



# DETAILED STUDY OF GARCINIA INDICA

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## Abstract

The goal of the current investigation is to review the morphologic traits, distribution, chemistry, and pharmacological action of the plant *Garcinia indica*. Hydroxycitric acid (HCA), *garcinia indica*, also known as kokum fruit, is found in various plant parts along with flavonoids, anthocyanins, phenolic acid, and isogarcinol. These constituents are useful for generating a range of pharmacological activities, including those related to anti-inflammatory diseases, anti-cancer, anti-ulcer, anti-oxidant, antibacterial, anti-inflammatory, antidepressant, antimicrobial, anti-aging, hepatoprotective, neuroprotective effect, anti-diabetic, and antihyperlipidemic properties.

## Introduction

One of the major native tree spice crops, kokum (*Garcinia indica* Choisy), is found in evergreen and semi-evergreen forests and is grown in the Western Ghats of India, the South Konkan region of Maharashtra, Coorg, Wayanad, and Goa [1]. One underappreciated yet medicinally significant tree species is *Garcinia indica*, a tall, slender tree indigenous to India's Western Ghats. When fully grown, the globose or spherical fruit of *G. indica* is a deep purple color and is thought to have numerous health benefits [2]. Every state has a variety of colloquial names for kokum, including the following (Dhamija et al. 2013). Twenty of the 200 species in the genus *Garcinia* are found in India (Ramachandran, 2014) [3] and used as a sourcing agent in traditional recipes, as well as to make juice and syrup [4]. The tropical rain forests of the Western Ghats, extending from the Konkan southward to Mysore, Coorg, and Wayanad, are home to *Garcinia indica* (*G. indica*). It bears fruit from April to May, and it flowers from November to February. Astringent is the root. The fruit's seeds contain edible oil that is marketed as "Kokum butter." Small and complex compounds, such as xanthenes and xanthone derivatives, have been identified from different species of *Garcinia* over the past few years [5]. Garcinol shares structural similarities with curcumin, a well-known antioxidant that has both an enol version of a  $\beta$ -diketone moiety and phenolic hydroxyl groups [6]. Among these significant phytochemicals with various anticancer qualities is ganciclovir. Among the many *Garcinia* species that can be found in tropical Asia and Africa are *Garcinia indica*, a little evergreen tree. Garcinol is one of these polyisoprenylated benzophenones, which are extracted from the fruits and leaves of these trees [7].

## Morphological characters

Family: Clusiaceae

Synonym: *Brindonia indicia* Thou

Common name: Kokum

Kannada name : Tittidika

Sanskrit name : Vrikshamla

Malayalam name : Pinampuli

Tamil name : Murgalli

Kokum trees display a great variety of morphological differences in their natural habitat. Similar variances have been seen in the genotypes chosen for this investigation. The fact that these genotypes were taken from their natural environment may account for some of the physical differences. Fruit breeders need to evaluate the morphological features of trees. The great diversity found in the germplasm is reflected in the vast range of variances seen in plant height, canopy volume, girth of the plant, and canopy spread. From 5.20 m (IC552513) to 15.60

m (IC136687-1), plant height varied. IC136687-1 had the tallest plant measured at 15.60 meters, followed by IC136684-3 at 13.90 meters and IC136687-3 at 13.60 meters. In IC552513 (5.20 m), the lowest plant height was observed. The girth of the plant at 140 cm in height varied between 25.10 cm and 156.88 cm across the 29 genotypes of kokum. Plant girth was measured in ACC.FSC-1 at 156.88 cm, and IC 552522 at 25.10 cm, which was the lowest plant girth. One of the crucial factors for both bearing area and solar energy harvesting is canopy volume. ACC.FSC-9 had the greatest canopy volume ever measured. IC552513 had the lowest canopy volume [8].

## Distribution

*Garcinia indica* grows extensively in the forests of West Bengal, Assam, and Meghalaya as well as the Western Ghats of India. The Konkan region of Ratnagiri district in Maharashtra, Goa, Uttara Kannada, Udupi, and Dakshina Kannada districts in Karnataka, and the Kasaragod area of Kerala comprise the Western Ghats' coastal zone, where the tree is primarily found. It grows along the coast and well below an elevation of 800 meters (Braganza et al., 2012; Nayak et al., 2010). Because of their dioecious nature and cross-pollination, kokum trees have been found to exhibit a wide range of variation in the Western Ghats (Swami et al., 2014; Joseph and Murthy, 2015). According to a study done on 268 accessions of *G. indica* from various regions of the State of Goa, the total acid content of fresh fruit rind ranged from 1.2 to 11.2%, while the sugar level varied from 1.9 to 22.4o Brix (Braganza et al., 2012). According to the IUCN classification, *G. indica* is considered vulnerable. An organization called the Western Ghats Kokum Foundation (WGKF) strives to conserve and encourage the growth of *G. indica* in India [9]. The *Garcinia indica* Choisy (Thouars), often known as kokum, is an indigenous perennial tree species found in the Western Ghats of India. It is highly prized and has been underutilized for a long time. Kokum is a member of the subclass Dilleniidae and family Clusiaceae in the order Theales. The few significant genera that are members of the same family are *Garcinia*, *Hypericum*, *Vismia*, *Cratoxylum*, *Triandenum*, *Pentadesma*, *Mammea*, *Allanblackia*, *Calophyllum*, *Mesua*, etc (Robson and Adams, 1968). Kokum is a monopodial, evergreen, perennial tree that grows straight and has medium-length lateral branches. The extreme northern portion of Kerala, the coastal and interior regions of Karnataka, Goa, and the Konkan region of Maharashtra are all examples of the distribution of species on the western coast of India. The Andaman and Nicobar Islands, Orissa, and the northeastern parts of India are also home to a smaller population of the species (Rema and Krishnamurthy, 2000) [10].

## USES

Kokum has been used for a very long time in the Ayurvedic medical system of India. The fruits and leaves have astringent, sour, thermogenic, constipating, and digestive properties. Kokum rinds are used to make herbal remedies that are intended to treat gastrointestinal issues, rheumatic aches, and inflammatory illnesses. According to CHEMEXCIL (1992), the fruit is anthelmintic and cardiogenic. The rind's juice (sherbet) is used to treat ulcers, hemorrhoids, colic, and piles [11]. Due to their sour and acidic qualities, *Garcinia* fruits have long been employed in cooking and seafood preservation (Lewis and Neelakantan, 1965). Sharbat, a cooling agent that relieves heatstroke and quenches thirst, is made from the rinds of sun-dried fruit. *Garcinia* fruits are used in Ayurvedic medicine to treat urinary issues, and infections, and enhance digestion. The gummy exudates of *Garcinia* are employed as emetics and cathartics in folk medicine. *G. dulcis* [12]. The pharmaceutical industry has been interested in *Garcinia* plants because they can be used to treat a variety of conditions, including cancer, oxidative stress, inflammation, and microbial infections. *Garcinia* has several intriguing chemical families, including biflavonoids, acylphloroglucinols, procyanidines, anthocyanins, and xanthones [13]. *G. India* has been used for a variety of purposes since ancient times. In the kitchen, dried fruit rinds can be added as a garnish to give curries an acidic taste, or the fruit can be crushed, steeped in syrup, and drunk as a refreshing drink. The oil-rich seed of *G. indica*, sometimes referred to as kokum butter, has been utilized in the confectionery and cosmetics sectors in addition to the fruit rind. G[14] refers to the Ayurvedic medical system in India.

## PHARMACOLOGICAL ACTIVITY OF *GARCINIA INDICA*

**Anti-Arthritic Activity:** There are several forms of arthritis, the most common being inflammatory, psoriatic, osteo, and rheumatoid. Arthritis is a very common condition worldwide. Although it is frequently used to treat different types of anti-inflammatory arthritis, the precise etiology of arthritis is still unknown. Additionally, it is linked to major side effects such as stomach hemorrhage and an increased risk of other cardiovascular issues. Investigating safe and effective anti-arthritis medication alternatives derived from natural ingredients is therefore crucial.

**Anti-Inflammatory Effects:** The immune system's initial biological reaction to an infection, trauma, or irritability is inflammation. There is proof that the regulation of different inflammatory cytokines mediates anti-inflammatory effects. In response to infection and tissue injury, interleukin 6 (IL-6) is produced quickly and transiently. It stimulates acute phase responses, hematological and immunological responses, and aids in host defense. Barve, K. did a study. demonstrated that after 16 weeks, the induced hyperlipidemic animals had considerably higher amounts of IL-6 in their plasma and thoracic aorta than the normal animals did ( $p < 0.0001$  and  $p < 0.001$ , respectively). When mice were administered 25 mg/kg GEF, there was a slight drop in IL-6 levels in the thoracic aorta; however, when animals were administered 50 or 100 mg/kg GEF, there was a significant decrease in IL-6 levels ( $p < 0.01$ ). Furthermore, treatment with all concentrations of GEF resulted in a dose-dependent and substantial decrease in plasma IL-6 levels ( $p < 0.0001$ ).

**Antidepressant and Anxiolytic Effects:** The most prevalent mental illnesses, depression, and anxiety, are also the main contributors to psychosocial dysfunction. The first line of treatment for these illnesses is pharmacotherapy, however, it can have side effects that include reliance, tolerance, psychomotor effects, drowsiness, and amnesia. These factors emphasized how crucial it is to discover novel psychopharmacological medications with a brief half-life and minimal adverse effects. In this sense, natural products seem like good

options for these illnesses' pharmacological treatment Dhamija's research used rat and mouse models to examine the antidepressant and anti-anxiety properties of *G. indica*. They discovered that the fruit rind of *G. indica* exhibited strong antidepressant and anti-anxiety properties without affecting motor function or requiring central nervous system stimulation.[15]

**Anticancer activity:** Studies were conducted on normal intestinal cells as well as colon cancer cells to examine the effects of garcinol and its derivatives. The outcomes demonstrated that, although not affect healthy cells, garcinol successfully slowed the proliferation of cancer cells. Furthermore, it was discovered that garcinol effectively decreased cell invasion and survival in colorectal cancer cells and may have chemopreventive qualities.

Garcinol's potent growth inhibitory action in human leukemia cells was exhibited by apoptosis induction and modification of arachidonic acid metabolism, which further enhanced the compound's anti-inflammatory and anti-cancer characteristics.

**Anti-HIV Activity :** A crucial component of gene activity is histone acetylation. The histone acetyltransferase p300 is inhibited by garcinol. Isogarcinol derivatives were created and described. Certain compounds can block PCAF-HAT activity while leaving p300-HAT activity unaffected. LTK-13A and LTK-14A lost their activity, whilst LTK-15 lost its ability to inhibit HAT. LTK-13, LTK-14, and LTK-19 were shown to have IC50 values of 5-7  $\mu\text{M}$ , which is comparable to isogarcinol, to inhibit p300-HAT activity[16].

**Antimicrobial Activity :** Throughout history, people have utilized the fruit of the garcinia indica plant as a culinary additive and preservative. Studies have demonstrated the antibacterial and antifungal properties of plant extracts derived from various plant sections. Potential active ingredients for this action include proanthocyanidin, furfural, flavonol, and flavone. The garcinia indica plant may prove to be a useful source of antibacterial compounds in the future, according to this research.

**Anthelmintic Activity :** One of the main causes of productivity losses, particularly in third-world nations, is helminthiasis. The search for novel medicinal sources for the creation of anthelmintics has been prompted by the growing resistance of helminths against anthelmintics, even though there exist chemical and management methods to control the disease. To determine whether the plant demonstrates such an action, Swapna et al. employed *Garcinia indica* crude extract from petroleum ether, ethyl acetate, methanol, and water. The worms fed with the methanol extracts showed the quickest rate of paralysis and death among all of the extracts at a dosage of 50 mg/ml. Despite the presence of anthelmintic activity, the active ingredient causing it is unclear and needs to be isolated and identified.

**Anti-ageing :** The skin's elasticity, smoothness, moisture content, and lubrication are all maintained by hyaluronic acid and elastin. On the other side, sagging, dry, and wrinkled skin is caused by the enzymes hyaluronidase and elastase, which break down hyaluronic acid and elastin, respectively. A study was conducted to determine the anti-hyaluronidase and anti-elastase activity of *Garcinia indica* fruit rind methanolic extract in response to reports that plant metabolites with antioxidant activity can inhibit these enzymes. To examine their activity, the methanolic extract was separated into water and ethyl acetate fractions. According to the study, hyaluronidase inhibition was shown to be 94% by the methanolic extract at 750  $\mu\text{g/ml}$  and 83.33% by the ethyl acetate fraction at concentrations as low as 25  $\mu\text{g/ml}$ . Conversely, elastase was inhibited by 64.02% in methanolic extract at a dose of 200  $\mu\text{g/ml}$  and 81.02% in water fraction at the same concentration. This implies that the water fraction should be used more extensively to find the relevant metabolite and include it in anti-aging products [17].

**Antioxidant and Hepatoprotective activity :** Deore et al. investigated the hepatoprotective and antioxidant properties of an aqueous and ethanolic extract of the rind of the *Garcinia indica* Linn fruit on Wistar albino rats that were exposed to 1.5 ml/kg of carbon tetrachloride-induced liver damage. Biochemical markers such as serum bilirubin (SBRN), alkaline phosphatase (ALKP), alanine transaminase (ALT), and aspartate transaminase (AST) were used to assess the level of liver protection. Biochemical markers such as sulfoxide dismutase (SOD), glutathione (GSH), lipid peroxidation (LPO), and catalase (CAT) were used to assess the antioxidant impact. Gogoi et al. assessed the total phenolic content and free radical inhibition properties of the methanolic fruit rind extract of *Garcinia indica* fruit rind. Using the DPPH and  $\beta$ -carotene linoleate assays, Selvi reported on the ability of the chloroform extract of kokum rind to scavenge free radicals. Marketed concentrated syrup and kokum's hot and cold aqueous extract both show the ability to scavenge free radicals. Kokum fruit methanolic extract shows strong antioxidant properties equivalent to those of regular ascorbic acid. It was discovered that in the phenazine methosulphate/NADH nitroblue tetrazolium combination, ganciclovir exhibited superoxide anion scavenging action.

**Antifungal activity :** The antifungal properties of kokum rind aqueous extract were revealed by Varalakshmi and colleagues against *Penicillium* sp. and *Candida albicans*. Kokum rind extract in chloroform prevented *Aspergillus flavus* from growing and from producing aflatoxin.

**Neuroprotective Effects :** Significant neuroprotective potential against 6-OHDA was demonstrated by the methanolic extract of kokum fruit, suggesting that it has anti-Parkinson's activity in rats. Additionally, the expression of LPS-induced anti-inflammatory mediators was decreased by garcinol. inhibited the production of nitric oxide in LPS-treated astrocytes by iNOS and COX-2. Its anticholinesterase properties were also discovered. Cyanidin-3-glucoside exhibits neuroprotective potential by inhibiting neurite development and neurofilament protein expression[18].

**Antihyperlipidemic activity :** In a rat model of cholesterol-induced hyperlipidemia, the methanolic extract of *Garcinia indica* demonstrated potent antihyperlipidemic action, surpassing the efficacy of the conventional medication lovastatin. Significant antioxidant activity in the extract led to a reduction in triglyceride and cholesterol levels. The extract's hydroxy citric acid, garcinol, and anthocyanins

may be responsible for this action. A dose of 400 mg/kg/day showed the greatest antihyperlipidemic effect. More investigation into its mode of action may result in the creation of potent antihyperlipidemic medications.

**Antidiabetic activity :** Oxidative stress associated with type 2 diabetes was found to cause a significant reduction in glutathione (in its GSH-reduced form). Researchers looked at a medication that has anti-diabetic properties and restores GSH. For four weeks, streptozotocin-induced type 2 diabetic rats were fed an aqueous extract of *Garcinia indica* at doses of 100 mg/kg and 200 mg/kg. Ultimately, blood parameters including GSH levels and blood glucose levels while fasting and after meals were examined. In type 2 diabetic rats, an aqueous extract of *G. indica* dramatically lowered blood glucose levels while fasting and after meals. In rats with type 2 diabetes, the extract also increased erythrocyte GSH levels. The effects of drugs at higher doses, such as 200 mg/kg, were more noticeable. In diabetes, increasing intracellular antioxidant erythrocyte GSH will be helpful, particularly in lowering the chance of complications[20].

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