

CHAPTER 7

A tree of Krishna (*Neolamarckia cadamba*): ethnomedicinally, culturally, and pharmacologically important species

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Abstract: *Neolamarckia cadamba*, a revered tree species known as Kadamba or Kadam, boasts significant cultural, medicinal, and pharmacological importance. Its diverse bioactive compounds confer anti-inflammatory, antimicrobial, and antioxidant properties, rendering it a valuable resource in traditional medicine. The utilization of its bark, leaves, and flowers in ethnomedicinal practices underscores its therapeutic potential. This chapter provides a comprehensive overview of *N. cadamba*'s phytochemical profile and pharmacological mechanisms, aiming to inform the development of novel therapeutic agents and guide future research endeavours.

Keywords: Traditional knowledge, medicinal, cultural, ecological significance

INTRODUCTION

The botanical name of this species has been the subject of a long-term taxonomic debate beginning in the 1930. The problem arose in the year 1785, by Jean-Baptiste Lamarck described a specimen under the name *Cephalanthus chinensis*. Later, in 1984, Jean Marie Bosser created the new generic name *Neolamarckia*, honouring Lamarck, for the Asian genus which matched Richard's description of his *Anthocephalus*, transferring *Nauclea cadamba* as *Neolamarckia cadamba* (Razafimandimbison, 2002). Through a tentative taxonomic revision, it shifts from *Anthocephalus* to *Neolamarckia*, which occur as scientists gain deeper

understanding of plant relationships through ongoing research. The botanical naming of this species has been a subject of discussion. This is common in taxonomy, as science evolves. The core of the issue lies in the interpretation of historical plant specimens and application of the rules of botanical nomenclature. As botanical classification advances, particularly with the aid of modern techniques like genetic analysis, scientists determined that the genus *Anthocephalus* as previously revised by taxonomist (**Razafimandimbison, 2002; Nair et al., 2022; Zhang et al., 2023**). *Neolamarckia cadamba* (Roxb.) Bosser, is an evergreen deciduous and fast-growing tree species belongs to the *Neolamarckia* genus of the Rubiaceae family. It is commonly known as “Burflower-tree” as “Kadamba” in Sanskrit and as “Kodom” in Bengali (**Kumar, 2024**). It is widely distribution in Andaman Island, Bangladesh, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, India, Jawa, Laos, Lesser Sunda Island, Malaya, Myanmar, Nepal, New Guinea, Nicobar Islands, Sri Lanka, Sulawesi, Sumatera, Thailand, and Vietnam (**POWO, 2025**). In India’s sub- Himalayan region, stretching from one side to Nepal, another side to West Bengal and Assam, northern and south-eastern regions of India like Bihar, Chhattisgarh, Madhya Pradesh, and Andhra Pradesh, Karnataka, Uttarakhand, and Kerala (**Dwevedi et al., 2015; Singh et al., 2023**). It is mostly found in dry to moist areas specifically riverbanks, swampy, permanently flooded and periodically flooded areas. In Hindu mythology, the Kadamba tree is believed to the Lord Krishna’s favourite tree. It is often depicted in association with his playful activities. It holds a sacred place in various cultural and religious ceremonies (**Mondal et al., 2020**). It has a wide range of biological and pharmacological activities. It contains cadambine alkaloids, leaves contain alkaloids, tannins, steroids, saponins, and glycosides (**Nie et al., 2022**). Fruit peel of *N. cadamba* contains bioactive compounds due to the presence of steroids, phenolics, tannins, flavonoids, triterpenoids, glycosides, carotenoids, ellagitannins, anthocyanins, vitamin C, and essential oil. The kadam fruit has higher quantities of magnesium, zinc, calcium, essential minerals, and iron. Fruit peel contains compound such as sucrose, citric acid, quinic acid, pinitol, catechine, pcicose, glucose, chlorogenic acid, myo-inositol, and altrose (**Selvakumar et al., 2022**). Quinic acid shows astringent activity. Pinitol is an insulin mimicker with proven activities such as anti-diabetic, anti-inflammation, antioxidant, and immunomodulatory properties. The polyphenol compounds catechins and chlorogenic acid including antioxidant, UV-radiation, anti-allergenic, antiviral, hepatoprotective, cardioprotective, anti-inflammatory, anti-pyretic, anti-obesity, anti-microbial, anti-cancer, anti-hypertension, and central neural system stimulator activities. Yo-inositol is present in fruit includes depression, obsessive-compulsive disorder, and polycystic ovary syndrome. D-

psicose is a rare sugar it controls obesity, Alzheimer's disease, diabetic neuropathy and hyperglycemia (Mondal et al., 2009; Selvakumar et al., 2022). Kader et al., (2022) reported many phytoconstituents such as cadamine, quinovic acid, cadambine, cadambagenic acid, α -dihydrocadambine, isodihydrocadambine, β -sitosterol, amygdalin, phelasin, ursolic acid, linalool, and geraniol that belong to alkaloids, coumarins, terpenoids, diterpenoids, triterpenes glycosides, sterols, flavonoids, amides, and fatty acids (Singh et al., 2023). Fruit contains rich source of essential oil, linalool, geraniol, curcumene, terpinolene, camphene and myrcene (Batta and Rajput, 2021). It is used to cure many ailments such as diarrhoea, inflammation, haemoptysis, coughing, vomit, sores, ulcers, and debility (Singh et al., 2023). Bark of this plant reported to possess tonic, astringent, febrifugal, inflammation, digestive problem, diuretic, and fever. Leaves are used to treat ulcers, wounds, diabetes, and menorrhea (Verma et al., 2018). In Ganjam district, the tribal mostly use the root paste duly for antimicrobial and anthelmintic activities (Zayed et al., 2014). It plays a vital role in ecological significance as its dense foliage provides habitat and food for various species of birds, insects, and other wildlife. The flower attracts pollinators such as bees, butterflies, and beetles contributing to the biodiversity (Yadav et al., 2022). It is broadly an excellent characteristic of the fibre, nutritive, it is utilized for the wood industry and traditional medicine. It provides an ideal raw material of paper, pulp, fibreboard and plywood, etc., and is considered as an excellent source for biomass production (Zhang et al., 2023). Flowers of *N. cadamba* is extracted for preparing essential oil and are utilized in the preparation of 'attar' (Indian perfumes) (Verma et al., 2018; Batta and Rajput, 2021). Research is going to validate its traditional uses and explore its pharmacological potential.

METHODOLOGY

The survey was carried out based on field and literature surveys. The field survey was carried out in 2022-2024 in selected areas (Figure 1). A systematic semi-structured questionnaire was carried out in tribal communities. The data presented in the current chapter is accumulated from various electronic catalogues like PubMed, Scopus, Science Direct and Web of Science, Goggle scholar and library searches of journals and books. The plant list was done based on International Plant Name Index and Kew Botanical Garden Plant name databases. Relevant articles and books published were selected and reviewed (Saxena and Brahmam, 1995; Verma et al., 2018; Batta and Rajput, 2021; Kumar, 2024).

MORPHOLOGY

It is a large deciduous tree with spreading sub-whorled branches; bark smooth, dark grey. The bark is grey, smooth in young trees, rough and longitudinally fissured in old trees. Leaves elliptic-oblong or ovate, 12-28 x 10-15 cm, entire, acute or shortly acuminate, glabrous or pubescent beneath, secondary nerves 7-13, strong, base sometimes subcordate or sometimes suddenly cuneate on the petiole; petiole 2.6-7 cm; stipules 1.2- 1.6 cm. Head globose, 5-7 cm diam.; peduncle stout, 1.2- 4 cm. Flowers small orange- coloured, fragrant. Sepals erect, narrowly oblanceolate, 3 mm long. Corolla 7.4 mm long. Stigma white, far exserted. Pseudocarp large, fleshy, orange (**Saxena and Brahmam, 1995; Figures 2-3**).



Figure 1: Information collected from local communities

ETHNOMEDICINAL USES

N. cadamba is a promising species within the Rubiaceae family, characterized by its distinctive medicinal values (**Singh et al., 2023**). Various plant parts of *N. cadamba* is used to treat fever, uterine complaints, blood diseases, skin disorders, tumour, anaemia, eye inflammatory, antipyretic, diuretic, and laxative (**Pandey and Negi, 2016; Nayak and Kumar, 2023; Kumar et al., 2022**). In 2022, Singh et al., reported ethnomedicinal uses of *N. cadamba* of different plant parts in different areas of India. In Table 1, it concluded that mostly bark, leaves, fruit, and flower followed by root and stem are used in the treatment of various ailments such as diarrhoea, mouth ulcers, nausea, vomiting, fever, wounds, diabetes, urinary tract infection, anaemia, and menorrhagia.

CULTURAL SIGNIFICANCE

According to ancient literature, this is associated with Lord Krishna in Vrindavana. In Hindu mythology, the Bhagavata Purana narrates how one day, Krishna, addressing his young cowherd friends about the Kadamb Tree in the Vrinda Forest on the bank of River Yamuna, said: “Look at these beautiful trees.



Figure 2: Leaves of *N. cadamba*



Figure 3: Flower of *N. cadamba*

Table 1: Ethnomedicinal uses of *N. cadamba*

Plant parts	Mode of uses	Diseases	Sources
Aerial part	decoction	Irritable dowl syndrome	Verma et al., (2018)
Bark	Decoction	Diarrhoea	Selvakumar et al., (2022)
Bark	Decoction	Mouth ulcers	Kader et al., (2022)
Bark	Powder	Nausea and vomiting	Kader et al., (2022)
Bark	Decoction	Fever	Kader et al., (2022)
Bark	Decoction	Colitis	Kader et al., (2022)
Bark	Decoction	Gum problem	Singh et al., (2023)
Flower	Paste	Black spots and pimples	Verma et al., (2018)
Fruit	Juice	Fever	Kader et al., (2022)

Leaves	Paste	Wounds and pimples	Nie et al., (2022)
Leaves	Decoction	Diabetes	Kaur et al., (2021); Verma et al., (2018); Mondal et al., (2020)
Leaves	Juice	Leucorrhoea	Kader et al., (2022); Mondal et al., (2020)
Leaves	Juice	Menorrhagia	Kader et al., (2022)
Leaves	Juice	Stomach pain	Singh et al., (2022)
Leaves and flower	Paste	Skin diseases	Yadav et al., (2022)
Root	Decoction	Urinary tract infection	Kaur et al., (2021)
Root and bark	Decoction	Snakebite	Dwevedi et al., (2015)
Stem and bark	Dried + decoction	Anaemia, uterine complaints	Mondal et al., (2009)
Stem and bark	Paste	Inflammation	Singh et al., (2022)

They live for the benefit of others. There is not a single part of the tree which is not useful. With their beautiful foliage, fragrant flowers, cool shade, roots, bark, wood, sprouts, fruits they serve” (Nair et al., 2022). In Sanskrit shloka, “*Ayi Jagadamba Mad-Amba Kadamba Vana-Priyavaasini Haasa-Rate*”, that is, Goddess Durga likes to live in the forest of Kadamba trees (Dwevedi et al., 2015).

PHARMACOLOGICAL VALUES

It revealed some major pharmacological activities such as anti-diabetic, antioxidant, antimicrobial, anthelmintic activity, antihepatotoxic effects, antilipidemic, anti-inflammatory, etc. The dried stem and bark reported to possess astringent, mucolytic, analgesic, anti-inflammatory, febrifuge and antiseptic properties (Mondal et al., 2009). In Table 2, it concluded that plants parts of *N. cadamba* possess many pharmacological activities like

antioxidant, and anthelmintic activity. The methanol extract of *N. cadamba* barks showed significant analgesic, anti-inflammatory and antipyretic activity (Kader et al., 2022). Researchers reported the antitumor activity this tree species (Dwevedi et al., 2015).

Table 2: Pharmacological values of *N. cadamba*

Plant parts	Pharmacological values	Sources
Bark	Anthelmintic activity	Kaur et al., (2021)
Bark	Analgesic, anti-inflammatory and antipyretic	Mondal et al., (2009)
Bark	Hepatoprotective activity	Kumar, (2024)
Bark	Antiepileptic effect	Mondal et al., (2022)
Bark and leaf	Antifungal activity	Kader et al., (2022); Dwevedi et al., (2015)
Flower	Antidiarrheal activity	Dwevedi et al., (2015)
Flower	Anti-cancer activity	Kumar, (2024); Pawar and Jadhav, (2023)
Flower	Antihepatotoxic activity	Mondal et al., (2022)
Fruit	Urithiatic activity	Mondal et al., (2022)
Fruit peel	Antioxidant activity	Selvakumar et al., (2022)
Fruits	Antioxidative activity	Nie et al., (2022)
Leaves	Hepatoprotective activity	Mondal et al., (2009)
Leaves	Antifilarial and antimalarial activity	Dwevedi et al., (2015)
Leaves	Antitumor activity	Dwevedi et al., (2015)
Root	Antilipidemic	Kaur et al., (2021)

Root	Hypolipidemic activity	Dwevedi et al., (2015)
Root	Nephrotoxicity	Mondal et al., (2022)
Root	Hypolipidemic activity	Mondal et al., (2022)
Root and bark	Antivenom activity	Dwevedi et al., (2015)
Root and flower	Antidiabetic effects	Acharyya et al., (2010); Nie et al., (2022)
Stem and bark	Antidiabetic	Kader et al., (2022)

Though it reveals the presence of bioactive compounds with diverse pharmacological properties such as in leaves parts, cadamine and indole alkaloids are present which is responsible for DNA topoisomerase IB inhibitory activity (**Kumar et al., 2015**). Bark contains quinovic acid which is responsible for anticancer activity and anti-inflammatory activity (**Dietrich et al., 2014; Dietrich et al., 2015**). Flower contains essential oil such as linalool, geraniol, and geranylacetate linalyl acetate which are responsible for anti-inflammation, analgesic activity and antioxidant activity (**Santos et al., 2022; Figure 4**).

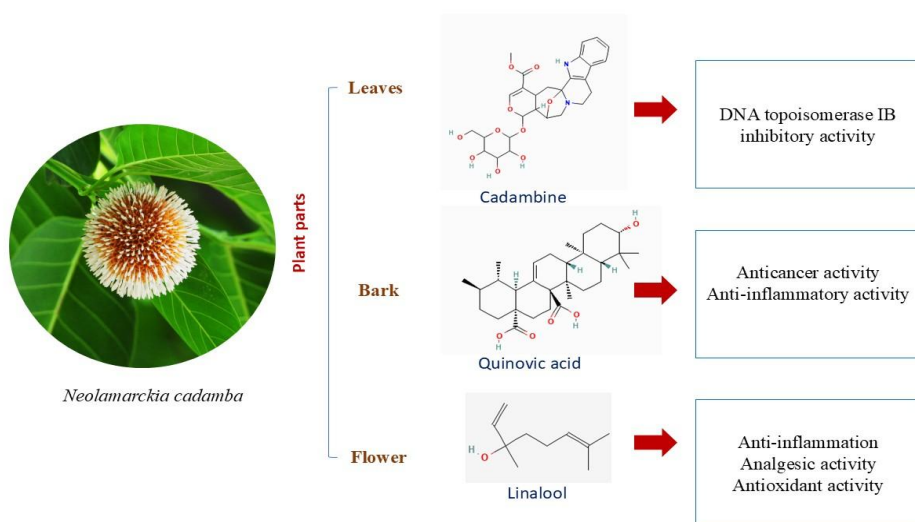


Figure 4: Plants parts of *N. cadamba* and compounds responsible for Pharmacological effects

CONCLUSION

Neolamarckia cadamba, a tree species deeply rooted in cultural and medicinal traditions, offers a wealth of opportunities for further research and development. Its diverse phytochemical profile and promising pharmacological potential underscore its significance in traditional medicine and its potential for modern therapeutic applications. The validation of traditional uses through scientific studies highlights the importance of preserving indigenous knowledge and the potential for discovering new drugs. Future research should focus on isolating and characterizing bioactive compounds, elucidating their mechanisms of action, and exploring their therapeutic potential. Additionally, sustainable cultivation and conservation practices need to be developed to ensure the long-term availability of this valuable resource. By bridging traditional knowledge with modern science, *N. cadamba* could contribute significantly to the development of novel therapeutic agents, thereby improving human health and well-being.

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