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Review Article

Phytochemicals, Pharmacological Properties and Traditional uses of *Garcinia gummi gutta (l.) N. Robson:* A Comprehensive Review

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Abstract

Herbal therapy has been practiced for centuries by ancient civilizations and tribal communities, largely owing to the accessibility of locally available medicinal plants and their comparatively fewer adverse effects. *Garcinia gummi-gutta,* a tropical species belonging to the family *Clusiaceae,* is one such plant of considerable medicinal importance due to its diverse phytochemical composition and wide range of biological activities. Various parts of the plant, including the leaves, fruits, bark, seeds, latex, and roots, have been reported to contain bioactive constituents such as bioflavonoids, xanthones, benzophenones, organic acids, along with minor components like terpenoids, steroids, flavonoids, and phenolic acids. Several pharmacological properties have been documented, including antibacterial, antioxidant, antidiabetic, anti-inflammatory, anticancer, anti-obesity, antifungal, anthelmintic, antithrombotic, anticholinesterase, antiulcer, larvicidal, and wound-healing activities. These effects are primarily attributed to key compounds such as cambogin, camboginol, hydroxycitric acid, flavonoids, and xanthones. The present review summarizes the taxonomy, classification, vernacular names, morphological characteristics, geographical distribution, phytochemistry, and pharmacological potential of G. gummi-gutta. Nevertheless, further experimental and clinical investigations are required to better elucidate its pharmacokinetic and pharmacodynamic properties, thereby strengthening its potential role in modern herbal drug development.

Keywords: *Garcinia gummi-gutta (L.) Roxb.,* Phytochemicals, Pharmacological activities, Traditional medicine, Morphology

Introduction

Since ancient times, plants have served as essential resources for food, shelter, clothing, flavoring agents, and medicines [1,2]. Archaeological evidence suggests that medicinal herbs were used even in prehistoric periods [1]. Over time, systematic observation and empirical knowledge helped identify the therapeutic potential of plant-derived phytochemicals [3]. In India, traditional systems of medicine such as Ayurveda reached significant development during the Vedic period

(2000–800 BC), with classical texts like *Vrikesayurveda* describing medicinal plants in detail [2]. Later, the Greco-Arab (Unani) system further emphasized the medicinal use of plants [3]. However, accurate identification of medicinal species remains critical to ensure therapeutic reliability. Modern taxonomy, regional floras, and quantitative microscopy play an important role in proper species authentication [4,5].

The genus *Garcinia*, belonging to the family *Clusiaceae,* comprises nearly 250 species distributed mainly in tropical regions [6]. Among them, *Garcinia gummi-gutta* (L.) Roxb. (syn. *Garcinia cambogia* (Gaertn.) Desr.), commonly known as Malabar tamarind, is one of the most widely recognized species [7]. Several *Garcinia* species are found in the Western Ghats of India, including *G. gummi-gutta*, *G. imberti*, *G. indica*, *G. morella*, *G. pushpangadaniana*, *G. rubroechinata*, *G. talbotii*, *G. travancorica*, and *G. wightii* [8,9]. Among these, *G. gummi-gutta* is extensively distributed in Kerala and southern parts of India [8].

The fruit of *G. gummi-gutta* is traditionally used as a culinary spice and preservative and has gained attention as a nutraceutical ingredient [10]. The rind contains approximately 10–30% (-)-hydroxycitric acid (HCA), which has been widely studied for its hypolipidemic and weight-management properties [11,12]. In addition, the plant is a rich source of bioactive benzophenones such as camboginol (garcinol) and cambogin (isogarcinol) [13].

Various parts of the plant, particularly the fruit rind, leaves, and bark, have been used in traditional medicine for the management of conditions such as obesity, inflammation, microbial infections, abdominal disorders, diarrhea, dysentery, chronic ulcers, oxidative stress, and certain metabolic disorders [7,3]. Pharmacological investigations have reported a range of biological activities including anticancer, anti-obesity, anti-inflammatory, antibacterial, antifungal, antiviral, antioxidant, antidepressant, and antidiabetic effects [14-20]. Phytochemical studies indicate that the major constituents of *Garcinia* species include biflavonoids, xanthones, benzophenones, and organic acids, while minor components such as terpenoids, steroids, flavonoids, and phenolic acids are also present [15-17].

The plant is commonly known as Malabar tamarind and is referred to by various regional names such as kudampuli, brindle berry, upagi mara, simai hunase, and kodakkapuli [18,19]. It has several botanical synonyms including *Cambogia gummi-gutta L., Cambogia gutta L., Garcinia affinis, Garcinia cambogia Desr*., *Garcinia gutta Roxb*. and *Mangostana cambogia Gaertn* [4]. In different Indian languages, it is known as Upagi mara, Simai hunase, and Punarpuli (Kannada); Simachinta (Telugu); Dharambe (Marathi); Kodakkapuli (Tamil); Vrukshamlah (Sanskrit); Bilatti-amli (Hindi); and Kadumpuli, Kodapuli, Marapuli, Meenpuli, Perumpuli Pinumpuli, and Pinar (Malayalam) [8,9].

Morphological Description

Garcinia gummi-gutta (L.*) Roxb*. is an evergreen tree that may attain a height of up to 20 meters [21]. The plant produces a pale yellow, sticky exudate characteristic of many species within the genus [22]. The leaves are elliptic to obelliptic-ovate in shape, measuring approximately 6–13 cm in length and 2.5–6 cm in width [21,23]. The male flowers are tetramerous and borne in axillary fascicles, usually 3–8 in number, with a size of about 1–1.7 × 1–1.2 cm and pedicels 7–12 mm long. The sepals are orbicular with membranous margins bearing fimbril-like projections, while the petals are oblong, pale yellow to orange-yellow, and membranous along the margins. Stamens are arranged in a globose head, and the rudimentary pistil is either absent or, if present, shows a discoid stigma with a four-lobed cleft [23].

The female flowers are also tetramerous and occur solitary or in small fascicles (1–3) either terminally or axillary, measuring about 1.5–2 × 1.5 cm [21]. They contain 10–20 staminodes, and the ovary is 4–12 locular, approximately 1 mm long, with one ovule in each locule. The ovary is sub globose to ovoid and grooved, with stigmatic rays spreading and nearly free to the base, and margins crenate to tuberculate. The fruit is globose, 6–8 cm in diameter, prominently 6–10 grooved and turns yellow to orange-yellow upon ripening. The pericarp is thick and fleshy. The seeds are typically 6–8 in number, ovoid, measuring approximately 2–3.3 × 0.7–0.9 mm, compressed, and surrounded by a white or red pulpy aril [24].

The bark is grey to brown externally, with the inner bark appearing yellow or occasionally white [21]. The stem and twigs exude yellow, white, or cream-colored resin known as gamboge, a solidified sticky exudate also found in immature fruit rind and leaves [22,25]. The yellow exudation is considered a characteristic feature useful in species identification. The root system is of the taproot type, consisting of a thick central root with several lateral branches. It is woody, brownish in color, and provides strong anchorage and efficient nutrient absorption [21]. Field identification features include elliptic leaves measuring 6–13 cm in length, stigmatic lobes numbering 6–10, and deeply grooved fruits with 6–10 prominent ridges [23,24].

Figure 01: Distribution of *Garcinia* gummi gutta

Table 01: Key Diagnostic Characteristics of *Garcinia gummi-gutta*

Sl. No.	Parameter	Characteristic
1	Habit	Large evergreen tree
2	Branches	Parallel or pendulous
3	Leaf shape	Elliptic-oblong to obovate
4	Petiole length	1.5–2.0 cm
5	Stamen arrangement	Globose head
6	Number of stamens	12–20 per flower
7	Ovary	4–12 locular
8	Number of stigmatic lobes	6–10

9	Fruit shape	Globose, deeply grooved
10	Number of grooves	6–10
11	Seed	Ovoid, surrounded by pulpy aril
12	Distribution	Western Ghats (India), Sri Lanka

Taxonomical History of *Garcinia gummi-gutta*

The taxonomic history of *Garcinia gummi-gutta* is complex and reflects several revisions over time [26]. The species was initially described by Carl Linnaeus as *Cambogia gummi-gutta L.*, with Van Rheede referring to the plant as "Coddam-pulli" in *Hortus Malabaricus* [26,27]. Later, Desrousseaux (1792) recognized *Garcinia cambogia* (Gaertn.) Desr., and in 1968, N. Robson proposed the combination nova, renaming the species as *Garcinia gummi-gutta (L.)* N. Robson [26]. Robert Wight described *Garcinia conicarpa Wight* based on specimens collected from the Shevagherry Hills; however, T. Anderson subsequently treated it as a variety under *G. cambogia (Gaertn.) Desr. var. conicarpa* [26]. Wight also described another variety, papilla, under G. *cambogia*. Later, N.P. Singh proposed the combinations *G. gummi-gutta var. conicarpa (Wight)* N.P. Singh and *G. gummi-gutta var. papilla (Wight)* N.P. Singh [26,28]. These revisions highlight the taxonomic complexity within the genus and the need for continued systematic studies [26,29]

Ethnomedicinal Uses

The fruit rind decoction has traditionally been used in the management of rheumatism and bowel disorders [30]. The resin exhibits purgative properties, while the fruit itself is rich in organic acids with marked antiseptic activity [30,31]. Dried rind preparations have been used in conditions such as rickets and splenomegaly, and also in the coagulation of rubber latex [31].

Various parts of the plant including fruit rind, leaves, and bark—have been employed in traditional medicine for conditions such as obesity, inflammation, microbial infections, abdominal disorders, dysentery, diarrhea, infected wounds, leucorrhea, chronic ulcers, gonorrhea, and oxidative stress-related disorders [31,32].

Traditional Uses

Garcinia gummi-gutta is widely used as a culinary condiment, particularly in South India, where the dried rind is utilized for flavoring curries and preserving fish. The smoke-dried rind, commonly known as Malabar tamarind, has been used traditionally in fish preservation practices such as "Colombo curing" [33].

The species yields a yellow adhesive gum resin similar to gamboge obtained from *Garcinia morella,* though of comparatively lower quality. The seeds yield oil used in traditional medicinal preparations [31]. The wood is hard, grey, and cross-grained, making it suitable for furniture manufacture [21]. The dried rind has also been used for polishing precious metals and as a natural substitute for acetic or formic acid in rubber latex coagulation [31].

Although not prominently included in classical Ayurvedic texts, the plant has been extensively used in folk medicine for conditions such as edema, menstrual irregularities, ulcers, hemorrhoids, fever, rheumatism, and intestinal parasitic infections [30,31]. Due to its astringent properties, it has been incorporated in gargles for gum disorders and in preparations for gastrointestinal complaints. It has also found applications in veterinary medicine [31].

Chemo taxonomical Studies

The genus *Garcinia* is considered taxonomically challenging due to significant diversity in floral morphology and architectural variation among closely related taxa [29]. Morphological characters are often influenced by environmental and developmental factors, contributing to classification difficulties. Therefore, chemotaxonomic approaches have been employed to support systematic studies [34].

Secondary metabolites such as xanthones, benzophenones, and bioflavonoids are characteristic of the genus and serve as valuable chemotaxonomic markers [34,35]. Both volatile and non-volatile chemical profiles have been utilized to differentiate varieties within G. gummi-gutta, providing supportive evidence for taxonomic classification [25,34].

Phytochemicals

Despite its economic importance and widespread cultivation in South India, relatively limited phytochemical investigations have been reported for *G. gummi-gutta.* The fruit is particularly known for its high content of (-)-hydroxycitric acid (HCA), a major organic acid extensively studied for its biochemical and metabolic effects. Among secondary metabolites, benzophenones constitute the predominant class, followed by xanthones and bioflavonoids [34,35]. These bioactive compounds contribute significantly to the pharmacological potential of the species [35].

Table 02. Phytochemical Constituents Reported from *Garcinia gummi-gutta*

Phytochemical Class	Major Compounds Identified	Plant Part	References
Organic Acids	(−)-Hydroxycitric acid (HCA), malic acid, citric acid, tartaric acid, oxalic acid, ascorbic acid	Fruit rind, leaves	13, 14, 16
Benzophenones	Garcinol (Camboginol), Isogarcinol, Cambogin, Guttiferones I, J, K, M, N	Fruit, latex, bark, leaf	20, 21, 29
Xanthones	Garbogiol, Rheedixanthone A, Oxyguttiferones M, K, K2, I	Bark, root, fruit	19, 20,37
Bioflavonoids	Morelloflavone, Dihydromorelloflavone, Isomorellin, Amentoflavone	Heartwood, root, leaf	37

Flavonoids	Mangostin, Fukugicidin, GB-1	Leaf	37
Fatty Acids	Stearic acid, oleic acid, linoleic acid, elaidic acid, palmitic acid, arachidic acid	Seeds	22,37
Amino Acids	Arginine, glutamine, threonine, glycine, proline, GABA, leucine, isoleucine, ornithine, lysine	Fruit	17
Volatile Compounds	α-Copaene, sesquiterpenoids	Leaf	4

Pharmacological Activities of *Garcinia gummi-gutta*

Extensive experimental studies have demonstrated a wide range of pharmacological activities for *Garcinia gummi-gutta*, attributed primarily to hydroxycitric acid (HCA), xanthones, benzophenones (garcinol, isogarcinol), flavonoids, and related polyphenols [36,37].

Antibacterial and Antimicrobial Activity

Various solvent extracts of *G. gummi-gutta* have shown moderate to significant antibacterial activity against both Gram-positive and Gram-negative bacteria, including Escherichia coli, *Staphylococcus aureus*, Bacillus subtilis, and *Pseudomonas aeruginosa*. Disc diffusion and minimum inhibitory concentration (MIC) studies indicate that higher extract concentrations exhibit stronger inhibitory effects, with MIC values reported around 10% for certain strains. The activity is attributed to the presence of phenolic compounds and benzophenones [23,25].

Antioxidant Activity

The antioxidant potential of fruit rind extracts has been evaluated using in vitro assays such as DPPH radical scavenging, hydroxyl radical scavenging, ferric reducing antioxidant power (FRAP), and lipid peroxidation assays. Ethanolic and hydroalcoholic extracts demonstrated notable free radical scavenging capacity. Reducing power assays have indicated significant electron-donating ability, suggesting that the plant possesses substantial antioxidant potential comparable to standard antioxidants in certain models [24,25,33].

Anti-Inflammatory Activity

In vitro (HRBC membrane stabilization) and in vivo (carrageenan-induced paw edema) models have confirmed anti-inflammatory activity of leaf and fruit extracts. Bioactive compounds such as garcinol and guttiferones are reported to modulate inflammatory mediators, contributing to the observed effects [29,31].

Anti-Obesity and Hypolipidemic Activity

The anti-obesity effect of *G. gummi-gutta* is primarily associated with hydroxycitric acid (HCA), which inhibits ATP-citrate lyase, a key enzyme in lipogenesis. Experimental studies in high-fat diet and dexamethasone-induced hyperlipidemic animal models have demonstrated reductions in serum cholesterol, triglycerides, LDL levels, and body weight gain. Some clinical studies report hypotriglyceridemic effects, although long-term efficacy and safety require further validation [36-38].

Antidiabetic Activity

Extracts of *G. gummi-gutta* have shown improvement in glucose metabolism in experimental models. The proposed mechanisms include modulation of lipid metabolism, improved insulin sensitivity, and antioxidant-mediated pancreatic protection [38].

Antiulcer Activity

Fruit extracts have demonstrated protective effects against indomethacin-induced gastric ulcer in rats. The mechanism appears to involve reduction of gastric acidity and enhancement of mucosal defense [32].

Anticancer Activity

Polyisoprenylated benzophenones such as garcinol have shown inhibitory effects on tumor cell lines and modulation of cytokine signaling pathways, including interaction with transcription factors such as STAT-1. These findings suggest potential anticancer properties, although further mechanistic and clinical studies are required [29,32].

Wound Healing Activity

In vitro and in vivo studies indicate that methanolic fruit extracts enhance wound contraction and tissue regeneration in excision wound models. Histopathological observations support improved epithelialization and collagen deposition [26].

Anthelmintic, Antifungal and Larvicidal Activity

Fresh juice and ethanolic extracts have exhibited dose-dependent anthelmintic effects in earthworm models. Leaf extracts have demonstrated antifungal activity against species such as Phytophthora, Curvularia, and Corynespora. Larvicidal studies also report cytotoxic effects against mosquito larvae at higher concentrations [27-29].

Antithrombotic and Hematological Effects

Preliminary studies suggest that seed extracts may influence clotting time and platelet parameters, although their effects are not superior to standard drugs such as aspirin. Additional studies are needed to establish clinical relevance [30,34].

Diuretic Activity

Ethanolic and aqueous leaf extracts have demonstrated dose-dependent increases in urine output and electrolyte excretion in animal models, supporting mild diuretic potential [38].

Safety Considerations

While many experimental studies suggest beneficial biological activities, some reports have indicated potential adverse effects, including hepatotoxicity and reproductive alterations at high doses. However, hydroxycitric acid has been reported to exhibit a relatively high no-observed-adverse-effect level (NOAEL) in controlled settings. Further well-designed clinical trials are essential to confirm safety and therapeutic efficacy [36,38].

Conclusion

Garcinia gummi-gutta is a phytochemically rich medicinal plant with diverse pharmacological properties supported by experimental evidence. Activities including antibacterial, antioxidant, anti-inflammatory, anti-obesity, antidiabetic, antiulcer, anticancer, diuretic, and wound-healing effects have been reported. Despite promising preclinical data, comprehensive clinical investigations are required to validate its therapeutic potential and ensure safety for long-term use

Conflict of Interest

The Authors declares no conflict of interest.

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