

Review Article

Cadamba - Traditional Therapeutic Plant With Versatile Pharmacological Activities

Harshal S. Desale*¹ and Kundan J. Tiwari²

¹S.M.B.T College of Pharmacy, Nashik (Maharashtra) India.

²H.O.D., S.M.B.T Institute of D. Pharmacy, Nashik (Maharashtra) India.

ARTICLE INFO

Article history:
Received: 20/10/2022;
Revised: 05/11/2022;
Accepted: 20/11/2022.

Key Words:
Neolamarckia cadamba,
Anthocephalus cadamba,
Pharmacological activities, Planting technique.

Please cite this article as: Harshal Desale, et al. Cadamba-Traditional Therapeutic Plant With Versatile Pharmacological Activities. 4(5), 125-134.

ABSTRACT

The cadamba tree (*Neolamarckia cadamba* (Roxb.) is important because it contains the most phytochemicals and phytochemicals. Kadamba is one of houseplants with religious significance. This is a Ayurvedic remedy used for medical purposes in his countries such as China, India and Egypt. They are known for their herbal botanical medicinal use in hopeless disorders. Its flowers, roots, bark, leaves, and stems are used therapeutically against a variety of ailments such as diabetes, diarrhea, fever, inflammation, hemophilia, cough, vomiting, wounds, ulcers, weakness, and snake bites. The main components are triterpenes, tri-terpenoid glycosides, flavonoids, saponins, indole-alkaloids, cadamine, isocadambin.

©2023 Published by International Journal of PharmaO₂. This is an open access article.

*Corresponding author: e- mail: harshaldesale2001@gmail.com

INTRODUCTION

Humans have been using medicinal plants for their therapeutic value ever since the first humans emerged from the cave. The connection between nature and humans search for drugs can be traced back to the far past. There's plenty of evidence supporting this, such as preserved monuments, scientific documents, and original plant medicines. The Kadam tree is religiously and culturally highly valued in India to be sacred to Lord Krishna. Radha and Krishna conducted them play with love in sweet-smelling shade of the Kadamba

tree (Mondal *et al.*, 2020). Used to treat various diseases such as fever, leprosy, dysentery, blood and skin. It also has antioxidant, wound-healing and liver-protective properties. *Anthocephalus cadamba* is his remedy in Ayurveda and is mentioned in his literature in India for its pharmacological properties such as his as an antidiarrheal and antidote, analgesic and semen increase. An aqueous extract of *Anthocephalus cadamba* leaves is used in traditional medicine to treat pain, swelling, wounds, and menorrhagia. Bark soup is good for diarrhea, dysentery, and colitis, and bark is good for skin infections (Pathak *et al.*, 2022). It is

known as Kodom in West Bengal, it is grown in different regions of Bangladesh (Ahmed *et al.*, 2011a). It is known as Bakmee in Sinhala and Wild cinchona in English, is popular in India as Kadamb. The fruits and inflorescences are said to be edible by humans. Fresh leaves are fed to cattle. A yellow dye is obtained from the bark of the root. It is also used as low-grade wood and fuel (Don Paul, Weerakoon and Somaratne, 2015). This plant is used in several traditional and folkmedical systems around the world. Indians use the leaf paste orally for indigestion and topically for stomatitis in children. Lodhas boiled crushed leaves to remove subcutaneous inflammatory deposits. Leaves are highly nutritious, astringent and bitter. Their brew is said to have been used to gargle for aphthous. The flowers are used as ripe fruits are fragrant, sour and astringent. Ripe fruit taken as a carminative/chewing agent. The bark is taken orally for coughs, fevers and eye irritation. Dry trunk bark is used for various skin diseases, anemia, uterus. It is also used as a folk medicine (ethnic medicine) in the treatment of disorders and is also used to improve semen quality. Soothes eye irritation. At Concan, fresh juice from the bark is applied to the infant's head when the Fontanelle is submerged (Acharyya, Padhy and Dash, 2018). The alkaloids cadamine and iso-cadamine are isolated from Kadamba

Traditional Therapy

Apply a paste of Kadamba leaves to localized pain and swelling wounds and affected regions to relieve pain. A decoction of Kadamba bark is used to clean infected wounds. A decoction of the bark of the plant is used as a gargle to treat stomatitis and gum infections in. A decoction of Kadamba is taken in doses of 30-40 ml to deal with diarrhea and irritable bowel syndrome. Tree bark powder is given with crystal sugar in doses 5-6 g in curing nausea and vomiting. Kadamba fruit juice is given in doses of 40-50 ml in treatment of immoderate sweating, thirst and burning sensations within the body. A decoction of the basis is taken in a dose of 30-40ml to treat urinary tract infections and kidney stones. A decoction of the bark of the tree is taken in dose of 30-40ml to treat fever can be Kadamba bark paste is carried out to blackheads and pimples. The sparkling juice of the leaves is taken in doses of 10-15ml of to deal with fluorescence and heavy menstruation. fresh fruit juices can help enhance milk supply in lactating females. A paste prepared from Kadamba trunk bark and her leaves facilitates treat ache, redness and itching from insect bites. the foundation, fruits, leaves and bark are used for medicinal functions. Externally, Wounds and Swelling may be bandaged with slightly warmed leaves to relieve pain and swelling, and purify to enhance wound recuperation. A leaf brew is also used for this motive bark paste is powerful against conjunctivitis when implemented externally. Internally, the broth crafted

leaf. The fruit also has medicinal properties. The seeds have medicinal "anti-venom" properties. Crush the seeds, dissolve in water, and drink as an "anti-poison" potion. Yellow dye can be obtained from root bark. Heavy leaf shedding can increase the O.C. content of the soil. has no distinct heartwood, making it easy to saw. Therefore, in the Philippines, this tree is called jewel tree, miracle tree. This is a serious concern for conservation. Due to the failure of propagation of *A. cadamba* by traditional methods by seeds and cuttings, the distribution of this sacred tree is very limited, and large-scale production of this tree to maintain it requires micropropagation technology. Restoration and preservation of it is therefore of great importance due to its many medicinal properties. However, in its related species, *A. indica*, regeneration of multiple shoots has been reported. Derivation of somatic embryos from internode segments was reported, but there was no complete plant regeneration and field establishment of zygotic embryos). However, little work has been done up to develop a micropropagation protocol for *A. cadamba* by direct regeneration using apical and nodal explants (Joshi and Mathur, 2015).

from the bark is an effective remedy for diarrhea, dysentery, and colitis. The juice of the bark blended with cumin and sugar suppresses vomiting. Its juice will quench your thirst for excessive heat. Kadamba is an remarkable panacea for lactapitta, edema and cough. A decoction of the basis is useful for urinary troubles which includes dysuria, urolithiasis, and diabetes. Menorrhagia is efficaciously dealt with with fresh juice of leaves or its decoction. Fruit juice enhanced the breast milk supply of her nursing moms and is also powerful as a milk remover. Kadamba improves pores and skin coloration and is consequently effective in pores and skin diseases. skin bark is regularly used for burning and fever. (Abdul Kader *et al.*, 2022).

Uses of Kadamba

Kadamba has advantages in ceiling boards, lighting constructing production, plywood, pencil making, fit rails, flooring, paper pulp wood, packing boxes, toys, clogs, tea chests, carvings, packing containers, etc. Kadamba timber is used for cheaper furniture when well seasoned and handled. The tree is likewise suitable for aesthetic and ornamental purposes and is planted along roadsides. The fruits, leaves and bark of *A. cadamba* have medicinal properties and the seeds have medicinal anti-venom properties. Root bark is also used for herbal Yellow. *A. cadamba* timber have robust deciduous properties of and increase soil natural carbon of. The fruits and inflorescences of *A. cadamba* are eatable, and the fresh leaves are fed to cattle. The smell of orange blossoms attract bees as pollinators. *A. Kadamba* flowers

are also significant material used in Indian perfumes, sandalwood is used as base, and in beekeeping it is a good bee food (Bijalwan, 2014). The dried leaves are used as a folk medicine to treat anemia, uterine problems and improve semen quality, and are said to have astringent, expectorant, analgesic, antipyretic and antiseptic properties. However, few phytochemical and pharmacological or biological test reports on this plant have been published in publications. Chlorogenic acid isolated from leaves has been reported to have hepatoprotective activity and lipid peroxidation in liver microsomes (Verma, Chaudhary and Kumar, 2019). Traditional medicine claims that the roots of this plant contain diuretic properties and protect from urinary tract disorders (Saisruthi and Sreedevi, 2017a). Its bitter and pungent bark is used in Ayurvedic medicine for diseases of uterine, blood disorders, leprosy and dysentery. A decoction of leaf is suggested as a mouthwash for mouth ulcers. Crude extracts of cadamba have shown biologically active. Anti-inflammatory, antihepatotoxic, analgesic, hypoglycaemic, antibacterial and anthelmintic (Chandel *et al.*, 2012). In the traditional Indian system, various parts of *Neolamarckia cadamba* are used for skin diseases, anaemia, stomatitis, dysentery, leprosy, fever, blood diseases, diarrhoea, urological diseases, inflammation of eyes, diuretics and anti-urolithic drugs (Khandelwal *et al.*, 2019).

Traditional healers in Chhattisgarh use Kadam bark to treat hoarseness in the throat. After, the bark is mixed with honey, cold water fruit and cumin (Zeera) and given to patients internally. He is considered one of its most promising treatments. Chhattisgarh natives soak the bark in bath water. They say this herbal bath softens the skin and relieves it of any infections. Traditional healers in the Bastar area use Kadam bark to treat eye ailments. Also used for mouth ulcers. His traditional healer of the Chhattisgarh plains for the same purpose he prefers a decoction of leaf bark. Children's treatment is done by giving fruit juice to treat stomach irritation. A decoction of the leaves is good for wounds and ulcers. The berries are edible. Wood is used to make papers, crates, boxes, and furniture. Its wood is used as fuel (Rp, 2013).

Planting Technique

A. cadamba has been observed to grow best by planting 4- to 5-month-old whole seedlings or plastic bag-grown seedlings in early June and July of the monsoon. Natural seeds collected from jungle (wilderness) in August-September grow to about 30-40 cm tall in soil balls with a success rate of 90-100%. In Assam in, the species was planted in woodlands, but after the central canopy layer of part was completely removed, it became too open for trees to grow. Spacing tests show that the narrowest spacing of 1.83m x 1.83m gives a height of and the widest spacing of 3.66m x 3.66m is the lowest. Distance

also seems to have a direct effect on the survival of plants. Observed survival rates were higher at longer distances and vice versa. Another study recommended that 8.5 m x 8.5 m spacing yields more height above the biomass than either wider spacing or closed spacing. Allowed distance in Arunachal Pradesh is 45m x 4.5m or 5.0m x 5.0m, commonly 2.0m x 2.0m in West Bengal. If herbivore protection is maintained, the tighter spacing can penetrate weeds with little maintenance.

Botanical Characteristics

Leaves shiny simple, green, opposite, less or more stalk less to stalked, ovate to elliptic, measuring 15-50cm x 8-25cm. flower bisexual, 5-lobed, calyx funnel-shaped tube, corolla a-shaped gametophytic disc narrow tube, intertwined narrow lobes bud stamens 5, tube inserted into corolla, filamentous and short lower ovary, two petals, upper part sometimes fan-shaped 4-Style developed, stigma fusiform. Containing numerous carpels and four hollow or contaminated structures on top.

Fruit and Seed Description:

Fruit is a small capsule, Dense, fleshy yellow or orange inflorescence 4 parts containing seeds



Figure: Picture of Cadamba Tree

MICROSCOPY

Leaves simple oblong, unicellular trichomes, Rubiaceae. Stomata on underside of leaves. The phloem formed rings and oil balls that showed presence of grains, calcium oxalate crystals. Characters Hand-crushed *Neolamarckia cadamba* smells of methyl salicylate.

Cortex is composed of thin-walled rectangular cells, phloem filaments, and some cells are composed of prismatic crystals of chlorophyll a calcium oxalate.

Synonyms

- *Neolamarckia cadamba* (Roxb.) Bosser
- *Anthocephalus chinensis* (Lamk.) A. Rich. ex Walp.

- *Sarcocephalus cadamba* (Roxb.) Kurz.
- *Anthocephalus macrophyllus* (Roxb.) Havil.
- *Anthocephalus indicus* A. Rich.
- *Nauclea cadamba* (Roxb.)
- *Anthocephalus morindaefolius* Korth (Kumar *et al.*, 2019).

Description

Neolamarckia cadamba, commonly known as KADAM, is an enduring equatorial tree. His genus name is named after the French naturalist Jean-Baptiste Lamarck. This species is widely, but incorrectly called the *Anthocephalus Chinesis*. It has fragrant orange coloured flowers in globular clusters which are dense. This plant also appears in his Indian religions and myths.

Fully grown Kadam trees can reach heights of to 45 m.

Large tree with straight cylindrical trunk and broad crown.

Fast growing with broad branches, fast growing in the first 6-8 years.

Trunk length is 13-32 cm.

Flowering begins after the plant is 4-5 years old.

The fruit of cadamba is a small, fleshy capsule containing about 8000 seeds that occur densely.

Biology

Birds and other animals help disperse edible fruit. At years old, Kadam can bloom. Flowering begins in Indonesia from April to August and sometimes from March to November, while in India blooms from December to July. Flowers are bisexual.

Ecology

A. cadamba is an early successor species, often found in secondary forests and swamps along river banks, transition zones between areas of permanent and periodic flooding, and in deep moist alluvial areas. grows best.

Religious Significance of Kadamba

The Kadamba tree is associated in with Lord Krishna who usually plays the flute under it. Many of his Leelas (pranks) of Lord Krishna are said to have been performed under the Kadam tree. In Southern India, the Kadamba tree is connected with the goddess Parvati Devi, who is assumed to reside in the Kadam Forest (Kadamba Vanavasini). Therefore, this tree is called "Parvati Tree" here. Worship of trees is said to guarantee wealth and offspring. The flower of is also the sacred flower of Lord Karthikeya. A branch of the tree is dedicated to Lord Shiva in his year. Various religions in India firmly believe that it is of great importance to mankind, is the home of the gods. In Sanskrit Shloka, "Ayi Jagadamba Mad-Amba Kadamba Vana-Priyavaasini Haasa-Rate", means Goddess Durga likes to dwell in Kadamba tree forest (ArulJothi, K *et al.*, 2020).

Pharmacological Activities

Antioxidant Activity

Whole plant extracts (bark, leaves, flowers and fruits) of *A. cadamba* inhibited lipid peroxidation and rapidly increased superoxide dismutase (SOD) and catalase activity, resulting in It has been proclaimed to have high antioxidant activity (Umachigi *et al.*, 2007; Kumar, Khan, *et al.*, 2010). The antioxidant capacity of extracts isolated from *A. cadamba* may act as therapeutic agents in the cure of radical-induced pathological damage (Chandrashekar and Prasanna, 2009). In another study, an extract, a fraction rich in AC-4 and alkaloids, was isolated from bark and leaves of *A. cadamba* using two different isolation methods, and an in vitro assessment of antioxidant Both properties and anti-proliferative properties were evaluated (Fatima *et al.*, 2016). Similarly, hydroethanolic extracts of flower spikes of *A. cadamba* increased DPPH, hydrogen peroxide, nitric oxide scavenging capacity, reducing capacity, total antioxidant capacity, and inhibition of lipid peroxidation (thiobarbituric acid-reactive substance production). And showed significant antioxidant capacity. RBC membrane stabilization assay. In the DPPH assay, the IC₅₀-values of the extract were 146.5 and 24.8 µg/mL in the nitric oxide scavenging assay, while the concentration range of the extract was 0.50–2.0 mg/ml and lysed rat erythrocyte membranes. greatly protected from is induced by hypotonic solutions (Alam, Ghani, *et al.*, 2008). Similarly, methanol extracts of leaf callus and internode callus of this plant also have total phenolic content and positive antioxidant activity of in the DPPH radical scavenger activity assay of Leaf, twig, and callus extracts also demonstrated the potential to protect plasmid DNA (pBR322) from attack by hydroxyl radicals generated by Fenton's reagent (DonPaul, Weerakoon and Somaratne, 2015).

Anti-tumor Activity

Recently, several studies were performed on *A. cadamba* to evaluate its anti-tumor activity. A reported cytotoxicity study with methanolic extracts (200 and 400 mg/kg) of *A. cadamba* leaves was done by the trypan blue assay by inoculating Ehrlich's ascites carcinoma (EAC)-treated mice. the extract showed direct cytotoxicity against the EAC cell line. Its dose-dependently reduced tumor volume, tumor weight, viable cell count, and extended lifespan in EAC tumor-bearing mice (Dolai *et al.*, 2012). Kamal *et al.* showed that leaves of *A. cadamba* possessed moderate cytotoxic activity (Brine Shrimp Lethality Bioassay) of crude methanol extract and lethal concentration value 50 (LC₅₀) of extract was 130.617 ± 0.82 µg. /ml (A. T. M. M. Kamal *et al.*, 2015). Two flavonols namely 6-Hydroxycoumarin-(4→8)-(-)-epicatechin and 6-Hydroxycoumarin-(4→8)-(-)-epicatechin-(4→6)-(-)-epicatechin, separated from the leaves of *A. cadamba*, both compounds exhibited potent antioxidant

and antigenotoxicity, with 50% of 435.71 g/mlIt also showed cytotoxicity with growth inhibition. Both compounds also exhibited moderate cyclooxygenase-2 inhibitory activity (Chandel *et al.*, 2016). Two new monoterpenes, indole-alkaloids (vincosamide N-oxide and isodihydroaminocadumbine), and seven known triterpenoids and alkaloids (valesiacotamine, isovalesiacotamine, vincosamide, dihydrocadumbine, cadambine, ursol acid and oleanolic acid) were isolated. All molecules from *A. cadamba* fruit were evaluated in vitro: antiproliferative activity against human lung cancer cell line H1299, cytotoxicity profile in mouse macrophage cell line RAW 264.7, and cytotoxicity profile in MCF-7 cells. Induction of apoptosis. The compounds vallesiachotamine and isovallesiachotamine were found to have potent anticancer activity with IC₅₀ values of 4.24 and 3.79 μ M, respectively. Both compounds showed significant fragmentation of chromatin within nuclear cells as a result of apoptosis. Furthermore, none of the compounds showed toxic effects on normal cells (Mishra *et al.*, 2018).

Anti-Diabetic Effects

Alcoholic extract from stem of *Neolamarckia cadamba* was reported to have anti-diabetic (hypoglycemia) potential in alloxan (120-150 mg/kg)-induced diabetic rats and may resolve problems associated with this disease, such as fatigue and irritation. Experimental studies proved that 400-500 mg/kg drug extract is effective in treating diabetes because presence of flavonoids or insulin-like that stimulate insulin secretion effect (ku10). Alcoholic and aqueous extracts from the root of *Anthocephalus cadamba* also had antidiabetic activity at a dose of 400 mg/kg body weight and were tested on normoglycemic and alloxan-induced hyperglycemic rats (Ahmed *et al.*, 2011b).

Nephrotoxicity

Ethanol extract from the root of *A. cadamba* plays a potential role in reducing cisplatin-induced nephrotoxicity. The Reno protective ability of extract (200 and 400 mg/kg) was studied in Wistar rats. Extract significantly reduced cisplatin-induced nephrotoxicity. This was confirmed by decreased serum marker levels, lipid peroxidation, total urinary protein, and increased clearance of creatinine. (Saisruthi and Sreedevi, 2017b). At the same time, aqueous extracts of *A. Kadamba* fruit have an antidote and is effective against nephrotoxicity caused by arsenic. Administration of the crude extract (100 mg/kg, po) was observed to reduce the toxic effects of arsenic trioxide on the kidneys of mice (Jyotsana and Komal Lata Nagpal, 2017).

Diuretic and Laxative Effects

Various extracts of bark were tested for diuretic and laxative effects and a methanolic extract of its bark (300

mg/kg) caused a significant increase in urination (diuretic effect) showed (Mondal *et al.*, 2015).

Anthelmintic Activity

Various extracts from *A. cadamba* bark have dose-dependent anthelmintic activity. The efficacy of the test sample was found to be inversely proportional to the time it took the worms to paralyze/death. Activity was compared to the reference drug piperazine citrate. Of the extracts tested, chloroform extract and extract of petroleum ether were found to have strong anthelmintic activity, while methanol extract exhibited moderate activity (Mondal, Ramana and Suresh, 2011). Similarly, aqueous and methanolic extracts of leaves have remarkable anthelmintic properties performed on the adult Indian earthworm *Pheretima posthuman*. One study examined anthelmintic activity using aquarium worms (*Tubifex tubifex*), and the study concluded that *A. cadamba* leaves exhibited moderate and significant anthelmintic activity (A. T. M. Mostafa Kamal *et al.*, 2015). Fresh bark juice also showed significant anthelmintic activity at concentrations of 25, 50, and 100 mg/ml (Md. Asif Hassan *et al.*, 2013).

Antibacterial Activity

Aqueous extracts from *A. cadamba* fruit reported antimicrobial activity against *E. coli*, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Staphylococcus aureus*, *Yersinia enterocolitica* and *Listeria innocua* as a promising antioxidant (Pandey and Negi, 2017). Mishra and Siddiqui reported a very low MIC for a methanol extract from immature fruit, inhibiting the growth of *Staphylococcus aureus* and *Pseudomonas aeruginosa* with a MIC as low as 1.00 mg/mL. Silver nanoparticles synthesized using leaf and fruit extracts were also tested for antibacterial activity using four human pathogens, namely *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus subtilis*. However, the silver nanoparticles prepared using leaf extracts were shown to be dominant. Antibacterial activity rather than fruit extract (Kirtiwar, Gharpure and Balaprasad, 2018).

Lipid-Lowering Activity

From experimental studies conducted by various investigators, it can be analysed that alloxan (150 mg/kg of weight of body) induced a decrease in lipid levels in diabetic rats. Oral administration of *A. cadamba* extract of root (500 mg/kg body weight) for 30 days effectively reduced, phospholipids, triglyceride, total cholesterol and lipid peroxide levels in dyslipidaemia animals (Kumar, Mahdi, *et al.*, 2010). Both the bark and leaves of *Kadamba* are effective in normalizing the symptoms of medroga described in Ayurveda and the abnormal lipid profile specifically prescribed in the modern classics with reference to hyperlipidemia. However, the leaves are clinically effective in medroga, and the leaves are few. More potent than the bark, it is the drug of choice

for the treatment of medoroga (Swetha.Ch and V.Narasimha, 2019).

Gastroprotective Effects

The anti-ulcer activity of aqueous and methanol extracts of Kadamba leaf and bark was studied in both pylorus ligation and aspirin-induced ulcer models. Both extracts at doses of 200, and 400 mg/kg p.o. It resulted in significant suppression of gastric lesions induced by pyloric ligation-induced ulcers and aspirin-induced gastric ulcers. At the same time, the extract also showed a significant decrease in free acid, ulcer index, gastric volume, pH, , total acidity, , and ulcer inhibition rate (Gupta and Ganjewala, 2015).

Geranyl Acetate Esterase Inhibitory Activity

Gupta and Ganjewala reported the unique property of a methanol extract from *A. cadamba* fruit to inhibit lemongrass geranyl acetate esterase (GAE), which is associated with GAE inhibitory activity. It was first report. It has also been that reported vonoids contained in fruit extracts act as suicide agents prior to cholesterol esters and his GAEGupta and Ganjewala, 2015).

Antivenom Activity

A methanolic extract of root bark of Cadamba has been found to be useful as an antidote for snakebites. Used to neutralize *Naja kaouthia* and *Vipera russellii* venom, which can cause haemorrhage, cardiotoxicity, neurotoxicity, defibrination, and inflammation. Pentacyclic triterpenes (free or as glycosides) are very important in providing about 20% protection against snake venom (Lakhmale, Acharya and Yewatkar, 2012).

Immunomodulatory Activity

A. hot aqueous extracts of cadamba leaves have promising immunomodulatory capacity as demonstrated by antibody responses in immunized animals. Increased interleukin-2 expression at both gene and protein levels clearly points to its application in immunocompromised animals (Khandelwal *et al.*, 2018)

Urolithic Activity

A methanolic fruit extract of *A. cadamba* was also reported to have promising urolithic activity in calcium oxalate-induced nephrolithiasis in Wistar albino rats. The extracts (200 and 400 mg/kg, p.o.) were found to be effective in both therapeutic and prophylactic treatment groups. Calcium oxalate crystals are reduced by extract administration, as shown by pizzolato staining and histopathological studies (Prathibhakumari and Prasad, 2018).

Sedative and Antiepileptic Effects

The sedative and antiepileptic effects of ethanolic extracts of cadamba bark have also been reported in various experimental animal models.

extracts at doses of 100, 200, and 400 mg/kg p.o. It also showed a significant increase in tonic swelling, and death time. Induced Seizure Model Alldoses were tested (Nagakannan *et al.*, 2011).

Antifilarial and Antimalarial Activities

Mosquito-borne diseases such as dengue, malaria, , filariasis, chikungunya and Japanese encephalitis kill thousands of people each year in India as well as other countries. Dimethyl sulfoxide extract from Cadamba delays larvicidal action against filamentous vectors at low concentrations with an LC50 of 0.61 ppm (Naresh Kumar *et al.*, 2013).

Antidiarrheal Activity

A hydroethanolic dry extract of the inflorescences of *Anthocephalus cadamba* (200-500 mg/kg) showed a dose-dependent decrease in the frequency of fecal debris in castor oil causing diarrhea in mice. This extract also dose-dependently reduced the accumulation of intestinal juice (Alam, Akter, *et al.*, 2008).

Nanotechnology

A nanoparticle formulation of the chlorophyll-rich bimolecular extract from *A. cadamba*, combined with the near-infrared dye, selectively kills skin cancer cells. Plant extracts are particularly toxic to cells of cancer due to increased formation of reactive species of oxygen, but the dye helps in the destroying of cancer cells by photothermal therapy (Pemmaraju *et al.*, 2018).

Agroforestry

Cadamba is a fast-growing tropical hardwood that is widely used for a variety of purposes. Therefore, a lack of genomic information is available, hampering progress in molecular breeding and genetic improvement in this species. Identified gene Illumina's paired-end sequencing technology (Ouyang *et al.*, 2016). This also helps prevent plants from becoming endangered due to the routine use of traditional methods for collecting plant material and extracting bioactive compounds. Moreover, it holds great promise for the controlled, on-demand production of a myriad of useful bioactive compounds on a continuous and large scale. Similarly, 3β-isodihydrocadumbin was separated from leaves and bark of *A. cadamba*. It is environmentally friendly with Mild Steel Corrosion Inhibitor (Raja *et al.*, 2013).

Phytochemistry

A huge number of plant constituents have been reported from different parts of *Anthocephalus cadamba*, resulting in the separation of different classes of compounds, namely esters from different parts thereof by different chromatographic and spectrophotometric methods was done (ZAYED *et al.*, 2014).

Formulation and Analytical Studies

Anthocephalus cadamba is used in paste form by tribes in Western Ghats to treat skin ailments (Umachigi *et al.*, 2007). Various methods have been earlier developed to analyze its extracts. These methods include HPTLC, TLC, and various spectroscopic methods such as IR, mass, and NMR spectroscopy (Himanshu Gurjar and S. K. Jain, 2010).

Conclusion

The study of medicinal plants has recently received renewed attention. The important reason is that other medical systems have many side effects often lead to serious problems. It's time to examine its medicinal properties in levels. Very few toxicological studies are available. These were reported to possess different pharmacological activities such as, antifilarial, antioxidant, hypolipidemic, antitumor, antipyretic, nephrotoxicity, diuretic, laxative, antidiabetic, antihepatotoxic, analgesic, anti-inflammatory, antimalarial, sedative, antiepileptic, immunomodulatory, nanotechnology, agroforestry, gastroprotective, anthelmintic, wound healing, antimicrobial, GAE inhibition, toxicological studies, and antidote. Various gas chromatography-mass spectrometric studies and solvent extracts revealed a number of chemical compounds and their structures. This review focuses primarily on pharmacological studies that have demonstrated therapeutic potential and chemical constituents of *A. cadamba*.

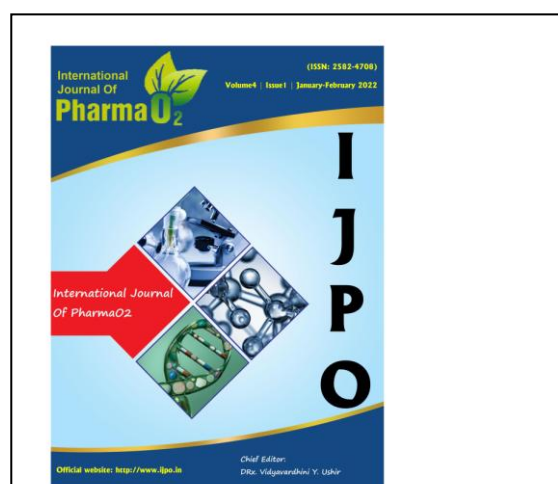
References

1. Abdul Kader, S., Abid Ali Khan, M., Ahamad, N., Singh, S. and Maheshwari, R.K. (2022) 'Phytochemical and Pharmacological Attributes of Astonishing Kadamba Tree (*Neolamarckia cadamba* (Roxb.) Bosser) for Integrated healthcare', 9. Available at: www.jetir.org/g561 (Accessed: 26 August 2022).
2. Acharyya, S., Padhy, R. and Dash, S.K. (2018) 'Pharmacognostic Studies on the Root of *Anthocephalus cadamba* (Roxb.) Miq.', *Pharmacognosy Journal*, 10(5), pp. 973–978. Available at: <https://doi.org/10.5530/pj.2018.5.165>.
3. Ahmed, F., Rahman, S., Ahmed, N., Hossain, M., Biswas, A., Sarkar, S., Banna, H., Khatun, M.A., Chowdhury, M.H. and Rahmatullah, M. (2011a) 'Evaluation of *Neolamarckia cadamba* (Roxb.) Bosser leaf extract on glucose tolerance in glucose-induced hyperglycemic mice', *African journal of traditional, complementary, and alternative medicines: AJTCAM*, 8(1), pp. 79–81. Available at: <https://doi.org/10.4314/AJTCAM.V8I1.60549>.
4. Ahmed, F., Rahman, S., Ahmed, N., Hossain, M., Biswas, A., Sarkar, S., Banna, H., Khatun, M.A., Chowdhury, M.H. and Rahmatullah, M. (2011b) 'Evaluation of *Neolamarckia Cadamba* (Roxb.) Bosser Leaf Extract on Glucose Tolerance in Glucose-Induced Hyperglycemic Mice', *African Journal of Traditional, Complementary, and Alternative Medicines*, 8(1), p. 79. Available at: <https://doi.org/10.4314/AJTCAM.V8I1.60549>.
5. Alam, M.A., Akter, R., Subhan, N., Rahman, M.M., Majumder, M.M., Nahar, L. and Sarker, S.D. (2008) 'Antidiarrhoeal property of the hydroethanolic extract of the flowering tops of *Anthocephalus cadamba*', *Revista Brasileira de Farmacognosia*, 18(2), pp. 155–159. Available at: <https://doi.org/10.1590/S0102-695X2008000200002>.
6. Alam, M.A., Ghani, A., Subhan, N., Rahman, M.M., Haque, M.S., Majumder, M.M., Majumder, M.E.H., Akter, R.A., Nahar, L. and Sarker, S.D. (2008) 'Antioxidant and Membrane Stabilizing Properties of the Flowering Tops of *Anthocephalus Cadamba*', <https://doi.org/10.1177/1934578X0800300114>, 3(1), pp. 65–70. Available at: <https://doi.org/10.1177/1934578X0800300114>.
7. ArulJothi, K. N., Irusappan, S., Amarnath, G., Chandrasekaran, S., K. S.A.B., Harishankar, M., Babu, J. v and A, D. (2020) 'A LITERARY REVIEW ON KADAMBA (ANTHOCEPHALUS KADAMBA)- AN AYURVEDIC HERB', *IJSR - International Journal of Scientific Research*, Volume 9 Issue 7(2), pp. 63–65. Available at: <https://doi.org/10.36106/IJSR>.
8. Ashish Kumar Gupta and Deepak Ganjewala (2015) (PDF) *Geranyl acetate esterase (GAE) inhibitory activity of *Neolamarckia cadamba* fruit extract*. Available at: https://www.researchgate.net/publication/282375918_Geranyl_acetate_esterase_GAE_inhibitory_activity_of_Neolamarckia_cadamba_fruit_extract (Accessed: 1 November 2022).
9. Bijalwan, A. (2014) 'A Potential Fast Growing Tree for Agroforestry and Carbon Sequestration in India: *Anthocephalus cadamba* (Roxb.) Miq.', *American Journal of Agriculture and Forestry*, 2(6), p. 296. Available at: <https://doi.org/10.11648/J.AJAF.20140206.21>.
10. Chandel, M., Kumar, M., Sharma, U., Kumar, N., Singh, B. and Kaur, S. (2016) 'Isolation and characterization of flavanols from *Anthocephalus cadamba* and evaluation of their antioxidant, antigenotoxic, cytotoxic and COX-2 inhibitory activities', *Revista Brasileira de Farmacognosia*, 26(4), pp. 474–483. Available at: <https://doi.org/10.1016/J.BJP.2016.02.007>.
11. Chandel, M., Sharma, U., Kumar, N., Singh, B. and Kaur, S. (2012) 'Antioxidant activity and identification of bioactive compounds from leaves of *Anthocephalus cadamba* by ultra-performance liquid chromatography/electrospray ionization quadrupole time of flight mass spectrometry Asian

- Pacific Journal of Tropical Medicine', *Asian Pacific Journal of Tropical Medicine*, pp. 977–985. Available at: www.elsevier.com/locate/apjtm (Accessed: 26 August 2022).
12. Chandrashekar, K.S. and Prasanna, K.S. (2009) 'Antimicrobial activity of *Anthocephalus cadamba* Linn', *Journal of Chemical and Pharmaceutical Research*, 1(1), pp. 268–270. Available at: www.jocpr.com (Accessed: 26 August 2022).
 13. Dolai, N., Karmakar, I., Suresh Kumar, R.B., Kar, B., Bala, A. and Haldar, P.K. (2012) 'Evaluation of antitumor activity and in vivo antioxidant status of *Anthocephalus cadamba* on Ehrlich ascites carcinoma treated mice', *Journal of Ethnopharmacology*, 142(3), pp. 865–870. Available at: <https://doi.org/10.1016/J.JEP.2012.05.050>.
 14. DonPaul, A.M., Weerakoon, S. and Somaratne, S. (2015) 'ANTIMICROBIAL AND ANTIOXIDANT PROPERTIES OF LEAF, TWIG AND CALLI EXTRACTS OF *Neolamarckia cadamba* (Roxb.)'.
15. Fatima, N., Ahmad, M.K., Ansari, J.A., Khan, H.J., Rastogi, N., Srivastava, S.K., Ahmad, S. and Ali, Z. (2016) 'Antiproliferative and Antioxidant Studies of *Anthocephalus cadamba* Rox. Miq. Bark', *Indian Journal of Pharmaceutical Sciences*, 78(4), pp. 525–531. Available at: <https://doi.org/10.4172/PHARMACEUTICAL-SCIENCES.1000147>.
 16. Himanshu Gurjar and S. K. Jain (2010) *PHYTOCHEMICAL SCREENING ON THE STEM BARK OF ANTHOCEPHALUS CADAMBA (ROXB.) MIQ. | INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH*. Available at: <https://ijpsr.com/bft-article/phytochemical-screening-on-the-stem-bark-of-anthocephalus-cadamba-rox-b-miq/> (Accessed: 1 November 2022).
 17. Joshi, A. and Mathur, N. (2015) 'Online) An Open Access', *Online International Journal Available at*, 4(3), pp. 8–18. Available at: <http://www.cibtech.org/cjb.htm> (Accessed: 26 August 2022).
 18. Jyotsana and Komal Lata Nagpal (2017) *Restorative Effect of Cadamba Fruit Extract on Arsenic-Induced Nephrotoxicity In Albino Mice - Ignited Minds Journals*. Available at: <http://ignited.in/p/57393> (Accessed: 1 November 2022).
 19. Kamal, A. T. M. Mostafa, Chowdhury, K.A.A., Rana, Md.M., Islam, A., Khan, E.A., Haque, Md.A., . A. and Chy, Md.M.H. (2015) 'Study of Cytotoxic, Thrombolytic and Anthelmintic Activity of Extract of *Neolamarckia cadamba* (Roxb.) Leave', *European Journal of Medicinal Plants*, 10(2), pp. 1–9. Available at: <https://doi.org/10.9734/EJMP/2015/17121>.
 20. Kamal, A. T. M. M., Chowdhury, K.A.A., Rana, M.M., Islam, A., Khan, E.A., Haque, Md.A., Anaytulla and Chy, M.M.H. (2015) 'Study of cytotoxic, thrombolytic and anthelmintic activity of extract of *Neolamarckia cadamba* (Roxb.) leave.', *European Journal of Medicinal Plants*, 10(2).
 21. Khandelwal, V., Choudhary, K., Goel, A., Bhatia, A.K., Gururaj, K., Gupta, S. and Singh, S. v (2018) 'Immunomodulatory activity of *Neolamarckia cadamba* (Roxb.) Bosser with reference to IL-2 induction', *Indian Journal of Traditional Knowledge*, 17(3), pp. 451–459.
 22. Khandelwal, V., Choudhary, P.K., Goel, A., Bhatia, A.K., Pant, G., Chaubey, K.K., Gupta, S., Shoor, & and Singh, V. (2019) 'Cytokines modulating potential of *Neolamarckia cadamba* (Roxb.) Bosser', *Indian Journal of Traditional Knowledge*, 18(1), pp. 88–93.
 23. Kirtiwari, S., Gharpure, S. and Balaprasad, A. (2018) 'Effect of Nutrient Media on Antibacterial Activity of Silver Nanoparticles Synthesized Using *Neolamarckia cadamba*', *Journal of Nanoscience and Nanotechnology*, 19(4), pp. 1923–1933. Available at: <https://doi.org/10.1166/JNN.2019.16117>.
 24. Kumar Bussa, S. (2010) 'ANTIDIABETIC ACTIVITY OF STEM BARK OF NEOLAMARCKIA CADAMBA IN ALLOXAN INDUCED DIABETIC RATS', *International Journal Of Pharmacy & Technology IJPT*, 2(2), pp. 314–324. Available at: www.ijptonline.com (Accessed: 28 August 2022).
 25. Kumar, N., Ram, A., Kumar Handa, A., Shukla, A., Kumar, D., Dev, I. and Chand, L. (2019) 'Allelopathic impact of *Anthocephalus cadamba* (Roxb.) Miq. and *Melia dubia* Cav. on *Triticum aestivum* L.: Bioassay study', ~ 1265 ~ *Journal of Pharmacognosy and Phytochemistry*, 8(1).
 26. Kumar, V., Khan, M.M., Khanna, A.K., Singh, R., Singh, S., Chander, R., Mahdi, F., Mahdi, A.A., Saxena, J.K. and Singh, R.K. (2010) 'Lipid lowering activity of *anthocephalus indicus* root in hyperlipidemic rats', *Evidence-based Complementary and Alternative Medicine*, 7(3), pp. 317–322. Available at: <https://doi.org/10.1093/ECAM/NEN001>.
 27. Kumar, V., Mahdi, F., Chander, R., Singh, R., Mahdi, A.A., Khanna, A.K., Bhatt, S., Singh Kushwaha, R., Jawad, K., Saxena, J.K. and Singh, R.K. (2010) 'Hypolipidemic and antioxidant activity of *Anthocephalus indicus* (Kadam) root extract', *Indian Journal of Biochemistry & Biophysics*, 47, pp. 104–109.
 28. Lakhmale, S.P., Acharya, R. and Yewatkar, N. (2012) 'ETHNOMEDICINAL CLAIMS ON ANTIVENOM ACTIVITY OF CERTAIN FRUIT

- AND SEED DRUGS - A REVIEW', *undefined* [Preprint].
29. Md.Asif Hassan, Afia Ferdous, Rayhan Chowdhury and Kousik Ahmed Khan (2013) 'EVALAUTION OF ANALGESIC, ANTHELMINTIC AND CYTOTOXIC POTENTIAL ACTIVITY OF BARKS OF ANTHOCEPHALUS CADAMBA', *International Journal of Innovative Pharmaceutical Sciences and Research*, 1(1). Available at: https://www.researchgate.net/publication/312465496_International_Journal_of_Innovative_Pharmaceutic_SciencesandResearch_wwwijipsrcom_EVALAUTION_OF_ANALGESIC_ANTHELMINTIC_AND_CYTOTOXIC_POTENTIAL_ACTIVITY_OF_BARKS_OF_ANTHOCEPHALUS_CADAMBA (Accessed: 1 November 2022).
 30. Mishra, D.P., Khan, M.A., Yadav, D.K., Rawat, A.K., Singh, R.K., Ahamad, T., Hussain, M.K., Saquib, M. and Khan, M.F. (2018) 'Monoterpene Indole Alkaloids from Anthocephalus cadamba Fruits Exhibiting Anticancer Activity in Human Lung Cancer Cell Line H1299', *ChemistrySelect*, 3(29), pp. 8468–8472. Available at: <https://doi.org/10.1002/SLCT.201801475>.
 31. Mondal, S., Bhar, K., Sinha Mahapatra, A., Mukherjee, J., Mondal, P., Tazib Rahaman, S. and Nair, A.P. (2020) "'Haripriya" God's Favorite: Anthocephalus cadamba (Roxb.) Miq.-At a Glance'. Available at: https://doi.org/10.4103/pr.pr_102_19.
 32. Mondal, S., DashG., K., Acharyya, A., Acharyya, S. and Hp, S. (2015) 'Studies on diuretic and laxative activity of bark extracts of Neolamarckia cadamba (Roxb.) Bosser', *Drug Invention Today* [Preprint].
 33. Mondal, S., Ramana, H. and Suresh, P. (2011) 'HYGEIA JOURNAL FOR DRUGS AND MEDICINES Anthelmintic activity of Neolamarckia cadamba barks', *Hygeia.J.D.Med*, 3(2), pp. 16–18. Available at: www.hygeiajournal.com (Accessed: 26 August 2022).
 34. Nagakannan, P., Shivasharan, B.D., Veerapur, V.P. and Thippeswamy, B.S. (2011) 'Sedative and antiepileptic effects of Anthocephalus cadamba Roxb. in mice and rats', *Indian Journal of Pharmacology*, 43(6), pp. 699–702. Available at: <https://doi.org/10.4103/0253-7613.89829>.
 35. Naresh Kumar, A., Jeyalalitha, T., Murugan, K. and Madhiyazhagan, P. (2013) 'Bioefficacy of plant-mediated gold nanoparticles and Anthocepholus cadamba on filarial vector, Culex quinquefasciatus (Insecta: Diptera: Culicidae)', *Parasitology Research*, 112(3), pp. 1053–1063. Available at: <https://doi.org/10.1007/S00436-012-3232-Z>.
 36. Ouyang, K., Li, J., Zhao, X., Que, Q., Li, P., Huang, H., Deng, X., Singh, S.K., Wu, A.M. and Chen, X. (2016) 'Transcriptomic analysis of multipurpose timber yielding tree Neolamarckia cadamba during xylogenesis using RNA-Seq', *PLoS ONE*, 11(7). Available at: <https://doi.org/10.1371/JOURNAL.PONE.0159407>.
 37. Pandey, A. and Negi, P.S. (2017) 'Phytochemical composition, in vitro antioxidant activity and antibacterial mechanisms of Neolamarckia cadamba fruits extracts', *https://doi.org/10.1080/14786419.2017.1323209*, 32(10), pp. 1189–1192. Available at: <https://doi.org/10.1080/14786419.2017.1323209>.
 38. Pathak, R., Sharma, H., Kumar, N. and Author, C. (no date) 'A Brief Review on Anthocephalus cadamba'.
 39. *Antibacterial properties of Anthocephalus cadamba fruits | Semantic Scholar* (no date). Available at: <https://www.semanticscholar.org/paper/Antibacteria-l-properties-of-Anthocephalus-cadamba-Mishra-Siddique/e53644c15aae0d39bc4f45e412e0a83f3fad> (Accessed: 26 August 2022).
 40. Pemmaraju, D., Appidi, T., Minhas, G., Singh, S.P., Khan, N., Pal, M., Srivastava, R. and Rengan, A.K. (2018) 'Chlorophyll rich biomolecular fraction of A. cadamba loaded into polymeric nanosystem coupled with Photothermal Therapy: A synergistic approach for cancer theranostics', *International Journal of Biological Macromolecules*, 110, pp. 383–391. Available at: <https://doi.org/10.1016/J.IJBIOMAC.2017.09.084>.
 41. Prathibhakumari, P.V. and Prasad, G. (2018) 'Inhibition of CaOx crystals by Neolamarckia cadamba: An in vivo approach', *bioRxiv*, p. 253179. Available at: <https://doi.org/10.1101/253179>.
 42. Raja, P.B., Qureshi, A.K., Abdul Rahim, A., Osman, H. and Awang, K. (2013) 'Neolamarckia cadamba alkaloids as eco-friendly corrosion inhibitors for mild steel in 1M HCl media', *Corrosion Science*, 69, pp. 292–301. Available at: <https://doi.org/10.1016/J.CORSCI.2012.11.042>.
 43. Rp, M. (2013) 'A Comparative Study and Extract Optimization for Antimicrobial Properties of Different Parts of Anthocephalus Cadamba. A Comparative Study and Extract Optimization for Antimicrobial Properties of Different Parts of Anthocephalus Cadamba.. WebmedCentral AYURVEDIC MEDICINE 2013;4(1):WMC002116 A Comparative Study and Extract Optimization for Antimicrobial Properties of Different Parts of Anthocephalus Cadamba'.
 44. Saisruthi, K. and Sreedevi, A. (2017a) 'Amelioration of cisplatin- Induced nephrotoxicity by roots of Anthocephalus cadamba', *Biomedical and Pharmacology Journal*, 10(3), pp. 1433–1439. Available at: <https://doi.org/10.13005/BPJ/1250>.
 45. Saisruthi, K. and Sreedevi, A. (2017b) 'Amelioration of cisplatin- Induced nephrotoxicity by roots of Anthocephalus cadamba',

- Biomedical and Pharmacology Journal*, 10(3), pp. 1433–1439. Available at: <https://doi.org/10.13005/BPJ/1250>.
46. Saraf, himanshu (no date) 'HYPOGLYCEMIC EFFECTS OF METHANOLIC EXTRACT OF ANTHOCEPHALUS CADAMBA BARK IN ALLOXAN INDUCED DIABETIC RATS (ROX B) MIQ.', *ijpsr.com* [Preprint]. Available at: https://www.academia.edu/1018435/HYPOGLYCEMIC_EFFECTS_OF_METHANOLIC_EXTRACT_OF_ANTHOCEPHALUS_CADAMBA_BARK_IN_ALLOXAN_INDUCED_DIABETIC_RATS_ROX_B_MIQ (Accessed: 28 August 2022).
47. Swetha.Ch and V.Narasimha (2019) 'COMPARATIVE CLINICAL STUDY OF KADAMBA (ANTHOCEPHALUS CADAMBA (ROXB.) MIQ) BARK AND LEAF IN MEDOROGA', *AYUSHDHARA*, 6(2), pp. 2095–2101. Available at: <https://ayushdhara.in/index.php/ayushdhara/article/view/446> (Accessed: 26 August 2022).
48. Umachigi, S.P., Kumar, G.S., Jayaveera, K., Kishore, K.D. v, Ashok, K.C.K. and Dhanapal, R. (2007) 'Antimicrobial, Wound Healing and Antioxidant Activities of Anthocephalus Cadamba', *African Journal of Traditional, Complementary, and Alternative Medicines*, 4(4), p. 481. Available at: </pmc/articles/PMC2816507/> (Accessed: 27 August 2022).
49. Verma, R., Chaudhary, F. and Kumar, J. (2019) 'Pharmacology & Clinical Research Evaluation of Anti-Inflammatory, Analgesic and Antipyretic Properties of Neolamarckia Cadamba on Wistar Albino Rats', *J of Pharmacol & Clin Res*, 7(2). Available at: <https://doi.org/10.19080/JPCR.2019.07.555709>.
50. ZAYED, M.Z., Ahmad, F.B., Ho, W.-S. and Pang, S.-L. (2014) 'GC-MS ANALYSIS OF PHYTOCHEMICAL CONSTITUENTS IN LEAF EXTRACTS OF NEOLAMARCKIA CADAMBA (RUBIACEAE) FROM MALAYSIA', *International Journal of Pharmacy and Pharmaceutical Sciences*, pp. 123–127. Available at: <https://innovareacademics.in/journals/index.php/ijpps/article/view/1824/9709> (Accessed: 27 August 2022).



IJPO is

- Peer reviewed
- Bi-monthly
- Rapid publication
- Submit your next manuscript at journalpharma02@gmail.com