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ANTHOCEPHALUS CADAMBA: A REVIEW ON COMPREHENSIVE PHARMACOGNOSTIC AND PHARMACOLOGICAL STUDY

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Abstract: Anthocephalus cadamba (family: Rubiaceae) is also known as kadamb. It is huge evergreen tree with large leaves and beautiful ball shaped flower and fruit. It is natural ayurvedic remedy which is use for medicinal purpose in several countries such as china, India and Egypt. Many pharmaceutical companies currently conducting extensive research on plant material for their potential medicinal value. The kadamb possess significant pharmacological properties for various hopeless disorder due to presence of variety of chemical constituents in them. The therapeutic uses of its flower, root, bark, leaves and stem against the various disorder like diabetic mellitus, diarrhoea, fever, inflammation, haemoptysis, cough, vomiting, wound healing, ulcer and also useful for snake bite. The major chemical constituents of the plant are triterpenes, triterpenoid glycoside, flavonoid, saponin, indole alkaloids, cadambine, isocadambine, isodihydrocadambine. In this article we review the pharmacognostic and pharmacological studies of Anthocephalus cadamba.

Keywords: Anthocephalus cadamba, Introduction, Pharmacognostical, Physicochemical, pharmacological activities.

1. INTRODUCTION

Medicinal plants play an important role for health maintenance of the foremost portion of the earth population. There are number of plants which is for medicinal purpose in several countries. Ayurvedic science established in India and Its neighbouring countries. Countries such as China, India, and Egypt are well known for the active usage of medicinal plants in the treatment of various incurable diseases. India also mentioned botanical paradise because of largest producer of the medicinal plants. It was developed even before the medieval period, when people had little knowledge of science. There are a sort of ancient therapeutic measures based on medicinal plants that have been developed in India. There are sort of ancient therapeutic measures based on medicinal plants that have been developed in India (1, 2, 3). Medicinal plant can cure several disease and aliments such as diabetic, cardiovascular, cancer and liver damage.

Anthocephalus cadamba Roxb. Synonym Neolamarckia cadamba (Roxb.) Bosser belonging to Rubiaceae family is locally called as Kadamb. Kadamba is one of the important plants which possesses many of medicinal Properties and is taken under consideration as a mythic tree and explained in various Ayurvedic classics (5). “A. cadamba could also be an outsized tree with a broad umbrella shaped crown and straight cylindrical bole. The branches are characteristically arranged in tiers. The tree may reach a height of 5 m with a stem diameter of 100-160 cm and sometimes it’s a little buttress up to 2 m high. The bark is grey, smooth and very light in young trees, but rough and longitudinally fissured in old trees”.

The branches spread horizontally and drop at the tip. The leaves are glossy green, opposite, simple sessile to petiolate, ovate to elliptical have15–50 cm long and 8–25 cm wide (14). The fruit lets are numerous, somewhat fleshy, with their upper part containing 4 hollow or solid structure, fleshy yellow orange infructescence containing approximately 8000 seeds (2). Anthocephalus cadamba bark, fruits, roots and leaves contain various chemical such triterpenes, cadambine, triterpenoid glycoside, isocadambine,

isodihydrocadambine (6). They are utilized within the treatment of various disorders like diabetes mellitus, fever, inflammation, diarrhoea, cough, vomiting, ulcers, debility and microbial infections.

The Cadamba is typically mentioned as "Kadamba" in Sanskrit and Hindi and as wild cinchona in English. Other vernacular names have been listed in the **Table1**. It is an evergreen tropical tree found in different parts of India, Bangladesh, Nepal, Myanmar, Sri Lanka, Cambodia, Laos, Philippines, Malaysia, Indonesia, Papua New Guinea, and Australia (5). The tree is extremely regarded religiously and culturally in India being sacred to the Lord Krishna. Radha and Krishna conducted their love play in the hospitable and sweet-scented shade of the Kadamba tree. Shiva and Parvati came to Sahyadri and there a child was born to the divine couple. Since the birth happened under a Kadamba tree, the child was named Kadamba, and was placed in charge of the Sahyadri region. The word Kadamba lends its name to the Kadamba Dynasty which ruled from Banavasi in what the state of Karnataka from 345 AD to 525 AD (2,7,9). The studies were carried out in accordance with WHO General Guidelines for "Herbal Drug Standardization methodologies" (9,14).

Within the sunshine of all the above and keeping the medicinal overview of A. cadamba, this investigation was being carried out to study some pharmacognostic and pharmacological activity. The findings from this study would be useful as standards for the species as well as a source of reference for further scientific investigation of the species. This review is based on the significance of the Cadamba and its derived products to humankind.

2. LOCALIZATION

In India, it is found in the temperate Himalayas (which extend from Kashmir to Bhutan), Garhwal, Himachal Pradesh, Sikkim, Assam, Karnataka, Kerala and Manipur. In Garhwal, it is particularly distributed in the temperate zones of Pauri, Tehri, Chamoli, and Uttarkashi districts, while in Himachal Pradesh it is prevalent in the districts of Chamba, Kangra, Manipur, Bilaspur, Kullu, Sirmour, and Shimla (4,6).

Table 1: Vernacular names of A. cadamba (8,9)

Sr. No.	Language	Names
1.	Hindi	Kadam, Kadamba
2.	Marathi	Kadamb
3.	English	wild cinchona
4.	Sanskrit	Varttapushpa, Priyka
5.	Tamil	Kapam, Vellai
6.	Telugu	Kadambamu
7.	Kannada	Kadawala
8.	Assam	Roghu, Kadam

3. MORPHOLOGY OF PLANT

Anthocephalus cadamba (Roxb.) Miq belongs to Rubiaceae family. (Figure. No. 1 &2): picture of Cadamba plant (Anthocephalus Cadamba miq.)

4. PLANT DESCRIPTION

Anthocephalus cadamba could also be a bigger tree, the height of this tree may reach 20-45 m and thus the diameter of truck is 100-160 cm with broad crown and straight cylindrical bole. At the age of 4 years kadam may start flowering. In India it is flowering in July to December. Flowers are bisexual [6,10].

5. ORGANOLEPTIC CHARACTERS

Colour: Green (Leaf)
Touch: Glossy (Upper), Rough (Lower)
Odour: Odourless
Taste: Acrid, Bitter.
Size : 15-50 long; 8.0-26 cm wide
Shape: Simple, Ovate-elliptical, Petiolated.
Margin: Slightly undulated
Venation: Pinnate

6. ECOLOGICAL RANGE

Light is that the foremost vital condition for Anthocephalus cadamba growth. In its natural habit, the almost temperature varies from 32 to 42^{o} C and thus the minimum temperature varies from 3.2 to 15.5^{o} C. A. cadamba is sensitive to frost (13). The mean annual rainfall for growing ranges from 1500 to 5000 mm. However, some A. cadamba also can grow locally on much drier sites with as little as 200 mm annual rainfall such as in in central parts of South Sulawesi. The range of the altitude for growing is between 300 to 800 m above water level. Within the equator region it's found from just above water level up to an elevation of 1000 m (14).

7. BIOPHYSICAL LIMITS

Altitude: - 300 to 800 m
Mean annual temperature: -23^{O} C
Mean annual rainfall: - 1600 m
Soil type: - Prefers well drained Entisols. Kadam does not grow well on 'leached and poorly aerated soils.

8. PROPAGATION AND PLANTING

I) Sowing

Because of their small size, the seeds are mixed with fine sand the ratio is 1:10 and sown in seedbeds. Alternatively, a salt or pepper pot can be used for sowing. "The seedbeds should be protected from heavy rain and not watered too much as damping-off are often a haul. To prevent damping off disease, seedling should be placed in well-ventilated condition". A lightweight fungicidal aerosol even be used to prevent the damping-off. 'Direct sowing is not successful thanks to the small size of the seeds and their sensitivity to drought excessive moisture and direct sun. (14)

II) Preparation for planting out

Germination usually takes places 2 to 3 weeks after sowing. When the seedlings are 8 to 12 weeks old, they are going to be transplanted to nursery beds or polythene or plastic bags (14). 'It is usually recommended to use a medium that's enriched with organic matter. After 6 to 7 months, when the seedling are about 30 to 40 cm tall, they're ready to transplant into the field'. Under excellent care, seedling can sometimes be planted out once they're 10 to 15 cm tall.

III) Planting

The planting distance of Anthocephalus cadamba within the sector is usually around 3–4 by 3–4 m. A wider spacing of 4–5 by 4–5 m is typically applied by small holders in our study village in South Kalimantan; variety of their plantations have been intercropped with fruit, food crops and rubber. "In other sites in South Kalimantan, Anthocephalus cadamba plantations have been intercropped with upland rice". Anthocephalus cadamba has also proved to be an outstanding shade for tree for dipterocarp line planting. (13,14).

Table 2: Flowering and fruiting period of A. cadamba in selected countries

Country	Flowering	Fruiting
India	May-June	January–February
Indonesia	April–August	June–August
Laos	April–August	October–December
Philippines	April–May	September–February

9. CHEMICAL CONSTITUENT (4-11)

I. **Heartwood:** pinocembrin, chrysin, naringenin, kaempferol, aromadendrin, quercetin, taxifolin, dihydrowogonin, Dihydrotectochrysin.
II. **Stem:** Padmakastein, amygdalin, prunetin, sakuranetin, puddumetin.
III. **Root:** Ursolic acid, stigmasterol, prunetinoside, glucogenkwanin.
IV. **Seed:** Naringenin-5-Oα -L-rhamnopyranoside, 4´-O-methylliquiritigenin -7-Oα -L-rhamnopyranoside, naringenin 4´-methylether 7-xyloside, β -sitosterol-3-O-D-galactopyranoside.
V. **Leaves**: Quercetin-3-rhamnoglucoside, kaempferol.
VI. **Fruit:** Essential oil and thus the most constituents of oils are linalool, geraniol, linalyl acetate, α-selinene, 2-nonanol, β-phellandrene, α-bergamottin, terpinolene, camphene and myrcene [(1)].
VII. **Commercially available:** Cadambagenic acid, quinovic acid, β -sitosterol, cadambine, cadamine **(fig. no. 3).**

10. MEDICINAL USES

The roots, fruits, leaves, bark skin is used from medicinal purposes. Externally, the wounds and ulcers are dressed in its leaves slightly warmed to alleviate the pain, swelling and for cleansing and better healing of wounds (1). Internally, the decoction of bark skin is an effective remedy for diarrhoea, dysentery and colitis. The juice of bark skin combined with cumin seeds and sugar alleviates vomiting.

It is utilized within the treatment of various ailments like DM, diarrhoea, fever, inflammation, haemoptysis, cough, vomiting, wounds, ulcers, debility and antimicrobial activity (8). The fruit juice augments the amount of breast milk in lactating mothers and also works well as a lactodepurant. Kadamba is rewarding in skin diseases as it improves the complexion of the skin. In burning sensation of the body and fever, the bark skin is typically used. The bark skin and thus the fruits are salubrious in general debility (3-8).

11. MATERIAL AND METHODS

I. Plant Material

The leaves of the Anthocephalus cadamba (Roxb) Miq. Was generally used.

II. Preparation of Extract

The leaves of Anthocephalus cadamba shaded dried and then these are made into coarsely powdered from using dry grinder. The powdered leaves of the plant (300 gm.) was packed in Soxhlet apparatus and continuously extracted with 20% ethanol till complete extraction, after completion of extraction the solvent was removed by distillation and then concentrated extract obtained was dried under reduced pressure using rotatory evaporator at temperature not exceeding 40oC and then give moderate heating on water bath. The ethanolic extract was kept in Petri dish and it was stored in the desiccator at cool place (10,12).

12. PHYSICOCHEMICAL EVALUATIONS

The determination of various physicochemical parameters such as total ash, acid insoluble ash, water soluble ash, foreign matter, moisture content, Alcohol Soluble Extract, Water soluble extract, foaming index, swelling index and Determination of pH were carried out by the methods given in the WHO guidelines for standardization of herbal drugs (15-22).

a. Moisture Content:

2 gms of sample is taken in a previously weighted Petri plates. Petri plates with the samples were kept in the oven and maintained at a temperature 110º c for drying. After 3 hrs Petri plates were taken out weight was noted down. This procedure is repeated for 4 to 5 times until the constant weight is reached (12).

You take care of moisture = Difference in weight / Weight of the sample X 100.

b. Ash values

i. Total Ash:

2 gms of each powder is taken in 3 heated silica dishes to avoid any moisture content. The materials are ignited to 100^0 -150^0C in an electric ignition till the charring of the drug material. Then it's kept in an incinerator at 50^0C, temperature allowed to roll back to Zero. Then it's away from furnace and cooled in a desiccator to room temperature and weighed (12, 21).

Total ash = Weight of residue / Weight of the sample X 100

ii. Acid Insoluble Ash:

The total ash, which was obtained was boiled for 5 minutes with 25ml of diluted hydrochloric acid, collect the insoluble matter in an ash less filter paper, wash with predicament (hot water) and ignited to constant heat (21).

You take care of acid insoluble ash = Difference in weight / Weight of sample X 100

iii. Water Soluble Ash:

The total ash, which was obtained, was boiled for 5 minutes with 25 ml of water. Collect insoluble matter in Gooch crucible or on an ash less filter paper, wash with hot water and ignite it for 15 minutes at a temperature not exceeding 450^0C (12).

Water soluble ash=Weight of total ash -weight of insoluble matter.

You take care of water-soluble ash=Difference in weight /weight of sample x100

c. Extractive values

i. Alcohol Soluble Extract:

5 gm powder was taken during a volumetric flask, 100 ml of alcohol was added there to, and flask was kept for 24 hrs. The solution was filtered next day, and 25 ml of this filtrate was evaporated during a previously weighed evaporating dish on a water bath (12,21). Later it had been dried within the oven at 110ºc to get rid of traces of alcohol. Constant weight was noted down.

% alcohol soluble extractive = Difference in weight / Weight of the sample X 100

ii. Water soluble extract:

5 gm powder was taken during a volumetric flask few drops of chloroform and subsequently 100 ml of distilled water was added there to. It had been kept for 24 hrs, shaking frequently for the primary 6 hrs. next day the solution was filtered, and 25 ml of this filtrate was evaporated during a previously weighed evaporating dish on a water bath. Later it has been dried in the oven at 110^0 C to get rid the traces of water (21). Constant weights were noted.

% of water soluble extractive =Difference in weight /Weight of sample x100

iii. Foreign matter:

The 100-gm sample was weighed then spread in a thin layer and foreign matter was sorted into groups either by visual inspection, employing a magnifying lens or with the assistance of an appropriate sieve consistent with the wants the rest of the sample was sifted through a sieve no. 250 dust considered as mineral admixture (2,12). The portions of sorted foreign matter were weighed.

iv. Swelling Index:

Perform simultaneously no fewer than three determinations for any given material. Introduce the required quantity of the herbal material concerned, previously reduced to the specified fineness and accurately weighed, into a 25-ml glass-stoppered measuring cylinder. The interior diameter of the cylinder should be about 16 mm, the length of the graduated portion about 125 mm, marked in 0.2ml divisions from 0 to 25 ml in an upwards direction. Unless otherwise within the test procedure, add 25 ml of water and shake the mixture thoroughly every 10 minutes for 1 hour. Allow to face for 3 hours at room temperature, or as specified. Measure the quantity in ml occupied by the herbal material, including any sticky mucilage. Calculate the mean value of the individual determinations, associated with 1 g of herbal material (9).

v. Determination of pH:

The determination of pH was administered at room temperature of 25^0c. Calibration of the apparatus was done using buffer solution to pH7 water soluble and alcohol soluble solutions was kept ready, then the electrodes were immersed in both the solutions and readings were recorded (12).

13. PHYTOCHEMICAL EVALUATIONS

The dried leaves powder of Anthocephalus cadamba was evaluated for various phytochemicals using various standard methods (18-20).

Table No.3: Phytochemical Tests of A. cadamba (2,8)

Sr. No.	Test	Methanol	Petro. Ether	Chloroform
	Tannins	+	-	+
	Phenols	+	-	-
	Alkaloids	+	-	-
	Saponins	+	-	-
	Quercetin	-	-	-
	Proteins	-	-	+
	Flavonoids	+	-	+
	Steroids	+	+	+
	Coumarin	-	+	+
	Glycosides	+	-	+

14. PHARMACOLOGICAL ACTIVITIES

I. Analgesic, antipyretic and anti-inflammatory activities

Extracts of the bark and leaf of Anthocephalus cadamba possess the analgesic, antipyretic and anti-inflammatory activities (10). The defatted aqueous extract of the leaves of Anthocephalus cadamba showed significant analgesic and anti-inflammatory activity at varying doses (50, 100, 300 and 500 mg/kg) (23). The methanolic extract of the bark of A. cadamba was successfully evaluated for analgesic, antipyretic and anti-inflammatory activities by some workers (24).

II. Antidiarrhoeal activity

The dry hydroethanolic extract (200-500mg/kg) of the flowering tops of Anthocephalus cadamba exhibited a dose dependent decrease in the frequency of faecal dropping in castor oil induced diarrhoea in mice. The extract also produced a dose-dependent reduction in intestinal fluids accumulation (25).

III. Diuretic and Laxative activity

The various extracts of the barks of Neolamarckia cadamba were studied for its diuretic and laxative activity and it was found that the methanol extract (300 mg/kg) of the bark of Neolamarckia cadamba significantly showed in increases the urinary output (diuresis) as compared with aqueous, chloroform and petroleum ether extract, whereas the chloroform extract (300 mg/kg) produced significant laxative property (10,25).

IV. Hypolipidemic activity

From the experimental studies carried out by the workers showed the marked decrease in the lipid level in alloxan (150 mg/kg body wt.) induced diabetic rats. Oral administration of root extract (500 mg/kg body wt.) of Anthocephalus indicus for 30 days in dyslipidaemic animals resulted in significant decrease in total cholesterol, phospholipids, triglycerides and lipid peroxides (1,3,5).

V. Anti-hepatotoxic effects

Anthocephalus cadamba have been reported to be used for its hepatoprotective activity. The hepatoprotective activity is due to the presence of chlorogenic acid (CGA) isolated from Anthocephalus cadamba (19). It was also found that the intraperitoneal administration of CGA to mice at a dose of 100 mg/kg for 8 days exhibited a better liver protective action than silymarin (SM), in CCl4 administered mice. The antioxidative activity of CGA is responsible for its hepatoprotective nature. CCl4 is used as a model of liver injury (26).

VI. Antioxidant activity

Studies on antioxidants are crucial, particularly in the food industry and in therapeutic research. The reactive oxygen species (ROS) and free radicals are by products of biological metabolism, which is responsible for cell membrane breakdown, membrane protein damage, and DNA mutation. These can further initiate the development of many diseases such as cancer, liver injury, cardiovascular diseases, cellular damage, and the aging process. The indigenous enzymatic systems (superoxide dismutase, glutathione peroxidase, catalase), chemical scavengers and dietary antioxidants (α -tocopherol, β -carotene, ascorbic acid, glutathione, uric acid), and hormones (estrogen, angiotensin) are able to remove free radicals formed in cells and thus protect against oxidative damage (1,3,19)). Further, antioxidant phytochemicals found in several medicinal plants, fruits, and vegetables also protect to the human body from disease by scavenging ROS and free radicals (30).

VII. Antivenom activity

Snakebite is one of the major causes of the high mortality rate in India and other developing countries. Various antivenom immunotherapies have been developed for specific treatment against snake venom envenomation. There are various side effects of such therapies, viz., anaphylactic shock, pyrogen reaction, and serum sickness (5). Most of these symptoms may be due to the action of higher concentrations of non-immunoglobulin proteins present in commercially available hyperimmune antivenom (29).

VIII. Antimicrobial And Wound Healing Activity

Anthocephalus cadamba has been reported for antimicrobial activities. The plant has been reported to possess potent antibacterial and antifungal activity against Escherichia coli, Micrococcus luteus, Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa, Salmonella typhi, Klebsiella pneumonia, Proteus mirabilis, Candida albicans, Trichophyton rubrum, Asperagillus niger, Asperagillus flavus and Asperagillus nidulans. The experimental evidence also shows that A. cadamba extract has potent wound healing capacity (5). The aqueous extract of A. cadamba also found effective against Rathyi bactertriticia causal organism of tundu disease of wheat, and effective against foot and mouth disease of animals (27).

IX. Anthelmintic activity

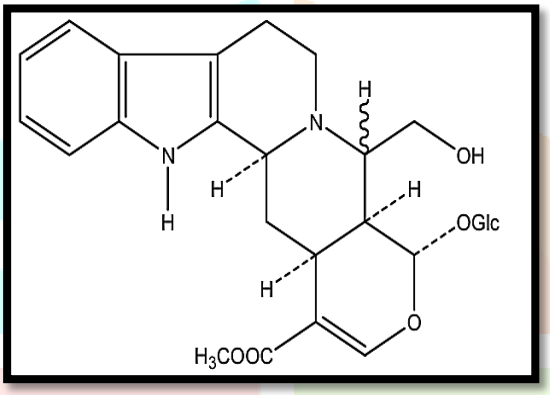
Aqueous and ethanolic extracts of mature bark of Neolamarckia cadamba has been reported for its anthelmintic activity against earthworms, tapeworms, and roundworms (1,3,5).

X. Antidiabetic activity

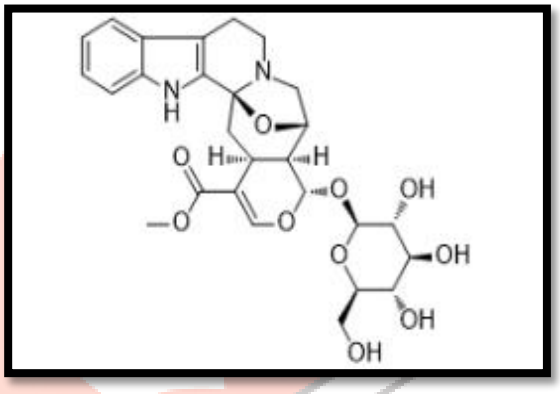
The alcoholic extract of the stem bark of Anthocephalus cadamba, been reported to exhibit antidiabetic (Hypoglycemic) potential in alloxan (120-150 mg/kg) induced diabetic rats and rectifying the problems like fatigue and irritation associated with this disease. The experimental studies showed that the 400-500 mg/kg extract of drug are effective in the treatment of diabetes and it is thought to be due to the presence of flavonoids, which stimulate the insulin secretion or possess an insulin-like effect (5). The alcoholic and aqueous extract of the roots of Anthocephalus cadamba also possess the anti-diabetic activity in dose 400 mg/kg body weight and was tested against the normoglycemic and alloxan induced hyperglycaemic (28).

Figure No.1: Cadamba Plant

Figure No.2: Cadamba Flower



Iso dihydro cadambine



cadambine

Figure No.3: Chemical constituent

15. CONCLUSION

Research in ayurvedic medicinal plants has gained a rehabilitated focus freshly. The main reason is that the other system of medicine associated with number of side effects that often cause to serious problems. This review has shown various Pharmacognostical, physico-chemical and pharmacological activities of the Cadamba. Particularly, the leaves and bark have great significance. For the identification of various Phytoconstituents the extracts of cadamba were utilized for phytochemical screening. Anthocephalus cadamba has various medicinal activities but it is time to explore its medicinal values at molecular level with the help of various biotechnological techniques.

This study can be beneficial in evaluating the identity and purity ensuring the safety and efficacy of the herb. The standards obtained in this study can be used by herbal manufacturing industries and laboratories for quality control and assurance in their products. There is an urgent requirement for intensive studies on this plant to exploit it for the treatment of various incurable diseases prevalent across the world.

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