Anthocephalus Cadamba: A Review

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ABSTRACT

Anthocephalus cadamba is one of such ayurvedic remedy that has been mentioned in many Indian medicinal literatures. This article discusses about the medicinal values of *Anthocephalus cadamba*. In this communication, we reviewed the phytochemistry of *Anthocephalus cadamba* and its application in the treatment of various ailments like diabetes mellitus, diarrhoea, fever, inflammation, haemoptysis, cough, vomiting, wounds, ulcers, debility and antimicrobial activity. The major constituents of the plant are triterpenes, triterpenoid glycosides, flavanoids, saponins, indole alkaloids; cadambine, cadamine, isocadambine, isodihydrocadambine. This review discusses the investigations made by various workers related to chemical constituents, pharmacological action and toxicological studies of this plant since years till date.

Key words: *Anthocephalus cadamba*, Indole alkaloids, Pharmacological action, Antimicrobial action and Toxicological studies.

INTRODUCTION

Anthocephalus cadamba Miq., Syn. *A. indicus, A. rich, A.chiensis* (Lam.) Rich. Ex. Walp, *Neolamarckia cadamba* (Roxb.) Bosser. (Family-Rubiaceae) commonly called kadamba enjoys a hallowed position in Ayurveda- an Indian indigenous system of medicine. It is also named as Kadam. Other vernacular names of *Anthocephalus cadamba* have been listed in the Table 1. The tree is a medium to large sized deciduous tree attaining a height of 20-40 m and a girth of about 2-2.5 m with clean cylindrical branches and rounded crown. It is frequently found all over the India on the slopes of evergreen forests up to 500 m. It is found in the sub-himalayan tract from Nepal eastwards on the lower hills of Darjeeling terai in West Bengal where it is common; in Chota Nagpur (Bihar), Orissa and Andhra Pradesh, in the Andamans, it is very common in damp places along large streams, and in Karnataka and Kerala on the west coast, and western ghats at low level in wet places. It is also distributed in Thailand and Indo-china and eastward in Malaysian archipelago to Papua New Guinea.[1, 2] The bark of the plant is reported to possess tonic, bitter, pungent, sweet, acrid, astringent, febrifugal, anti-inflammatory, digestive, carminative, diuretic, expectorant, constipating and antiemetic properties and is given to treat the fever and inflammation of eyes. The flowers are used as vegetable. The leaves are slightly aromatic with unpleasant taste but the decoction of leaves good for ulcers, wounds, and metorrhea. Additionally, it is useful in the treatment of snake-bite. It is often used in the form of powder (nygrodhadi kvatha churna) which is a herbal formulation. A general description about *Anthocephalus cadamba* has been summarized in Table 2.[3-5] The analytical parameters of plant mentioned in Table 3.[6,7]

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PHYTOCHEMISTRY

Anthocephalus cadamba primarily consist of indole alkaloids, terpenoids, sapogenins, saponins, terpenes, steroids,fats and

Table 1: Vernacular names of *Anthocephalus cadamba*

S.No.	Vernacular names
1	Sanskrit: Kadambah, Vrtta puspa, Priyaka
2	English: Wild chinchona
3	Hindi: Kadamb, Kadam
4	Assam: Roghu, Kadam
5	Tamil: Vellaikkatampu, Arattam, Kadappai
6	Malayalam: Katampu, Attutekka
7	Kannada: Kadamba mara, Kadavala, Neirumavinamara
8	Telugu: Kadambamu, Kadimi chettu
9	Indonesia: Jabon
10	Malaysia: Kalempayan
11	Cambodia: Thkoow

reducing sugars.[1,4] The bark also consist of tannins[2] and an astringent principle; which is due to the presence of an acid similar to cincho-tannic acid.[5] A new pentacyclic triterpenic acid isolated from the stem bark *Anthocephalus cadamba* named cadambagenic acid(18α-olean-12ene-3β-hydroxy 27,28-dioic acid) (Fig. 1), along with this acid quinovic acid (Fig. 2) and β sitosterol (Fig. 3) have also been isolated.[8] Dried stem bark of *Anthocephalus indicus* has been investigated for its steroidal and alkaloidal constituents having good therapeutic values.[9,10] Glycosidic indole alkaloids; cadambine ($C_{27}H_{32}N_2O_{10}$) (Fig. 4), 3α-dihydrocadambine ($C_{27}H_{34}N_2O_{10}$) (Fig. 5), isodihydrocadambine ($C_{37}H_{44}N_2O_{15}$) (Fig. 6)[11,12] and two related non-glycosidic alkaloids; cadamine ($C_{23}H_{23}N_3O_4$) (Fig. 7) and isocadamine isolated from the leaves of *Anthocephalus cadamba*.[13] The isolation and structure of 3β-dihydrocadambine and 3β-isodihydrocadambine (Fig. 8) alkaloids reported from the leaves of *Anthocephalus cadamba* with molecular formula ($C_{37}H_{44}N_{15}O_2$).[14] A new saponin named saponin B ($C_{48}H_{76}O_{17}$) reported from *Anthocephalus cadamba* (Miq.).[15] Anthocephalus cadamba also contain an acid called chlorogenic acid (CGA) (Fig. 9).[16] Recently some worker isolated two novel triterpenoid saponins, phelasin A and phelasin B from the bark of *Anthocephalus cadamba* (Roxb.) Miq.[17] Two novel monoterpenoid indole

Table 2: General description of *Anthocephalus cadamba*

S.No.	Description
1	Habitat: The tree is frequently found all over the India and it is also distributed in Thailand, Indo-china and east-ward in Malaysian archipelago to Papua New Guinea.
2	Parts used: Dried fruits, fresh fruits, leaves, flowers, barks, seeds and roots. Bark: Bark is dark brown, roughish, with longitudinal fissures peeling off in thin scales.
3	Leaves: Leaves coriaceous, elliptical-oblong or ovate, entire margin, pulvinus base, acute shortly acuminate, 18-30 cm long and 10-16 cm broad pubescent beneath.
4	Flowers: Flowers are small, yellow or orange in colour, globose heads which are in 3-5 cm in diameter.
5	Fruits: Fruit a fleshy, orange, globose pseudocarp 5-7 cm in diameter and yellow when ripe.
6	Seeds: Seeds are small, muriculate.

Table 3: Analytical parameters of *Anthocephalus cadamba*

S.No.	Parameters	Result
1	Foreign matters	Not more than (nmt) 2%
2	Total ash	8-9%
3	Acid-insoluble ash	0.6-1.5%
4	Water-soluble ash	2-2.5%
5	Sulfated ash	4-4.5%
6	Alcohol-soluble extractive values	4-6%
7	Water-soluble extractive values	4.5-5.0%

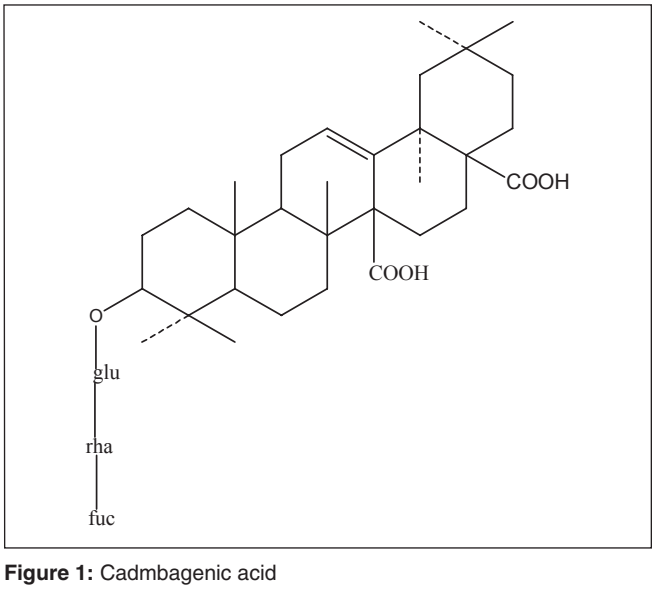

Figure 1: Cadmbagenic acid

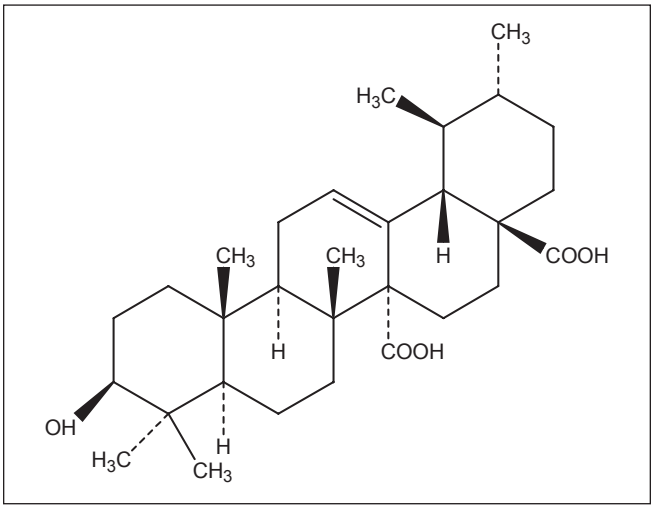

Figure 2: Quinovic acid

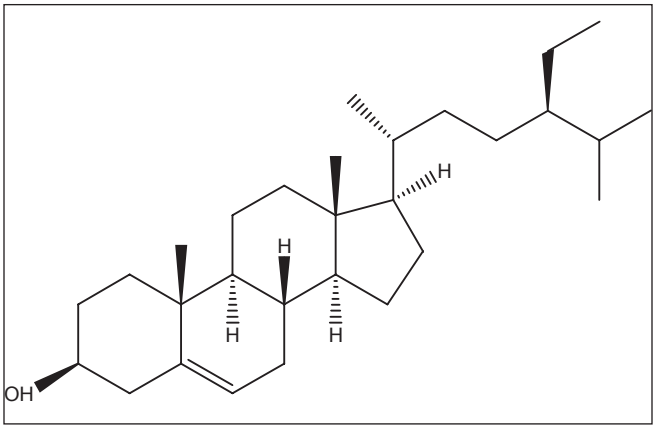

Figure 3: β - sitosterol

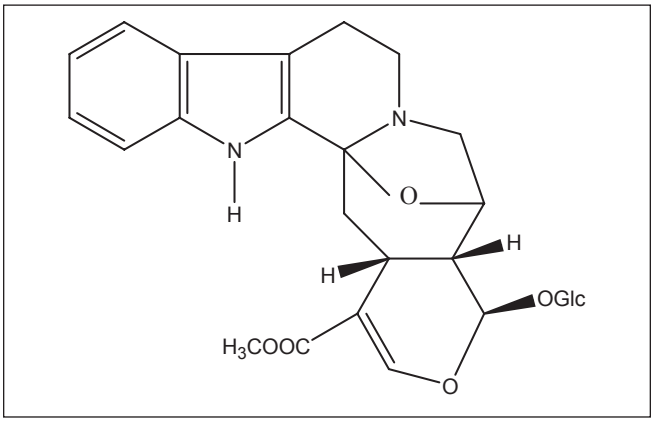

Figure 4: Cadambine

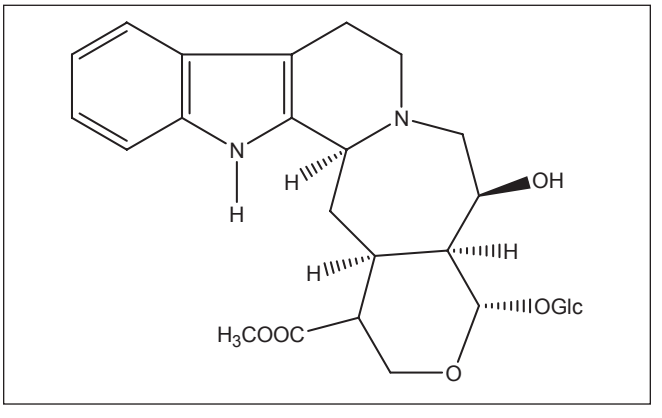

Figure 5: 3α-dihydrocadambine

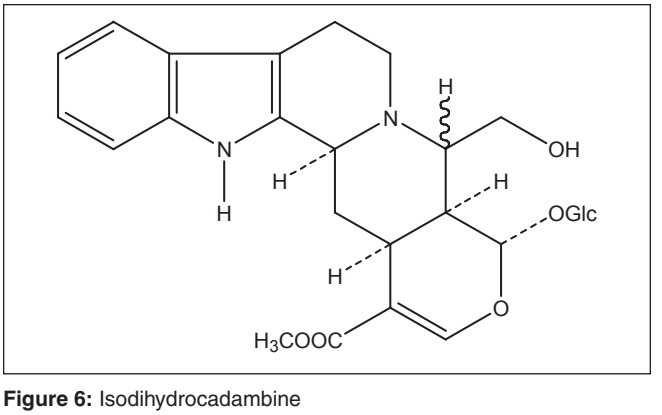

Figure 6: Isodihydrocadambine

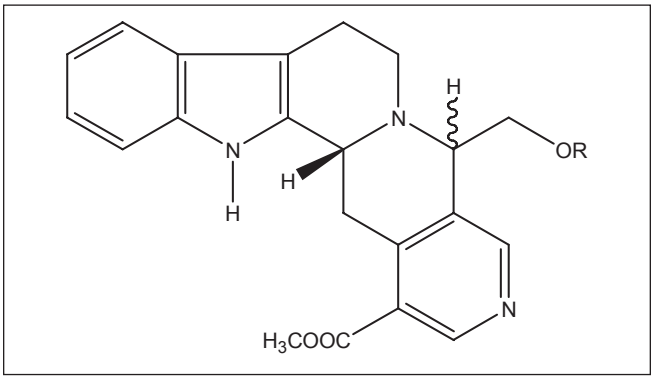

Figure 7: Cadamine

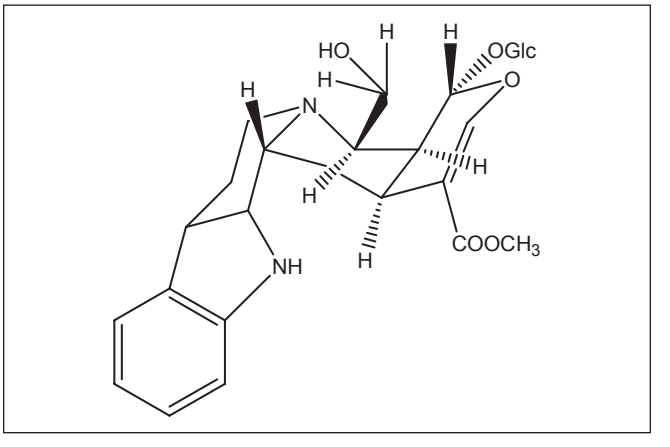

Figure 8: 3β-isodihydrocadambine

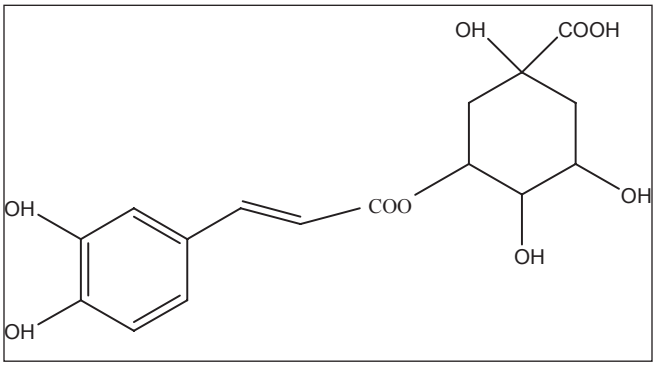

Figure 9: Chlorogenic acid

alkaloids, aminocadambine A ($C_{24}H_{27}N_3O_5$) (Fig. 10) and aminocadambine B ($C_{25}H_{29}N_3O_5$) (Fig. 11) obtained from the leaves of *Neolamarckia cadamba*, previously named *Anthocephalus chinensis*[18] whereas some worker biosynthetically synthesized glucosidic indole alkaloid cadambine from its biological precursor secologanin[19] which is the main precursor of various indole alkaloids. Three monoterpenoid gluco-indole alkaloids, 3β-isodihydrocadambine, cadambine and 3α-dihydrocadambine isolated from *Nauclea cadamba* (Roxb.).[20] The flowers of *Anthocephalus cadamba* yield an

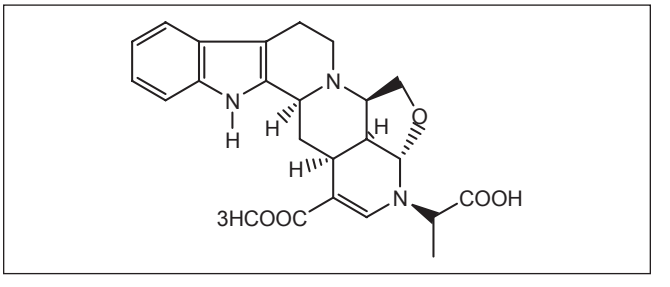

Figure 10: Aminocadambine A

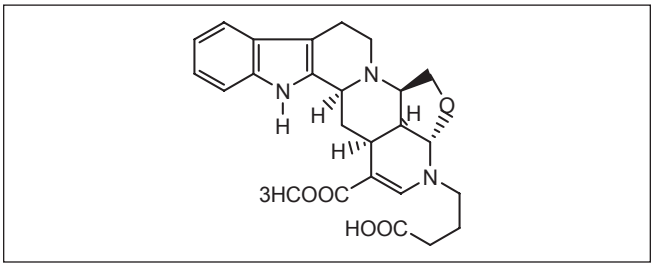

Figure 11: Aminocadambine B

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.[2] Two triterpenoid glycosides, glycosides A and B were isolated from the bark of *Anthocephalus cadamba* and defined as 3-*o*-(α-L-rhamnopyranosyl)-quinovic acid-28-*o*-(β-D-glucopyranosyl) ester and 3-*o*-(β-D- glucopyranosyl)-quinovic acid-28-*o*-(β-D- glucopyranosyl) ester respectively[21] and eight different alkaloids also obtained from *Anthocephalus cadamba* named cadambine, CFJ 83, isomalindan, cadamine, 2 derivs. HFP34, GZM28, malindan, dihydrocadambine (Fig. 12), 2 derivs. GPX71, GPX73, isomalindan, isodihydrocadambine, 2 derivs. GPX51, GPX53, malindan.[22] The seeds of *Anthocephalus indicus* composed of water-soluble polysaccharides D-xylose, D-mannose and D-glucose in the molar ratio 1:3:5.[23]

PHARMACOLOGICAL STUDIES

From literature survey it was found that the almost all parts of the plant *Anthocephalus cadamba* is used in the treatment of various diseases. Decoction of leaves are used as gargle in aphthae or stomatitis and in the treatment of ulcers, wounds, and metorrhea. Bark of the plant is used in fever, inflammation, cough, vomiting, diarrhoea, diabetes, burning sensation, diuresis, wounds, ulcers and in the treatment of snake-bite.[1,2,3,5]

Antidiabetic activity

The alcoholic extract of the stem bark of *Anthocephalus cadamba*, syn. *Neolamarckia cadamba* has 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.[24,25] 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

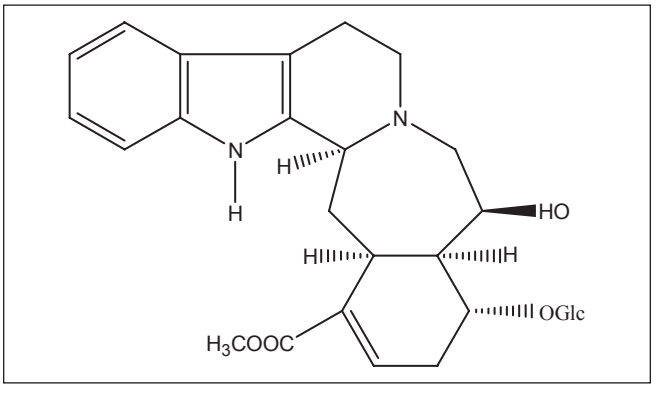

Figure 12: Dihydrocadambine

tested against the normoglycaemic and alloxan induced hyperglycaemic rats.[26]

Analgesic, Antipyretic and Anti-inflammatory activities

Extracts of the bark and leaf of *Anthocephalus cadamba* possess the analgesic, antipyretic and anti-inflammatory activities. 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).[27,28] The methanolic extract of the bark of *Anthocephalus cadamba* was successfully evaluated for analgesic, antipyretic and anti-inflammatory activities by some workers.[29,30]

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 diarrheoea in mice. The extract also produced a dose-dependent reduction in intestinal fluids accumulation.[31]

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.[32]

Antihepatotoxic 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*. 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 CCl_4 administered mice. The antioxidative activity of CGA is responsible for its hepatoprotective nature. CCl_4 is used as a model of liver injury.[16]

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 dyslipidemic animals resulted in significant decrease in total cholesterol, phospholipids, triglycerides and lipid peroxides.[33]

Antioxidant activity

The extract of *Anthocephalus cadamba* Syn. *A. indicus* possesses potent antioxidant activity by inhibiting lipid peroxidation and increase in the superoxide dismustase (SOD) and catalase activity.[33,34]

Antimicrobial and wound healing activity

Anthocephalus cadamba has been reported for antimicrobial activitites. The plant have been reported to posses 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*.[34,35] The experimental evidence also show that *A. cadamba* extract has potent wound healing capacity.[34] The aqueous extract of *A.cadamba* also found effective against *Rathyibacter tritici* a causal organism of tundu disease of wheat,[36] and effective against foot and mouth disease of animals.[37]

Anthelmintic activity

Aqueous and ethanolic extracts of mature bark of *Neolamarckia cadamba* has been reported for its anthelmentic activity against earthworms, tapeworms, and roundworms.[38]

Toxicological studies

The methanolic extract of *Neolamarckia cadamba* barks were studied for its toxicity in mouse models. The results suggested that acute toxicity was found in animal models at doses range higher than 3000 mg/kg and there was no mortality found at 3000 mg/kg dose in animal models. The sub-acute toxicity was carried out at dose 600 mg/kg. From the result it is suggested that *N. cadamba* is non-toxic at doses of 600 mg/kg.[29,39]

FORMULATION AND ANALYTICAL STUDIES

Anthocephalus cadamba have been widely used in the in various ayurvedic formulation in the form of churna (nygrodhadi kvatha churn) and oil (grahanimihira taila).[4] It is widely used in the form of paste by tribe in western ghats for treating skin diseases.[34] Earlier various methods have been developed to analyze *Anthocephalus* extract, these method include HPTLC, TLC, and various spectroscopic techniques like IR, Mass and NMR spectroscopy.[40]

CONCLUSION

Research in medicinal plant has gained a renewed focus recently. The main reason is that the other system of medicine associated with number of side effects that often cause to serious problems. Though *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. Few toxicological studies have been reported. The work could also be done in this direction to ensure free utility of the plant.

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