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Pharmacological Activity And Therapeutic Characteristics of Anthocephalus Cadamba: A Review

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A B S T R A C T

One such Ayurvedic treatment is Neolamarkia cadamba, which has been mentioned in numerous Indian medical literature sources. In this review, the medical benefits of antimicrobial and antidiabetic avtivity of Neolamarckia cadamba are discussed. Utilising plants as a medicine is known as herbalism. The family Rubiaceae includes Anthocephalus cadamba. In several countries, including China, India, and Egypt, ayurvedic medicine is used for therapeutic purposes. Numerous Indian medical texts have referenced the ayurvedic remedy anthocephalus cadamba. In this message, we went through Anthocephalus cadamba's phytochemistry and how it may be used to treat conditions including diabetes, diarrhoea, fever, inflammation, haemoptysis, colds, vomit, infections, wounds, debilitation, snake bites, and antibacterial activity. This project work discusses.

Keywords: *Anthocephalus; Cadamba*

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INTRODUCTION

The majority of the world's population relies on medicinal plants for their health care [1-2]. There are several different plants that are utilised for therapeutic purposes in numerous nations. India and the countries that border it have a long history with ayurvedic treatment.

India is known as the "Botanical Paradise" since it is the country that produces the most medicinal plants worldwide. A wide range of conditions and diseases, including as diabetes, cardiovascular disease, cancer, and liver damage, can be treated with medicinal plants. Rubiaceae's Anthocephalus cadamba, a Miq., Syn.A. rich, A. indicus, and A. chiensis (Lam. Neolamarckia cadamba (Roxb.) Bosser. (Family: Rubiaceae), sometimes called as Kadamba, is a rich. Numerous ailments, such as fever, leprosy, dysentery, blood, and skin, are treated with it. Additionally, it contains hepatoprotective, anti-oxidant, and wound-healing effects. An ayurvedic remedy called Anthocephalus cadamba has been described in a number of Indian literary works for its pharmacological effects, including anti-diarrhea, detoxifying, pain relief, and seminal fluids.

Traditional medicine has employed an aqueous extract of the Anthocephalus cadamba leaf to treat menorrhagia, as well as discomfort, swelling, and wounds. In addition to being helpful for skin diseases, the bark decoction is also helpful for diarrhoea, dysentery, and colitis [3-4].

Taxonomy

Since the 1930s, there has been taxonomic controversy over the species' botanical name. Scientific names are dependent on type specimens, which created an issue. Cephalanthus chinensis was the name given to a specimen in 1785 by Jean-Baptiste Lamarck, who claimed it was from Madagascar. The name Anthocephalus indicus was coined by Achille Richard in 1830. He claimed that the species originated in Asia and that his description was based on the same specimen as Lamarck's Cephalanthus chinensis. (According to the International Code of Nomenclature for Algae, Fungi, and Plants, Richard should not have modified the specific epithet and should have used the name A. chinensis instead of A. indicus.) The question is whether Richard actually used the same specimen as Lamarck; the geographical origin is alleged to be different, and the descriptions do not match; for instance, the inflorescences in Lamarck's Cephalanthus chinensis are axillary whereas they are terminal in Richard's Anthocephalus. If specimens were identical, Anthocephalus would be a synonym for Madagascan Cephalanthus and could not be used to refer to the Asian kadam tree in general. Even though Richard insisted they were the same, if they were distinct, Anthocephalus might be a general term for the kadam tree. Based on the latter theory, the kadam tree has been given the common name Anthocephalus chinensis. The majority of taxonomic sources currently hold the position that Cephalanthus chinensis, also known as Breonia chinensis (Lam.) Capuron, is a synonym of Richard's Anthocephalus indicus or Anthocephalus chinensis and that it is incorrectly used frequently for the kadam tree. (This incorrect usage of the scientific name is demonstrated by writing A. chinensis auct., where "auct." is an acronym for "of authors," as opposed to "of the proper authority." The first name for the kadam tree is William Roxburgh's Nauclea cadamba from 1824 as Richard's designation for it is inaccurate. In 1984, Jean Marie Bosser changed Nauclea cadamba to Neolamarckia cadamba (Roxb.) Bosser in order to honour Lamarck and the Asian genus that matched Richard's description of his Anthocephalus. This taxonomic study has not, however, been recognised by all botanical sources, and the term Anthocephalus is still used to refer to the Asian genus [5].

Plant Details -

Scientific Name: *Neolamarkia cadamba* Family (Rubiaceae)
India : Kadambah and Priyaka Wild Cinchona
Malayalam : Attutekka, Katampu
Indonesia : Jabon
Malaysia : Kalempayan
Cambodia : Thkoow
Common Name : Kadamb, Kadam

General Botanical Description -

a) **Habitat:** India, East-ward in Malaysian archipelago to Papua New Guinea
b) **Parts used:** Barks, Fruits, Leaves, seeds, Flowers and root.
c) **Bark:** Dark brown, adjective with longitudinal fissures peeling off in thin scales.
d) **Leaves:** Coriaceous, entire margin, elliptical-oblong, pulvinus base, with acute or shortly acuminate.
e) **Flowers:** flowers are small, Orange colored with globose heads.
f) **Fruits:** fruits are fleshy, orange, globose Pseudocarpand yellow.
g) **Seeds:** small and muriculate [6].

Distribution and Habitat –

Early successional species Neolamarkia Cadamba thrives in deep, damp alluvial settings, frequently in secondary forests along riverbanks and in the transitional zone between marshy, constantly flooded and occasionally flooded places.

Australia, China, India, Indonesia, Malaysia, Papua New Guinea, Philippines, Singapore, Vietnam, and Maharashtra make up the native range of the cadamba[7].

Plant profile -

Plant description -

The larger tree, Neolamarkia cadamba, has a trunk diameter of 100–160 cm and a height of 20–45 metres. It has a wide crown and a cylindrical bole that is straight. Kadam may start to bloom at the age of four. From July through December, India experiences its bloom. Flowers have two sexes [8].

Bark

Young trees have smooth, light bark, whereas elder trees have tougher bark. The bark is used to cure skin ailments. The bark of Anthocephalus cadamba is used to treat hoarseness of the throat (zeera) when combined with water, honey, and cumin. It is administered to the patient orally. Freshwater bathing keeps the skin healthy, smooth, and free of infections[9].

Leaf –

Glossy green, opposite, simple, ovate to elliptic, more or less sessile to etiolate, and measuring 15–50 x 8–25 cm are the characteristics of the leaves. The flowers are bisexual and 5-merous, with a funnel-shaped calyx tube and a gamopetalous saucer-shaped corolla with a short tube and narrow lobes that imbricate in the bud.

The inflorescence is clustered and has terminal globose heads without bracteoles and sub sessile fragrant orange or yellow flowers. Stamens 5, with short filaments and basified anthers, are inserted on the corolla tube.

Ovary inferior, binocular, occasionally four-locular in the upper portion, with a protruding stigma and style in the shape of a spindle. Fruits are able to multiply by having four hollow or solid structures in their upper sections. trigonal or irregularly shaped seeds.

Flower-

Small, orange-colored blooms are arranged in a globose head that has a diameter of 3–5 cm. The five-merous, bisexual flowers have a short tube-shaped calyx and a gamopetalous saucer-shaped corolla with narrow lobes that imbricate in the bud. Anthers are basifixed, there are five stamens, and they are attached to the corolla tube. Ovary inferior, binocular, occasionally four-locular in the upper portion, with a protruding stigma and style in the shape of a spindle. Flowers are the source of all vegetables.

Fruit –

Fruits are plentiful and have four hollow or solid structures in the tops of them. The fruits are meaty, orange, globose pseudocarps 5-7 cm in diameter, and yellow when they are fully ripe[10-12].

Propagation and planting –

Sowing-

The seeds are sown in seedbeds after being diluted (1:10) with fine sand due to their small size [13]. Alternately, you might plant using a salt or pepper pot. The seedbeds should be shielded from heavy rain and shouldn't be overwatered because damping-off can be an issue. Seedlings should be planted in well-ventilated areas to avoid the damping-off disease. You might also apply a gentle fungicidal spray to stop the damping-off [14]. Due to the tiny size of the seeds and their susceptibility to dry conditions, excessive moisture, and direct sunlight, direct sowing is not particularly effective.

Preparation for planting out –

After sowing, germination typically occurs two to three weeks later. The seedlings can be moved to nursery beds or polythene/plastic bags when they are 8 to 12 weeks old. Utilising a medium that is enriched with organic materials is advised. The seedlings are prepared to be transplanted into the field when they are about 30-40 cm tall, which takes around 6-7 months. Seedlings can occasionally be placed outside when they are 10-15 cm tall with proper care. Soerianegara and Lemmens (1993) claim that planting seedlings with a diameter of about 1 cm and a top will produce satisfactory results.

Planting –

A. cadamba is typically planted in fields at a distance of 3–4–3–4 m. In our study village in South Kalimantan, smallholders frequently use a larger spacing of 4-54-5 m; some of their plantations have been intercropped with fruit, food crops, and rubber (Figure 7). Upland rice has been intercropped with A. cadamba plantations in several locations in South Kalimantan. It has also been suggested that planting Leucaena leucocephala between the A. cadamba lines will produce positive outcomes.
It has also been demonstrated that Anthocephalus cadamba is a great shade tree for dipterocarp line planting [14].

Chemical constituents –

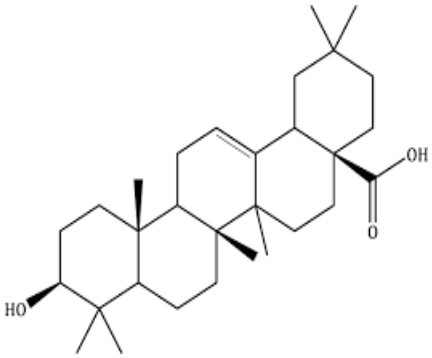
Stem - Triterpenic acid, cadambagenic acid, quinovic acid, β sitosterol

Leaf - Glycosidicindole alkaloids; cadambine, 3α dihydrocadambine isodihydrocadambine and two related non-glycosidic alkaloids; cadamine and isocadamine

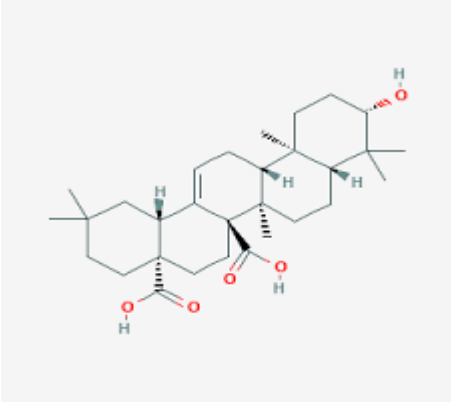
Fruit - Essential oil and the main constituents of oils are linalool, geraniol, geranyl acetate, linalyl acetate, α-selinene, 2-nonanol, β-phellandrene, α-bergamottin, p-cymol, curcumene, terpinolene, camphene and myrcene.

Whole Plant - Indole alkaloids, terpenoids, sapogenins, saponins, terpenes, steroids, fats and reducing sugars.

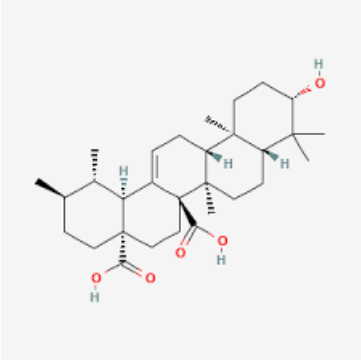
Seeds - The seeds of *Anthocephalus indicus* composed of water-soluble polysaccharides D-xylose, D-mannose and D-glucose in the molar ratio 1:3:5[15-19].



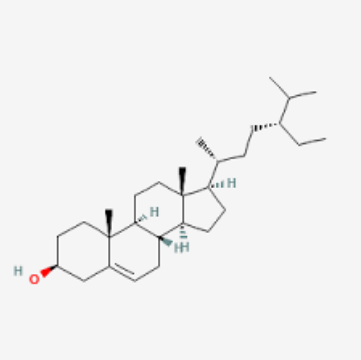
Triterpenic Acid



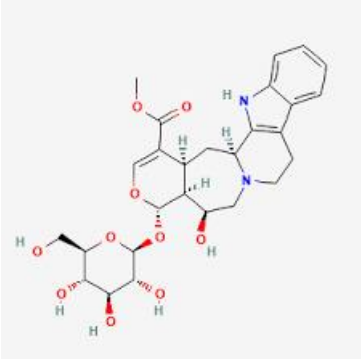
Cadambagenic Acid



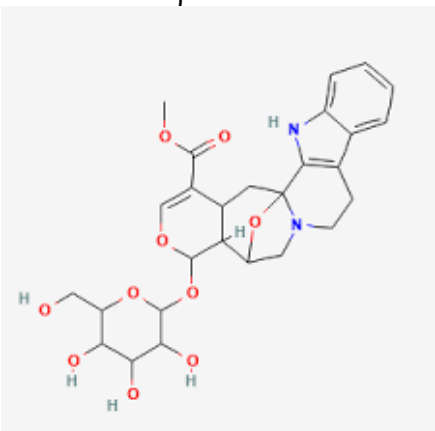
Quinovic Acid



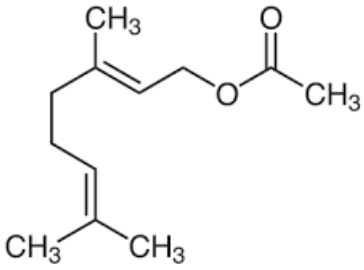
β sitosterol



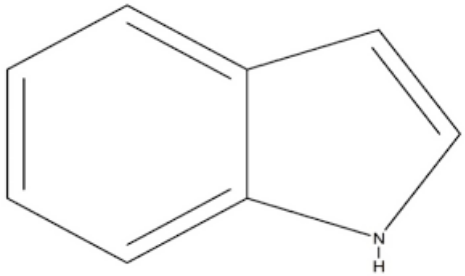
3α dihydrocadambine



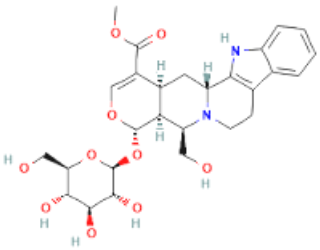
Cadambine



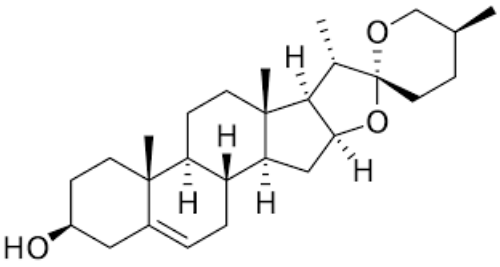
Geranyl Acetate



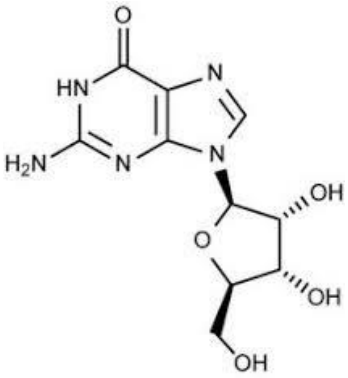
Indole Alkaloids



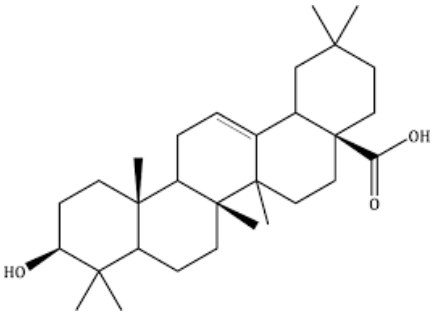
Isodihydrocadambine



Sapogenins



Terpenes



Triterpenic Acid

Medicinal and traditional uses-

- Diabetes Mellitus
- Diarrhea
- Reducing Fever
- Inflammation
- Cough
- Vomiting
- Wound
- Haemoptysis
- Ulcer
- Debility and Antimicrobial Activity

Pharmacological activities -

Antimicrobial Activity

Anthocephalus cadamba has been found to exhibit antimicrobial action. The following bacteria have been identified: Aspergillus niger, Aspergillus flavus, and Aspergillus nidulans. Salmonella typhi, Klebsiella pneumonia, Proteus mirabilis, Candida albicans, Trichophyton rubrum, and Micrococcus luteus. Research has also shown that A. cadamba extract has potent wound-healing properties. Additionally, the effectiveness of the aqueous extract of A. cadamba against the Rathyibactertriticia responsible for the wheat tundu disease and the animal foot and mouth disease has been reported[20-22]. We measured the soluble matter concentrations of several organic solvents, including water (9.25%), ethanol (5.90%), methanol (8.07%), pet-ether (0.31%), and ethyl acetate (1.22%). The investigations revealed that Neolamarckia cadamba bark included moisture (10.68%), ash (7.82%), protein (7.35%), crude fibre (28.80%), crude fat (1.64%), carbohydrate (43.71%), and calories (219 kcal/100 g). Neolamarckia cadamba's bark was analysed using the EDXRF technique to determine the relative abundance of the various elements, and the results show that the main elements were Ca (5.422%), K (3.691%), S (0.412%), and C (90.289%) [23].

Antidiabetic Activity

An alcoholic extract of the stem bark of Anthocephalus cadamba, syn. Neolamarckia cadamba, was discovered to have antidiabetic (hypoglycemic) potential, reducing symptoms including fatigue and pain in alloxan (120-150 mg/kg) induced diabetic rats. The 400-500 mg/kg extract of the drug's success in the treatment of diabetes in experimental trials is thought to be due to the presence of flavonoids, which stimulate insulin production or have an effect similar to insulin. When given to normoglycemic and alloxan-induced hyperglycemic rats, the alcoholic and aqueous extracts of Anthocephalus cadamba roots demonstrated anti-diabetic effects at a dose of 400 mg/kg body weight [24-26]. Bark ethanol extracts were found to include flavonoids, quinine, triterpenoids, saponins, and tannin, all of which were thought to play a significant role in antidiabetic effects based on phytochemical research. The most active ingredient in the ethanol-extracted bark was ethyl acetate, according to the results. GCMS analysis revealed the presence of phenolic chemicals that were expected to have antidiabetic effect, including pyrocatechol, antiroll, isopropyl myristate, and phenol [27-30].

The research of Modilal et al. (2001) on plant extract or phytochemicals included several pathways in reducing diabetes by raising, decreasing, or stimulating them has been listed in tabular form. In this overview, a few molecules that are used to manage diabetes are discussed, along with their methods for signal transduction that start the production of insulin or their functions in bringing blood glucose levels back to normal.

For antidiabetic actions, the researchers have utilised various extracts from plant components or specific phytochemicals [31-33].

Analgesic, Antipyretic and Anti-inflammatory Activities

Extracts of the bark and leaves of Anthocephalus cadamba contain analgesic, antipyretic, and anti-inflammatory effects. The defatted aqueous extract of Anthocephalus cadamba leaves showed significant analgesic and anti-inflammatory effects at various dosages (50, 100, 300, and 500 mg/kg). Some researchers successfully tested the Anthocephalus cadamba bark's methanolic extract for analgesic, antipyretic, and antiinflammatory properties [34-37].

Antidiarrhoeal Activity

In mice with castor oil-induced diarrhoea, Mondal [38] found that a dry hydroethanolic extract of the flowering tops of N. cadamba (200–500 mg/kg) showed a dose-dependent reduction in the frequency of faecal dropping. The amount of intestinal fluid buildup was reduced by the extract in a dose-dependent manner.

Animal tests were used in investigations to evaluate the antidiarrheal properties of the hydroethanolic extract of Anthocephalus cadamba's blooming tops. The amount of total mouse faeces decreased in a dose-dependent manner after administration of the dry hydroethanolic extract (250–500 mg/kg body mass, p.o.) . At dosages of 250 and 500 mg/kg, the extract significantly and dose-dependently reduced intestinal fluid buildup and gastrointestinal transit from 64.59% and 71.19%. The decrease rates with the control and standard medicine groups were 37.83% and 73.97%, respectively [38].

Diuretic and Laxative Activity

In his report on the diuretic and laxative activity, Kumar [6] discovered that the N. cadamba bark extract in methanol (300 mg/kg) significantly increased urinary output when compared to the extracts in aqueous, chloroform, and petroleum ether, while the chloroform extract (300 mg/kg) significantly increased laxative activity.

The diuretic and laxative effects of several Neolamarckia cadamba (Roxb.) Bosser bark extracts were examined in Wistar albino rats by Mondal [38]. For comparison of activity, agar-agar (300 mg/kg, p.o.) and furosemide (9 mg/kg, p.o.) were employed as reference standards. At the measured dosage regimen, the methanol extract considerably increased both urine electrolyte concentration and output, which is comparable to the reference standard with the exception of output. Significant laxative action was achieved by the chloroform extract.

It was discovered that the methanol extract (300 mg/kg) of the bark of Neolamarckia cadamba significantly showed in increases the urinary output (i.e., diuresis) as compared with aqueous, chloroform, and petroleum ether extract, whereas the chloroform extract (300 mg/kg) produced significant laxative property. This information was provided by Kumar [38].

Antihepatotoxic Effects

Sahu [39] looked into the possibility that the chlorogenic acid (CGA) extracted from N. cadamba is what is responsible for the hepatoprotective effect. It was shown that CGA administered intraperitoneally to mice at a dose of 100 mg/kg for 7 days displayed a greater liver protective activity than silymarin in mice given CCl4. The hepatoprotective properties of CGA are due to its antioxidative action [40]. Reported on the effects of ethanol-induced liver injury in rats caused by Anthocephalus indicus (3ml/kg body weight).The rat was found to be protected from the hepatotoxic effects of ethanol by treatment with powdered Anthocephalus indicus flowers (500 mg/kg), as shown by a significant decrease in serum levels of AST, ALP, GPT, and total bilirubinas as well as a significant increase in hepatic superoxide dismutase and catalase activities and a significant decrease in lipid peroxides. On treatment with A. indicus, hepatic enzyme levels and antioxidant enzyme levels partially recovered. Keywords: Hepatoprotective action, antioxidant activity, and Anthocephalus indicus [9, 41, 42].

Hypolipidemic Activity

Studies conducted by the team at Umachigi revealed a notable drop in the lipid level in rats with diabetes induced by alloxan (150 mg/kg body weight). In dyslipidemic rats, oral administration of Anthocephalus indicus root extract (500 mg/kg body wt.) for 30 days caused a considerable reduction in total cholesterol, phospholipids, triglycerides, and lipid peroxides [43].

Antioxidant Activity

According to Bhardwaj et al. [44] the extract of N. cadamba Syn. A. indicus exhibits strong antioxidant action by reducing lipid peroxidation and increasing the activity of the enzymes superoxide dismutase (SOD) and catalase [30]. Different extracts and fractions of Anthocephalus cadamba were examined for their antioxidant potential using a variety of in vitro assays, including the superoxide anion radical scavenging assay and the reducing power assay [44].

Antioxidant Activity

Anthocephaluscadamba Syn. A. indicus extract shows considerable antioxidant action by decreasing lipid peroxidation and enhancing superoxide dismutase (SOD) and catalase activity [42].

Anthelmintic Activity

Neolamarkia cadamba's mature bark has been reported to have anthelmintic activity against roundworms, tapeworms, and earthworms. George et al. [45] evaluated this claim. Neolamarckia cadamba (Roxb.) stem extract showed cytotoxic, thrombolytic, and anthelmintic action, according to Mali RG et al. (2004). The study used human red blood cells for thrombolysis, brine shrimp lethality for cytotoxicity, and aquarium worm Tubbier for anthelmintic action [46,47].

Antifungal Activity

Patel et al. [48] looked into the cadamba's antifungal properties. Aspergillus fumigatus and Candida albicans were both sensitive to the bark and leaf extract of the cadamba plant. Additionally, they discovered that the leaf extract from the cadamba tree exhibits greater antifungal activity than the bark extract. Cadamba has a potent antifungal effect [49]. The fruits of this plant were reported to have significant antifungal activity against the following organisms: Trichophyton rub rum, Candida albicans, Microsporum, and Aspergillus Niger, with zones of inhibition against Trichophyton rub rum for ethanolic and hot water extracts, respectively, of up to 15.0 mm and 12.0 mm. The MIC against Trichophyton rubrum and Aspergillus niger was found to be as low as 2.10 mg/ml and 2.5 mg/ml for ethanolic extracts of ripened fruit of A. cadamba, respectively.

Antifilarial and Antimalarial Activities

According to research by Patel et al. [48], mosquito-borne illnesses such malaria, dengue, chikungunya, filariasis, and Japanese encephalitis result in thousands of fatalities each year in India and other poor nations. Therefore, mosquito control is a major issue and is required to improve the health and standard of living of the nation's citizens and visitors. The growing resistance and resurgence of vector-borne diseases to synthetic pesticides has made management of many illnesses ineffective. Gold nanoparticles added to the extract have been found to be more deadly, causing 100% death at the larval stage at a very low dose (LC50 = 0.61 ppm), according to research. Another study discovered that the cademba's dimethyl sulfoxide extract has antimalarial properties.

Kumar et al. [50] Tribes in the Western Ghats frequently utilise the anthocephalus cadamba plant as a paste to cure skin conditions. Neolamarkia cadamba was examined for its antibacterial abilities against a variety of diseases. Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa were just a few of the organisms that this plant's alcoholic fruit extracts significantly inhibited, with maximum zones of inhibition of 24.0 cm and 22.0 cm for E. coli and P. aeruginosa, respectively. For methanolic extracts of A. cadamba's green fruit against P. aeruginosa and S. aureus, the mini mum MIC was as low as 1.00 mg/ml.

Antibacterial Activity

Both alcoholic and aqueous cadamba fruit extracts have been shown to have significantly higher antibacterial activity against a variety of microorganisms, (Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Micrococcus luteus, Bacillus subtilis, Salmonella typhi, Klebsiella pneumonia, Proteus mirabilis, Candida albicans, Trichophytonrubrum, Asperagillus niger, Asperagillus flavus and Asperagillus nidulans) [20,28,44].

Antiparasitic Activity

The Cadamba produces an anthelmintic activity, according to research by Pollard et al. [51]. Roundworm, tapeworm, pinworm, and threadworm infestations can all be treated with the herb successfully. Unhygienic behaviours and eating are the cause of the parasite infections.

Antivenom Activity

According to research by Mali et al., one of the main reasons for the high death rate in India and other poor nations is snakebites. For the express purpose of treating snake venom envenomation, a variety of antivenom immunotherapy's have been developed. These treatments can have a number of adverse effects, including serum sickness, pyrogen response, and anaphylactic shock. Higher amounts of non-immunoglobulin proteins found in commercially available hyperimmune antivenom may be to blame for the majority of these symptoms [52].

Anticancer Activity

According to Chandra et al. [20, 42] , the cadamba exhibits considerable anticancer activity. It is used to treat a variety of cancers, such as esophageal, breast, and colon cancer. The term "cancer" refers to a condition in which aberrant cells frequently proliferate uncontrollably and occasionally spread to other parts of the body. To develop therapeutic therapies for cancer, extensive research has been conducted. study by Dwevedi et al. (2015) on the The term "cancer" refers to a condition in which aberrant cells frequently proliferate uncontrollably and occasionally spread to other parts of the body. To develop therapeutic therapies for cancer, extensive research has been conducted. As anticancer drugs, the plant-based products have been researched.

Conclusion

Recent years have seen a revived interest in plant-based medicine research. The primary factor is that the medical system has a multitude of side effects that frequently result in major issues. Although Neolamarkia cadamba has historically been used for a variety of medical purposes, including antimicrobial, antidiabetic, antioxidant, hepatoprotective, antidiarrheal, diuretic etc, it is now time to investigate its molecular medicinal properties with the aid of various biotechnological techniques.To assure the plant's unrestricted utility, work may also be done in this direction, as was shortly demonstrated by numerous animal models.

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