 4. Chemical constituents of *N. macrophylla*

"Fatty acids including myristic acid, palmitic acid, stearic acid, palmitoleic acid, elaidic acid, oleic acid, erucic acid, behenic acid, hemeicosanoic, icosatetraenoate, and eicosatrienoic acid were found in gingerbread plum seed oil [33]. Fatty acid profiling identified oleic acid as the predominant monounsaturated fatty acid (42.46%), while linoleic and arachidonic acids constituted the main polyunsaturated fatty acids (35.08%)" [34].

2.7 Pharmacological Properties

2.7.1 Analgesic and anti-inflammatory activity

The extract showed analgesic effect by significantly reducing the number of abdominal constrictions induced by acetic acid [35]. (+)-catechin-3'-O-rhamnopyranoside from Nm stem bark was also able to diminish the nociceptive response induced by formalin, which suggests that it possesses a central acting analgesic effect with shorter onset and duration of action [35]. Furthermore, in both phase 1 and phase 2, catechin from the stem bark of *N. macrophylla* significantly ($p<0.05$) decreased the nociceptive response induced by formalin. Additionally, there was a notable inhibition of formalin-induced inflammation at the first, second, and third hours, although the effect was not statistically significant when compared to the control [30].

2.7.2 Antivenom activity

Significant antivenom action against the venom of *Naja nigricollis* has been shown by Nm stem bark [36]. In a different study, mice with 100% protection against venom-induced death

demonstrated remarkable antivenom action against N. nigricollis venom when given (+)-catechin-3~O-rhamnopyranoside from the stem bark of Nm.

“The methanol leaf extract of *N. macrophylla* and its ethylacetate and n-butanol fractions significantly protected mice against venom-induced lethality, with a 100% survival rate, according to a more recent in vitro study. The extract and its fractions also demonstrated a remarkable inhibition of the poisonous effects of PLA2 enzyme” [27].

2.7.3 Antioxidant and anthelminthic activity

“Among several extracts from species from Guinea-Bissauan flora, the hydroethanol extract obtained from the leaves of gingerbread plum (Neocarya macrophylla (Sabine) Prance ex F. White.) revealed to be one of the most cytotoxic towards human gastric AGS carcinoma cells” [36]. Gingerbread plum kernel protein fractions hydrolysates (albumin, globumin and glutelin) had indicated a very good antioxidant effect [22]. The fresh whole gingerbread plum kernels from Niger and Guinea exhibited good DPPH radical scavenging activity and reducing power in a dose–dependent manner [21]. Nm leaf has also demonstrated moderate anthelminthic activity with slow recovery weight [37].

2.7.4 Antidiabetic activity

The determination of the minimum effective dose reveals that 120mg/kg of Ethyl acetate fraction of Nm reduced the blood glucose by 28.9% after 4 hours. In addition, ethyl acetate fraction (120 mg/kg) possessed the most hypoglycemic activity compared to the other fractions of Nm. The Ethyl acetate fraction of Nm at 120mg/kg significantly reduced fasting blood glucose levels compared to the diabetic control($p=0.001$) and slightly decreased BMI [38].

2.7.5 Toxicity

An acute toxicity study was carried out to ascertain the median lethal dose of the plant's methanol stem bark extract because *N. macrophylla* is widely used in traditional medicine. In mice, the extract's intraperitoneal LD50 was 283 mg/kg, indicating that it was hazardous [35]. Acute toxicity study was carried out to determine the LD50 of Chlorogorm Fraction and it was estimated to be 565 mg/kg using Lorke’s method and The intraperitoneal LD50 of chloroform fraction of *N. macrophylla* was determined to be toxic and *N. macrophylla* [39]. The experimental animals fed Nm seed cake showed no discernible changes in their haematological or biochemical markers [20]. The acute and sub-chronic toxicological effects of diets enriched with Nm seed cake on albino rats were documented by Ajayi et al., [40]. Ibrahim et al., [41] reported that the aqueous stem bark extract of the plant indicated no mortality after treatment suggesting an LD50 value above 5000 mg/kg. After reporting on the short-term toxicological effects of Nm seed oil, Aboubacar et al., [42] came to the conclusion that moderate amounts of the oil are safe for human ingestion.

“Acute toxicity studies conducted on the extracts of the different parts of N. macrophylla indicated that the plant extracts are toxic. Effect of administration of the plant orally is yet to be validated scientifically. N. macrophylla is renowned for its various uses as medicine, food and cosmetics, yet its consumption raises concerns due to its toxicity. Compounds, such as phytates, oxalates, tannins, and alkaloids, can hinder nutrient absorption and pose potential health risks” [43].

3. CONCLUSION

The aim of this study was to examine published scientific reports on the pharmacological characteristics and chemical compositions of *N. macrophylla*. Numerous chemical families have been found, according to studies. It has been shown that this plant's extracts and the pure compounds that are isolated from it have a variety of pharmacological activities. Therefore, this study may serve as a valuable reference for the valuation of *N. macrophylla* in the pharmaceutical industry. Several studies focused on the phytochemical contents and some aspects of the ethnomedical claim that the plant can be used for treating microbiological infections, snakebite, pain, and inflammation, among other conditions. Various authors have come to the conclusion that the existence of the secondary metabolites found in the plant may be responsible for the majority of the pharmacological activities of the plant. However, these studies will be increased by the isolation and characterisation of these plant-based bioactive components

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models

(ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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