

The Biological Importance Of *Garcinia Cambogia*: A review

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Abstract

Garcinia cambogia extract (GCE) comes from a tropical fruit grown in India and Southeast Asia. The active ingredient has been identified: hydroxycitric acid (HCA). It is said to block fat and suppress the appetite. It inhibits a key enzyme, citrate lyase that the body needs to make fat from carbohydrates. It suppresses appetite by increasing serotonin levels; low serotonin levels are associated with depression and emotional or reactive eating.

Introduction

Garcinia cambogia, also known as Malabar tamarind, and known as *Garcinia*, is a plant native to Southeast Asia. The dried rind has been extensively used for centuries throughout Southeast Asia as a food preservative, flavoring agent and carminative, and is now popularly used as an ingredient of dietary supplements for weight loss in developed countries.

It was originally found only in the western peninsular coastal regions and the adjoining Western Ghats in the states of Maharashtra, Goa, Karnataka and Kerala, India as well as parts of Eastern India in the states of West Bengal, Assam and North Eastern Hill regions, but is today found growing in other parts of peninsular India [1].

Hydroxycitric acid (HCA), the principal acid of the fruit rind of *Garcinia cambogia* DSER (Hypericaceae), was shown to be a competitive inhibitor of adenosine 59-triphosphate (ATP) citrate lyase (EC 4.1.3.8), the enzyme that catalyzes the extra mitochondrial cleavage of citrate to oxaloacetate and acetyl CoA. This action of HCA reduces the acetyl CoA pool, thus limiting the availability of two-carbon units required for the biosynthesis of fatty acid and cholesterol [10, 11]. Moreover, it increases rates of hepatic glycogen synthesis, and decreases body weight gain. Leptin is an obese-gene product secreted mainly in adipose tissue. Serum leptin concentration was correlated positively with body weight and with visceral fat in humans and mice. Previous studies indicated that serum leptin levels and adipose tissue mass were higher in obese mice than in normal mice, but no difference was found in the serum leptin white adipose tissue (WAT) ratio [2] (Figure 1).

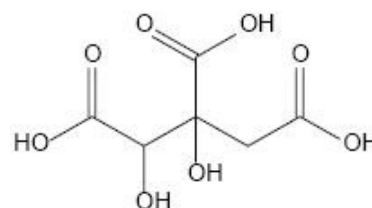
Description

Garcinia cambogia (Family: Guttiferae) is a small or medium sized tree with a rounded crown and horizontal or drooping branches. The fruit has six to eight seeds surrounded by a succulent aril and the tree is distributed commonly in the ever green forests of western Ghats, from Konkan southward to Travancore and in the forests of Nilgiris up to an altitude of 6000 ft. It flowers during the hot season and fruits ripen during the rainy season. The fruit is harvested, dried and ground into a powder. *Garcinia cambogia* extract is the calcium salt of hydroxycitric acid (Both 50% and 60% hydroxycitric acids are available), which is obtained from water extract of *Garcinia cambogia* fruit.

Garcinia is a slender but very sturdy evergreen tree and does not need elaborate irrigation or use of fertilizers, pesticides or herbicides. The trees are normally found growing in the riversides, forests, wastelands and have been recently cultivated for their fruits. The fruits are round, oblong or oval with pointed tips and, are crowned by the

four parted stalkless stigma. When raw they are dark to light green in color and crimson red with a yellow tinge to dark violet or purple when fully ripe. The fruits are initially small and grow up to the size of a lemon. An average *Garcinia* tree bears hundreds of fruits and each fruit weighs around 21-85 g. The fruit contains three to eight large seeds and is covered with whitish sweet pulp.

The seeds are placed in a pattern similar to that in orange especially by the yeasts and fungi. The fruits are manually harvested, deseeded and the rinds sun dried. The rinds appear black in color, are shrunken and hard. Drying decreases the water activity required for the growth of microbes and concomitantly increases the shelf life of the rind. This helps in making the rinds available throughout the year for human consumption [3].



(-)-Hydroxycitric acid

Figure 1: Botanical description.

Botanical Name: *Garcinia cambogia*

Family: Guttiferae

Plant Parts Used: Fruit rind

Common/Trade Names: Vilati - Amla

Sanskrit and Hindi Names: Vrikshamla

Other Common Names of *Garcinia Cambogia*: Brindle berry, brindall berry, garcinia, malabar tamarind, gamboge, gorikapuli, uppagi, garcinia kola, mangosteen oil tree.

Habitat: India and South East Asia.

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Proximate and Phytochemical Composition of Garcinia

Studies have shown that the rind contains moisture (80.0 g/100 g), protein (1%), tannin (1.7%), pectin (0.9%), Total sugars (4.1%) and fat (1.4%). Garcinia leaves are reported to contain 75% moisture, 2.3 g of protein, 0.5 g of fat, 1.24 g fiber, 17.2 g of carbohydrates, 15.14 mg of iron, 250 mg of calcium, 10 mg of ascorbic acid and 18.10 mg of oxalic acid [4]. The seed is very rich in stearic, oleic and stearic triglycerides [5]. The plant also contains hydroxycitric acid lactone and citric, but in minor quantities [6].

Culinary Uses of Garcinia

Garcinia is an important culinary agent and is used as an acidulant for curries by people living in Maharashtra, coastal Karnataka and Goa, India. In summer the ripe rinds are ground in a blender with sugar and cardamom and consumed as a cooling drink [1]. Addition of Garcinia is supposed to enhance the taste of coconut-based curries and to remove the unpleasant smell of mackerel and sardines (They are also used in some vegetable dishes and to prepare chutneys and pickles (especially with prawns and cartilaginous fishes like sharks, ray fish and other cartilaginous fish)

Industrial Use

The Garcinia rinds are commercially used to prepare concentrated syrups which on appropriate dilution gives the ready to use cool health drinks especially during the off season periods. The local community of Goa also uses the rinds to prepare wine. Dried rinds are powdered and marketed to be used as acidulant for traditional curries [3].

Traditional Medicinal Uses

The leaves and fruits are sour, astringent, thermogenic, constipating and digestive. The herbal preparations made from Garcinia rinds are used in the treatment of inflammatory ailments, for rheumatic pains and bowel complaints. The fruit is considered to be anthelmintic and cardiogenic. The juice (sherbet) made out of the rind is used for piles, hemorrhoids, colic problems, ulcers, inflammations, treat sores, dermatitis, diarrhea, dysentery, ear infection, to facilitate digestion and to prevent over perspiration or hyper perspiration. Garcinia natural antacid and the preparation rind, yogurt and salt is supposed to relieve gastric ulcerations and burning sensation. The Garcinia butter is useful in dysentery, diarrhea, phthisis pulmonalis and scorbutic disease [7].

Antifungal Effects

Increase in the incidence of invasive fungal infections coupled with limited potency, drug related toxicity, non-optimal pharmacokinetics and development of resistance to some agents by certain fungal strains have necessitated the need for newer effective agents from natural products [8].

Free Radical Scavenging Properties

Free radicals, consisting of ROS and RNS when generated in excess cause damage to DNA, lipids, proteins, and other biomolecules. Accordingly, antioxidants are needed to prevent the formation/ nullify the deleterious effects of the ROS and RNS. Studies have also shown that the marketed concentrated syrup, cold aqueous and hot (boiled) aqueous extract of Garcinia are also effective in scavenging the free radicals [9].

Anti-Lipid Peroxidation and Anti-Carbonyl Activities

Excess generation of free radicals damages the lipid membranes

and causes loss of cell functioning and cell death. The process of lipid peroxidation gives rise to a number of secondary products and one of the products, malondialdehyde is reported to be mutagenic, atherogenic and is implicated in the pathogenesis of various diseases [10]. Therefore, prevention of lipid peroxidation is extremely important for the optimal functioning of the cell.

Antiaging Activities

Aging is a natural process and one of the conspicuous features is the development of wrinkles and sagging of the skin. With age, due to the action of the enzyme elastase the elasticity of the skin decreases and this gradually causes sagging. Concomitantly the levels of hyaluronic acid also decrease and this makes the skin dry and wrinkled. Exposure of skin to sun and detrimental chemicals also hasten the process of aging and wrinkling and application of antioxidant rich cosmaceuticals is known to retard the process [11].

Recently, Sahasrabudhe and Deodhar [7] have observed that the whole methanolic extract as well as the ethyl acetate and water fraction of the methanolic extract prepared from the rind possesses anti-hyaluronidase and anti-elastase activities *in vitro*. The authors observed that the ethyl acetate fraction showed significant hyaluronidase inhibition and at a low concentration (25 µg/ml), while the aqueous fraction was effective against both elastase and hyaluronidase (90 µg/ml). Garcinia pigments are also reported to possess UV light absorbing properties, suggesting its usefulness in skin care [12].

Gastroprotective Effects

Peptic ulcer is a multifactorial disease and affects a significant number of the global population. Studies have shown that the oral administration of garcinol (40-200 mg/kg) reduced the indomethacin-induced gastric ulcerations in rats. The optimal effects were observed at 200 mg/kg and the protective effects were better than that of cetraxate-HCl used as a positive control. Garcinol was also effective in reducing water (23°C) immersion-induced gastric ulceration and the effects were similar to that of cetraxate-HCl used as positive control [13].

Antidiabetic Effects

Diabetes characterized by chronic hyperglycaemia, is a disease as old as mankind. Current reports suggest it to be the world's leading endocrine disorder and affects nearly 5% of the global population. Chronic hyperglycemia leads to secondary complications that are more dangerous than hyperglycemia and meriting constant medical attention and care [14]. Oral administration of the aqueous extract of the Garcinia rind (100 mg/kg and 200 mg/kg) for a period of 4 weeks to streptozotocin-induced type 2 diabetic rats is shown to be effective in decreasing both fasting and postprandial blood glucose.

Antineoplastic and Chemopreventive Effects

With regard to Garcinia studies have shown that the phytochemicals garcinol, isogarcinol, and xanthochymol affected the growth and proliferation of four human leukemia cell lines. The growth inhibitory effects of isogarcinol and xanthochymol were more potent than that of garcinol infections [15].

Lowering Lipid Effect

G. cambogian (malabar tamarind) is seen abundantly in the evergreen forests of Konkan in South India. Many traditional recipes in Kerala use it for its distinct-avour. Garcinia species are employed in traditional medicine for treatment of hepatitis, laryngitis and mouth.

The bi-avonones are the most dominant components in most *Garcinia* species [16]. Aqueous extracts of the stem bark of *Garcinia huillensis* are used in Zairean traditional medicine against venereal diseases, sores, bronchitis, pneumonia, angina, measles and dermatitis [17].

Anti-Obesity Activity

Recent reports from the WHO suggest that globally the number of obese people is increasing and with it the incidence of cardiovascular diseases, diabetes, digestive diseases and cancer. In the Ayurvedic system of medicine, *Garcinia* is used to treat illness related to obesity and multiple studies have shown that hydroxycitric acid (also known as *garcinia acid*) a component of *Garcinia* is reported to possess anti-obesity effects. Studies have shown that consumption of hydroxycitric acid reduces appetite, inhibits fat synthesis, lipogenesis, decreases food intake and reduces body weight [18].

Obesity is a major problem in the affluent societies of developing and developed world and the Health Risks associated with the obesity are Diabetes mellitus, Heart disease, High B.P., etc. WHO report-Globally with more than 1 billion adult's overweight- at least 300 million of them clinically obese? Main cause of obesity is a person consumes more calories from food than he or she burns. The *Garcinia* fruit is a rich source of hydroxycitric acid (HCA), the active agent that aids in weight loss by inhibiting fat production and suppressing appetite. *Garcinia cambogia* extract is quickly becoming a popular ingredient in many weight loss supplements [19].

The *Garcinia* fruit is a rich source of hydroxycitric acid (HCA), the active agent that aids in weight loss by inhibiting fat production and suppressing appetite. *Garcinia* contains citrine, an extract that is 50-60% HCA, which inhibits an enzyme that helps the body synthesize fat for storage in adipose tissue. HCA promotes energy, inhibits lipogenesis, lowers the production of cholesterol and fatty acids, increases the production of glycogen in the liver, suppresses appetite, and increases the body's production of heat by activating the process of thermogenesis [20].

Garcinia cambogia extract is quickly becoming a popular ingredient in many weight loss supplements. Many studies have been pointing to strong possibilities that it will help some people to lose weight. But like similar studies, the evidence is not conclusive. In spite of this it is been cited in many weight loss supplements has been an active ingredient for losing weight [21].

Garcinia cambogia belongs to the citrus family like oranges and lemons. It is a small tropical fruit that is too sour to eat but the rind is used as a spice in Indian cooking. It is indigenous to India and Africa. The active ingredient usually accredited for weight loss in this fruit is its extract, hydroxycitric acid. Hydroxycitric acid (HCA) unlike caffeine is not a stimulant. Neither is it an appetite suppressant, both of which work directly on the nerve centers of the brain. Both stimulants and appetite suppressants can have undesired side effects, including causing food binges any time you stop taking them. Instead, HCA satisfies the body's need for energy and improves the signaling system that the body uses to tell the brain when it has eaten enough. In overweight people this response is often delayed, causing them to continue to eat more than they need [22].

HCA seems to work best for people who overeat when they are anxious or stressed, as it will give the same calming effect that they get from food. Generally you do not need to eat any special foods when you are taking HCA, and there are no 'forbidden foods'. Choose healthy foods and you should find that you lose weight and fat slowly

but steadily without really trying. You can take slightly smaller portions if you wish and choose fruit instead of sugary snacks but you should not need to go hungry. This is a very natural way to lose weight. *Garcinia cambogia* extract (HCA) in weight loss supplements is usually combined with chromium.

Chromium is a mineral that is often lacking in our diets as we get older and a chromium deficit can contribute to weight gain and possibly diabetes. HCA and chromium seem to work in a positive synergy to regulate the body's blood sugar levels. However if you have diabetes already, you should see your doctor before taking any products containing chromium. Though HCA shows possibilities it is best to be cautious just like with all other weight loss supplements. For example do not take HCA if you are pregnant or breast feeding [23].

HCA has some significant advantages over many other weight loss supplement ingredients because it has been extensively tested in research laboratories on both human and animal subjects and no side effects have been found. Consequently it is considered a natural weight loss supplement [18].

Mechanism of Action

Normally the body converts carbohydrates (glucose, fructose, and galactose) taken by meal into energy (ATP) and the excess carbohydrates that cannot be used immediately for energy convert into glycogen. Glycogen is the storage form of carbohydrates, deposited in muscles and the liver.

When the glycogen stores are reasonably full, additional carbohydrates are then converted into excess of extramitochondrial Acetyl CoA required for fatty acid synthesis using ATP Citrate lyase enzyme. (-)-Hydroxycitric acid [(-)-HCA] is the principal acid of fruit rinds of *Garcinia cambogia* (-)-HCA was shown to be a potent inhibitor of ATP citrate lyase. The inhibition of this reaction limits the availability of acetyl-CoA units required for fatty acid synthesis and lipogenesis during a lipogenic diet, that is, a diet high in carbohydrates. This added glycogen load in the liver stimulates a longer lasting neuro-signal from the liver to the brain, indicating satiety (satisfaction), thus helping to suppress appetite longer. (-)-HCA as weight-controlling agent [24].

Inhibition of citrate lyase may aid aerobic endurance. Owing to a substantial increase in glucose uptake by working muscle, glucose homeostasis during sustained aerobic exercise requires a several fold increase in hepatic glucose output. As exercise continues and liver glycogen declines, an increasing proportion of this elevated glucose output must be provided by gluconeogenesis. Increased gluconeogenic efficiency in trained individuals is a key adaptation promoting increased endurance, since failure Potential Side Effects of *Garcinia Cambogia*.

Garcinia cambogia reportedly does not have any known adverse effects in healthy adults, but there are some people who are advised not to take it. According to experts, this includes children, pregnant and lactating women, those diagnosed with diabetes mellitus, and people with Alzheimer's or other forms of dementia disease. In the case of Alzheimer's patients, it is thought HCA might form acetylcholine in the brain, while diabetics could be affected by HCA's tendency to lower blood sugar. Conversely, in healthy adults this latter effect can purportedly curb cravings for sweets and carbohydrates. And it is important to discuss this with your health care professional [25].

Therapeutic Dosages

Supplements are available in various forms including tablets,

capsules, powders, extracts and even snack bars. *Garcinia cambogia* medications are usually standardised to contain fixed percentage of HCA. The usual dosage for garcinia is 300 to 500mg tablets three times daily taken half an hour before meals with water [26].

Toxicity

Various animal and human studies have been conducted on the safety of HCA. In summary, no serious or significant untoward effects were reported in any of those studies. All reported effects were comparable to placebo-treated animals and human subjects. Dose-dependent studies in animals assessed acute oral toxicity, as well as acute dermal toxicity, primary dermal irritation, and primary eye irritation.11 No gross toxicological findings were observed, and the authors concluded that HCA is safe under the experimental conditions employed.

To summarize how to achieve the best results with a *Garcinia cambogia* extract:

- Chose a preparation that is at a minimum 50% HCA and is not composed wholly of Ca salts: make sure K and/or Mg is present. If the product has a low lactone content, that is even better.
- Be sure to take an adequate dose. For a Ca/K preparation used successfully and reported in a peer-reviewed publication, the dose of extract was near 1.5 g three times a day before meals. In this 60% HCA preparation, that approximates 0.9 g of HCA prior to each meal.
- Take the preparation on an empty stomach, i.e., 30 to 60 minutes before each meal.
- Remember, "If you don't comply, don't complain." Take the right dose at the right time.

Conclusion

The active constituent in this herb is called Hydroxycitric acid or HCA and is gaining a reputation for assisting weight loss through appetite suppression and by reducing the body's ability to form adipose(fatty) tissue during times of overeating.

- *Garcinia* has also been historically used to treat gastric ulcers. A 2002 study indicates this herb works primarily through the action of one of these plant's constituents, garcinol. Garcinol is known to lower acidity in the stomach and protects the gastric mucosa.
- The rind of *garcinia cambogia* is also astringent, which is why it was also historically used in the treatment of diarrhea and dysentery as well as having the added benefit in the treatment of gastric and duodenal ulcers.
- The ability for *Garcinia*'s component, HCA, to reduce blood lipid levels and lower blood cholesterol is another feature of this amazing natural medicine.
- More recently, it has been proposed that *Garcinia cambogia* has a hepato protective ability against external toxins, such as alcohol. A recent study showed that *Garcinia* prevented liver cells from becoming fibrotic and stopped cell damage caused by high blood lipid levels.
- *Garcinia cambogia*, an exotic fruit grown in South India, has been used to impart a distinctive sour flavour to Indian cooking. It is

the source for a revolutionary natural diet ingredient, which is currently a rage in America, Japan, Europe and other western countries.

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