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Review on pharmacognostic and pharmacological activities of *Careya arborea* plant

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Abstract

Careya arborea Roxb, commonly known as wild guava which belonging to the family *lecythidaceae* which is popular as Padmaka, Kumbhi in Ayurveda. This tree can be identified by its thick dark grey bark, large showy flowers and leaves which turn red in winter. It is a significant medicinal value plant, hence most of the plant parts used in traditional systems of medicine. It has been used as antimicrobial, astringent, demulcent, antitumor, antipyretic and antipruritic, hepatoprotective, antimicrobial, antioxidant, CNS activity, antileishmanial, antidiarrheal, anticoagulant, analgesic, antitumour and cytotoxic activity. The pharmacological activity of the plant depends upon the chemical constituents present in the plants. The present review reveals an account of updated information on its pharmacognostic and pharmacological activities of the plant *Careya arborea*.

Keywords: Antimicrobial, *careya arborea*, CNS activity, *lecythidaceae*, pharmacognostic

1. Introduction

Careya arborea is a species of tree in the *Lecythidaceae* family, native to the Indian Subcontinent, Afghanistan, and Indochina. It is known as Kumbhi in Hindi, and Slow Match Tree in English.

The word *Lecythidaceae* means large tropical trees bearing large fruits with woody skins (wikipedia.org). *Lecythidaceae* is a family of tropical trees and consists of about 20 different genera and 450 different species. The family is generally concentrated in the wet regions of tropical South America, with some genera in Africa and Asia.

2. Taxonomical classification

Kingdom: Plantae

Clade: Angiosperms

Clade: Eudicots

Clade: Asterids

Order: Ericales

Family: *Lecythidaceae*

Genus: *Careya*

Species: *Careya arborea*

3. Geographical distribution

It is widely distributed in India, Srilanka, Malaya peninsula, occasionally planted in gardens and along roadsides. In Karnataka it is distributed in Belgaum, Bellary, Chikmagalur, Chitradurga, Coorg, Hassan, Mysore, North kanara, Shimoga, South kanara districts.

4. Botanical description

This tree can be identified by its thick dark grey bark. The tree propagates by natural reproduction through seeds and coppice. The large showy flowers and leaves which turn red colour in winter. It is deciduous tree, about 9-18m high (Fig 1).

Leaves are simple, glabrous and broadly obovate; found in cluster at the end of branches. Flowers are yellowish white; borne in thick, hard terminal spikes.

The fruits are large, green, fleshy, globrous and rounded. The bark is fissured and dark grey. The wood is medium coarse-textured, hard, heavy and strong. The sapwood is white while heartwood is reddish in colour.

The tree flowers in the month of april-May. Fruiting- The fruit ripen in the month of june-july. The tree reproduces through seed propogation Seeds dispersal takes place with the commencement of the rain (Ragavendra *et al.* 2015) [2].

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Table 1: Traditional uses of *Careya arborea* Roxb. (Nupur Ambardar and Vidhu Aeri, 2013)

Part used	Traditional uses
Whole plant	<ul style="list-style-type: none"> • Astringent, demulcent, antipyretic, antipruritic, in cough, cold and eruptive fevers Smallpox. • Snake bite.
Fruits	<ul style="list-style-type: none"> • Cold and cough. • Digestion promoter.
Flowers	<ul style="list-style-type: none"> • Aphrodisiac Acrid, cures 'Kapha', demulcent in cough and cold • Tonic. • Vaginal ruptures, Fever. • Colic and loose motions. • Cold and Cough.
Calyx	<ul style="list-style-type: none"> • Filaria.
Seeds	<ul style="list-style-type: none"> • Colic and loose motions.
Leaves	<ul style="list-style-type: none"> • Fever and swellings. • Ulcers and skin diseases.)
Twig	<ul style="list-style-type: none"> • Leech repellent.
Gum exudates	<ul style="list-style-type: none"> • Jaundice after delivery. • Tongue ulcers.
Stem bark	<ul style="list-style-type: none"> • Constipation. • Diarrhoea. • Skin diseases. • In asthma, dental diseases and snake bite.
Stem sap	<ul style="list-style-type: none"> • Menorrhagic.
Root	<ul style="list-style-type: none"> • Astringent.
Bark	<ul style="list-style-type: none"> • Washing and cleaning abscesses, boils, ulcers and diarrhoea • Ear pain. • Skin diseases. • Antipyretic, antipruritic and eruptive fever. • Smallpox and stomach disorders. • Wound healing and body pain. • Astringent and demulcent, Cough and Cold; Alexiteric, anthelmintic and in urinary discharges, Rheumatic pain and diarrhoea. • Eye complaints, Abortifacient. • Asthma, dental diseases and snake bite, Tumors, dyspepsia, bronchitis and colic • Coarse fibre for cordage ropes, cloth sacking and saddle making.

**Fig 1:** *Careya arborea* plant

5. Pharmacognostical Investigations

Careya arborea is a medicinal plant used in ayurveda and chinese medicine. The barks, leaves and fruits were used in the treatment of ulcer, haemorrhoids and tumour (Table 1). Several reports are available on the pharmacognosy of the leaves and barks of the medicinal tree. Histology of the fruit

and microscopy of the fruit powder were studied Tests for identification of phytochemical compound classes were carried out on methanol extract of the fresh fruit. The chemical constitution of the fruits was studied using HPTLC and HPLC, phytochemical screening revealed the presence of alkaloids, flavanoids, phenols, tannins, sterols, and fixed oils The fruit contain high amount of phenols, of which gallic acid present in high quantity which is responsible for antibacterial activity (Wadkar kiran and Magdum 2009) [3].

The pharmacognostic profile of leaves and stems of *Careya arborea* Roxb. (Lecthyidaceae), an important medicinal plant in the Indian system of medicine leaf and stem samples of this plant were evaluated by macroscopical, microscopical, physicochemical, phytochemical, fluorescence analysis of powder of the plant and other methods for standardization recommended by WHO. Macroscopically, the leaves are simple, broadly obovate in shape, acuminate apex with crenate, dentate margin, petioles (0.1-1.8cm) long.

Microscopically, the leaf showed the presence of median large size vascular bundle covered with fibrous bundle sheath, arrangement of xylem in cup shape and presence of cortical vascular bundle, patches of sclerenchyma, phloem fibers in groups and brown pigment containing cells in stem are some of the diagnostic features noted from anatomical study. Powder microscopy of leaf revealed the presence of parenchyma cells, xylem with pitted vessels and epidermis with anisocytic stomata. The investigations also included leaf surface data quantitative leaf microscopy and fluorescence analysis. Physicochemical parameters such as loss on drying, swelling index, extractive values and ash values were also

determined and results showed that total ash of the stem bark was about two times higher than leaf and water soluble extractive value of leaf and stem bark was two times higher than alcohol soluble extractive value. Preliminary phytochemical screening showed the presence of triterpenoids, saponins, tannins and flavonoids (Kumar *et al.* 2010) [4].

The pharmacognostic parameters of leaves and stem of *Careya arborea* was extensively investigated which showed its magnificent medicinal values (Prakash and Nisha, 2012) [5]. This is an imperative therapeutic plant used in Indian medicine. In his study, its leaves showed some unique characteristics of turning red colour in winter and it has thick dark grey bark and large showy flowers. The bark of *C. arborea* was conventionally used for the treatment of skin disease, epileptic fits, tumours, ulcer, bronchitis, abscesses, an antidote to snake venom, and astringents. The flowers and leaves are made in to paste and to cure several skin diseases, diarrhoea, dysentery with bloody stools and ear pain. Leaf pulp is used as poultice and it helps to heals rapidly (Prakash and Nisha, 2012) [5].

6. Pharmacological Investigations

6.1 CNS activity

Central nervous system (CNS) activity of the methanol extract of barks of *Careya arborea* in Swis albino mice and Wistar albino rats. General behavior, exploratory behavior, muscle relaxant activity and phenobarbitone sodium-induced sleeping time were studied. The results revealed that the methanol extract of barks of *Careya arborea* at 100 and 200 mg/kg caused a significant reduction in the spontaneous activity. Remarkable decrease in exploratory behavioral pattern, a reduction in muscle relaxant activity (rota rod and traction tests), and also significantly potentiated phenobarbitone sodium– induced sleeping time. The results suggest that methanol extract of *Careya arborea* exhibit CNS depressant activity in tested animal models. The results suggested that methanol extract of *Careya arborea* exhibit CNS depressant activity in tested animal models (Ramanathan S *et al.* 2008) [6].

6.2 Cytotoxic and Antioxidant activity

Careya arborea is used in traditional medicine for the treatment of tumours and other ailments. The successive chloroform and ethyl acetate extracts and crude 50% methanol extract exhibited potent cytotoxicity against cancerous RD, Hep-2 and HELA cell lines. They were found to be safe against the normal Vero cell line. The methanol and aqueous extracts possessed strong antioxidant activity against many oxidants in the *in vitro* antioxidant screening. The total phenol content of these extracts was found to be high. The results suggest strong cytotoxic and antioxidant properties and support the ethnomedical claims for the plant Senthikumar *et al.*, 2007) [7].

6.3 Induction of apoptosis and cytotoxic activity

Anticancer activity of the methanolic extract of bark of *Careya arborea* Roxb was evaluated. Cytotoxicity was assayed by Trypan blue dye exclusion method and MTT assay. The apoptosis was determined by the DNA fragmentation assay and the morphological studies were carried out for *Careya arborea*. CABE were found to be cytotoxic to DLA and EAC cell lines in a dose dependent manner in Trypan blue dye exclusion method. Concentration needed for 50% inhibition was found that 200µg/ml in DLA

cell lines and 120µg/ml in EAC cell lines respectively. In MTT assay concentration needed for 50% inhibition was found to be 17µg/ml in L929 cell lines. Its found that cytotoxic effect of CABE was associated with apoptosis on DLA cell lines by determination of morphological changes and DNA fragments. Thus it indicates that this substance can show different activities and has potential for cancer prevention which was dose dependent (Subhadradevi *et al.* 2010) [8].

6.4 Antifertility effect

The antifertility effect of methanolic root extract of *Careya arborea* Roxb. Was investigated in albino mice. The methanolic root extracts of the plant did not show any sign of acute toxicity up to the dose level of 5000mg/kg bodyweight in adult mice. At the dose level of 500mg/kg body weight the root extracts showed strong pregnancy inhibitory effects. The GC-MS analysis on the methanolic extract showed the presence of some phenolic compounds-hydroquinone, resorcinol, synergic acid, vanillic acid, gallic acid, 2-methoxy dibenzofuran. Presence of these phenolic compounds might be responsible for the anti-fertility activity of the plant (Jogen *et al.* 2011) [9].

6.5 Wound healing activity

Careya arborea is known as *Kumbhi* in Ayurveda and is an important medicinal plant. It has been used in Ayurveda in treatment of tumours, cough, bronchitis, haemorrhoids, intestinal worms, dysentery, ulcers and eruptive fevers. The wound healing activity of *Careya arborea* was confirmed with rats. This wound healing effect were extensively studied using different models of wound healing activity such as excision wound model, incision wound model, burn wound model and dead space wound model. This was applied topically at two different doses of extract *Careya arborea* 5% and *Careya arborea* 10%. Both doses of extract increased healing of wound in excision wound model. In incision wound model, breaking strength is high in both doses of extract when compare to control. Where as in case of wound contraction model, *Careya arborea* extract showed high wound contraction with less epithelization period and in case of dead space wound model, both doses showed significant wound healing activity. Both the doses of *Careya arborea* extract showed wound healing activity in all the models and the high dose of the extract was more effective compared to low dose (Ramesh and Dinesh, 2013) [10].

6.6 Anti-inflammatory Effect

The anti-inflammatory activities of methanol extract of *C. arborea* (MECA) at doses of 100 and 200 mg/kg were investigated in CFA induced inflammation using Indomethacin (5 mg/kg) as reference drug Inflammation was induced by injecting 0.1 ml of CFA containing 5 mg/ml of heat killed *Mycobacterium tuberculosis* into the sub plantar region of the left hind paw. Treatment with the extract and standard was started on the day of induction of inflamogens and continued up to 28 days. The effect of MECA on the production of nitric oxide, myeloperoxidase, gamma glutamyl transferase, malondialdehyde and C-reactive protein were determined. Oral administration of MECA (100 and 200 mg/kg) significantly reduced paw volume and tibio-tarsal joint diameter ($p < 0.001$) when compared with CFA control. The score of arthritic index in groups received methanolic extract was 100 and 200 mg/kg and in indomethacin was 5 mg/kg (Begum *et al.* 2014) [11].

6.7 Anti-allergic activity

Anti-allergic activity of *Careya arborea* was evaluated using isolated guinea pig ileum, isolated rat ileum preparation and passive paw anaphylaxis in rats. The effect of methanolic extracts (100, 200 µg/ml) of fruits and leaves were recorded on contraction induced by histamine and acetylcholine on isolated guinea pig ileum and isolated rat ileum, respectively. The inhibition of paw volume was studied (100,300mg/kg CLA, and 100, 300mg/kg CFA, p.o.) against comparing with vehicle. Dexamethasone (0.27mg/kg, p.o.) was used as a positive control. Anti-allergic activity investigation on methanolic extract of leaves (CLA) and methanolic extract of fruits (CFA) of *Careya arborea* (Lecythidaceae). It revealed that the anti-allergic activity of methanolic extract of the fruits (CFA) and leaves (CLA) of *C. arborea* might be due to presence of phenolic and flavonoid compounds (Daya and Patel, 2014) [12].

6.8 Anticonvulsant effect

The anticonvulsant activity of *C. arborea* Linn. bark against experimental induced seizures. Convulsion was induced by maximal electroshock seizures (MES), pentylenetetrazol (PTZ) and PTZ-induced kindling model. Petroleum ether (PE), chloroform (CH), methanol (ME) and aqueous (AQ) extract of *C. arborea* bark at 150 and 300 mg/kg b.w. were administered in all models. Mean values and standard error mean was determined for all models. The results revealed that ME and AQ extract of *C. arborea* bark at 300 mg/kg b.w. p.o. showed the most significant ($P < 0.01$) anticonvulsant effect by decreasing the duration of hind limb 10extension (extensor phase), clonus and also the duration of stupor phase, as compared with control in MES and PTZ and the extracts also inhibited seizure score in PTZ-induced kindling model (Gulab *et al.* 2013) [13].

6.9 Antidiarrhoeal effect

It's found that the methanol extract of the *Careya arborea* Roxb. Bark significantly reduced castor oil-induced diarrhoea in mice. This effect supports the local traditional use of the plant against diarrhoeal (Rahman and Saha 2006) [14].

6.10 Anti-ulcer activity

The anti-ulcer activity of stem bark of *Careya arborea* Roxb. on the wister strain albino rats was investigated. Dried stem bark of *Careya arborea* Roxb was subjected for preliminary phytochemical analysis and anti-ulcer activity against various models. In acute toxicity study, EECA was found safe till 3000mg/kg. The percentage of ulcer protection was validated based on Ulcer index and Gastric juice volume, pH and acidity of gastric juice. The phytochemical analysis of EECA showed the presence of carbohydrates, glycosides, phytosterols, phenolic compounds, tannins and saponins. The EECA has shown significant activity at both 300mg/kg and 600mg/kg dose level in a dose dependent manner. Phytoconstituents like tannins and saponins might be responsible for anti-ulcer activity of EECA (Kamal Kumar *et al.* 2013) [15].

6.11 Hepatoprotective and antioxidant effects

The hepatoprotective and antioxidant effect of methanolic extract of *careya arborea* stem bark was investigated in wister albino rats. The effect of the MECA and silymarin on serum transaminase, alkaline phosphates, bilirubin, uric acid, and total protein were measured in rats induced hepatotoxicity by carbon tetrachloride. Hepatoprotective effect can be

observed by using silymarin and MECA from these result, it is found that MECA possess potent hepatoprotective and antioxidant properties (Sambath kumar *et al.* 2005) [16].

6.12 Anticoagulant activity

Thrombotic diseases such as myocardial or cerebral infarction are serious consequences of the thrombus formed in blood vessels. Antithrombotic agents are used to prevent thrombosis and thrombolytic agents to dissolve the already formed clots in the blood vessels. Herbal preparations are been used since ancient times for the treatment of several diseases. Several plants used for the treatment of thromboembolic diseases in different systems of traditional medicine have shown anticoagulant or antithrombotic activity and such plants are claimed in the traditional system yet to be scientifically investigated (Shikha *et al.* 2014) [17].

6.13 Induction of callus

The callus induction of *Careya arboreya* Roxb belonging to the family-Lecythidaceae. The seeds of *C. arborea* used as source of explant in the Murashige-Scoog media as a basic culture medium. The callus was obtained by inoculating the surface sterilized seeds in culture vessels containing MS media supplemented with different concentration and combination of plant growth regulators for callus induction at 25 ± 2 °C placed under illumination, provided by white fluorescent tube light (200lux) and exposed to 16 hours of photoperiod and 60% of relative humidity, callus induction was found on each vessels in the media (Reddy *et al.* 2014) [18].

6.14 Gastro protective effect

- The gastro protective effect of *C. arborea* leaves (CALE) was investigated using different gastric ulcer models. A significant decrease occurred in the level of H+K+AT Pase, volume of gastric juice, and acid output while the level of gastric wall mucus was increased significantly. It also found that the antioxidant enzyme levels of LPO and SOD were decreased with concomitant increase in catalase activity in CRS-induced ulcers. High-performance thin-layer chromatography revealed the presence of quercetin, ellagic acid, and gallic acid in CALE which showed that *C. arborea* possesses significant gastro-protective activity (Prakash Chandra Gupta, Chandana V Rao, 2014) [19].
- Antimicrobial activity of *Careya arborea* Roxb., from leaf extracts showed potential antibacterial activity against *S. aureus* and *B. subtilis*. Ethyl acetate and ethanol extracts showed the highest zones of inhibition for Gram positive, gram negative bacteria and for fungus. *C. albicans*. *Careya arborea* leaf extracts were able to have a MIC range of 0.938-15 mg mL⁻¹, in two-fold dilution method. Gram-positive *B. subtilis*, Gram-negative *E. coli* and fungus. The leaf extracts found to be bacteriostatic and fungistatic at low concentrations. This could be due to the presence of phyto-compounds such as triterpenoids, steroids, flavonoids and tannins as major phytoconstituents with known antimicrobial agents. These phyto-constituents may be responsible for the antimicrobial activity of *C. Arborea* (Mahadev R. Mali *et al.* 2015) [20].
- The dried powdered bark of *careya arborea* Roxb. Extract was studied for antimicrobial activity which reveals significant antimicrobial activity against gram positive bacteria (*Micrococcus luteus*, *Staphylococcus*

aureus), gram negative (*Pseudomonas aerogenosa*, *E. coli*) and fungi (*Aspergillus niger*, *Candida albicans*). The highest zone of inhibition for bacteria found in *E. coli* and for fungi in *Candida albicans* (Navya and Anitha, 2018) [21].

- *Careya arborea* were analyzed for the pesticidal activity by leaf dip and diet bioassay techniques against *Spodoptera litura* and *Helicoverpa armigera*. *Spodoptera litura* and *Helicoverpa armigera* are the devastating pests of numerous wild and cultivated plants throughout the world. It has been reported to attack more than 150 species of agricultural crops including cotton, groundnut, tobacco, maize, bean, potatoes, soybean, rice, sunflower, tomato etc. Management of these insect has been largely based on insecticides, but the development of resistance to most of synthetic insecticides and an associated environmental problem has necessitated searching for some alternative natural pesticides. New types of the herbal pesticides originating from natural products, targeting *Spodoptera litura* and *Helicoverpa* could be a useful alternative for integrated pest management. Herbs were extracted successively with pet ether, chloroform, methanol, ethanol, and water. The pesticidal activity of all the extracts confirmed against *Spodopteralitura* and *Helicoverpa armigera* (Ramya and Roopashree, 2017) [22].

7. Conclusion

Use of herbal medicinal plants has been distinctive in our lives right from the primitive period till today and provided us with the data on the use of plants or plant products as therapeutic agents in treating various ailments by virtue of their phytoconstituents.

Careya arborea Roxb. is an important medicinal plant. Extensive literature survey revealed its pharmacological potential as an important traditional drug. The drug is enriched with flavonoids, tannins, terpenoids and sterols. The plant exhibits many pharmacological activities like antioxidant, antitumor, analgesic, hepatoprotective, antidiarrhoeal, anticoagulant and diuretic properties. However, a systematic pharmacological investigation is required to produce more potent formulations.

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