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, 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, Sri Lanka, 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 height (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, globose 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 propagation. Seeds dispersal takes place with the commencement of the rain (Ragavendra et al. 2015) [2].
Table 1: Traditional uses of Careya arborea Roxb. (Nupur Ambardar and Vidhu Aeri, 2013)

<table>
<thead>
<tr>
<th>Part used</th>
<th>Traditional uses</th>
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<tbody>
<tr>
<td>Whole plant</td>
<td>Astringent, demulcent, antipyretic, antipruritic, in cough, cold and eruptive fevers Smallpox.</td>
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<tr>
<td></td>
<td>Snake bite.</td>
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<tr>
<td>Fruits</td>
<td>Cold and cough.</td>
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<td></td>
<td>Digestion promoter.</td>
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<tr>
<td>Flowers</td>
<td>Aphrodisiac Acid, cures ‘Kapha’, demulcent in cough and cold</td>
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<td></td>
<td>Tonic.</td>
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<td></td>
<td>Vaginal ruptures, Fever.</td>
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<tr>
<td></td>
<td>Colic and loose motions.</td>
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<tr>
<td></td>
<td>Cold and Cough.</td>
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<tr>
<td>Calyx</td>
<td>Filaria.</td>
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<tr>
<td>Seeds</td>
<td>Colic and loose motions.</td>
</tr>
<tr>
<td>Leaves</td>
<td>Fever and swellings.</td>
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<tr>
<td></td>
<td>Ulcers and skin diseases.</td>
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<tr>
<td>Twig</td>
<td>Leech repellent.</td>
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<tr>
<td>Gum exudates</td>
<td>Jaundice after delivery.</td>
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<tr>
<td></td>
<td>Tongue ulcers.</td>
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<td>Stem bark</td>
<td>Constipation.</td>
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<td></td>
<td>Diarrhoea.</td>
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<td></td>
<td>Skin diseases.</td>
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<tr>
<td></td>
<td>In asthma, dental diseases and snake bite.</td>
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<tr>
<td>Stem sap</td>
<td>Menorrhagic.</td>
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<tr>
<td>Root</td>
<td>Astringent.</td>
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<tr>
<td>Bark</td>
<td>Washing and cleaning abscesses, boils, ulcers and diarrhoea</td>
</tr>
<tr>
<td></td>
<td>Ear pain.</td>
</tr>
<tr>
<td></td>
<td>Skin diseases.</td>
</tr>
<tr>
<td></td>
<td>Antipyretic, antipruritic and eruptive fever.</td>
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<td></td>
<td>Smallpox and stomach disorders.</td>
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<td></td>
<td>Wound healing and body pain.</td>
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<tr>
<td></td>
<td>Astringent and demulcent, Cough and Cold; Alexiteric, anthelminthic and in urinary discharges, Rheumatic pain and diarrhoea.</td>
</tr>
<tr>
<td></td>
<td>Eye complaints, Abortifacient.</td>
</tr>
<tr>
<td></td>
<td>Asthma, dental diseases and snake bite, Tumors, dyspepsia, bronchitis and colic</td>
</tr>
<tr>
<td></td>
<td>Coarse fibre for cordage ropes, cloth sacking and saddle making.</td>
</tr>
</tbody>
</table>

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 macroscopic, 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. Physiochemical parameters such as loss on drying, swelling index, extractive values and ash values were also
6. Pharmacological Investigations

6.1 CNS activity
Central nervous system (CNS) activity of the methanol extract of barks of *Careya arborea* in Swiss 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 inflammogens 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), pentyleneterazol (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 diarrhea 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, phytoestrogens, 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 arborea 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 mL1, 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
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 insects 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 Spodopterlitura and Helicoverpa armigera (Ramya and Roopashree, 2017)

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, antidiarrhoical, anticoagulant and diuretic properties. However, a systematic pharmacological investigation is required to produce more potent formulations.

8. References