GARCINIA GUMMI-GUTTA

Garcinia is the largest genus of the Clusiaceae family comprising nearly 250 species. Garcinia gummi-gutta (L.) (Syn.: Garcinia cambogia (Gaertn.); Common name: Malabar tamarind), is one of the most important members of the Clusiaceae family. It is a small or medium sized tree up to 12 m tall with dark green and shining leaves. The leaves are elliptic obovate, 2-5 inch long and 1-3 inch broad. Fruits are ovoid, 2 inches in diameter, yellow when ripe, with 6-8 grooves; seeds 6-8 surrounded by succulent aril. The aril and the fleshy covering encasing the seed is edible when ripe. The differentiation between male and female trees is known only at the flowering stage which takes approximately 7 to 9 years. G. gummi-gutta is a common species found in the Western Ghats, from the Konkan southwards to Travancore eastwards. The species has now been introduced elsewhere in the subtropical region of Asia including China, Malaysia and the Philippines. It is a common fruit plant of the Western Ghats, attributed with a wide range of applications ranging from food, medicines and nutraceutics. The fruit rind of G. gummi-gutta is the major source of (−)-hydroxycitric acid (HCA). In addition, secondary metabolites such as xanthones, benzophenones, organic and amino acids were also reported from this plant. The potential beneficial effects include antioxidant, antihelmenthic, antidiabetic, antimicrobial, antiobesity and hyperlipidaemic properties. Reports on the toxicity and observations during clinical trials suggest that G. gummi-gutta is safe for human consumption.

Characteristics of *Garcinia gummi-gutta* (L.) is as follows:

- Evergreen tree up to 20 m high; exudation pale yellow, sticky.
- Leaves: Elliptic, obelliptic-ovate, 6-13 x 2.5-6 cm.

- Male flowers: Tetramerous, 3-8 flowers on axillary fascicles, 1-1.7 x 1-1.2 cm, pedicel 7-12 mm long; sepals orbicular, margin membranous with fimbril like projections; petals oblong, pale yellow or orange yellow, membranous on margin; stamens in a globose head; rudimentary pistil absent or if present stigma discoid with 4 lobed clefts.
- Female flowers: Tetramerous, solitary or 1-3 fascicle on terminal or axillary, 1.5-2 x 1.5 cm; staminodes 10-20; ovary 4-12 locular, *ca*. 1 mm long, ovule one in each locule, subglobose or ovoid, grooved, stigmatic rays spreading, free nearly to the base, margin crenate, tuberculate. Fruits: Globose, 6-8 cm in diam., 6-10 grooved, yellow or orange yellow on ripening, pericarp very thick, fleshy.
- Seeds: 6-8, ovoid, 2-3.3 x 0.7-0.9 mm, compressed, surrounded by white or red pulpy aril.
- Field identification characters

  i Leaves elliptic, 6-13 cm long.

  ii Stigmatic lobes 6-10.

  iii Fruit deeply grooved, grooves 6-10.

TRADITIONAL USES

G. gummi-gutta is traditionally used as a condiment for flavouring curries and as a fish preservative. The traditionally smoke dried fruit rind of G. gummi-gutta, known as ‘Malabar tamarind’ was used for “Colombo curing” of fish, where the pickling was done in brine along with the smoke dried rinds of G. gummi-gutta. The species yield an yellow, adhesive gum resin similar to gamboge from G. morella, but of inferior quality and insoluble in water. The seeds yield an oil, which is used in medicine. The wood is grey, cross grained, shining, hard and can be used in furniture making. The dried rind was used for

polishing gold and silver and also used as a substitute for acetic and formic acids in the coagulation of rubber latex. Though the tree has been mentioned in the 17th century treatise of medicinal plants, Hortus Malabaricus, the species is not part of the Ayurvedic medicine of ancient India. However, it was widely reputed in the folk herbal healing practices and has been used traditionally for the treatment of edema, delayed menstruation, ulcers, open sores, hemorrhoids, fever, rheumatism, and also against intestinal parasites. The astringent properties of the rind make it an indispensable ingredient in gargles for weak gums, bowel complaints, constipation, diarrhoea and dysentery. The plant is used in veterinary medicine, for mouth diseases in livestock.

PHYTOCHEMICALS REPORTED FROM G. GUMMI-GUTTA

Though G. gummi-gutta is an economically important species, widely cultivated in south India, only a few reports are available in literature on the phytochemistry of the plant. The fruit is well known for the acidic nature and the chemistry and analytical techniques of hydroxycitric acid, the major organic acid in G. gummi-gutta, has been dealt with detail in literature. Benzophenones are the major secondary metabolites in G. gummi-gutta, followed by xanthones and biflavonoids.

1. Organic Acids

Organic acids are of great significance in plants as intermediates in the metabolic processes and are directly involved in growth and maturation of fruits. The organic acids play a key role in fruit flavour and taste. Most of the Garcinia fruits are well known for their sour taste and high acidity, and of the different acids reported from Garcinia fruits, (−)-hydroxycitric acid (HCA) is the important one, being an anti-obesity agent and a chiral molecule of wide utility in chiral synthesis (Jena, et al., 2002). Malic acid, ascorbic acid, tartaric, oxalic acid and

citric acids are also present to a lesser extent in Garcinia fruits. Hydroxycitric acid (HCA) is the major organic acid occurring in the fruits of G. gummi-gutta.

2. Benzophenones

Rama Rao et al. in the late 1970's, isolated the benzophenones camboginol (garcinol) and cambogin (isogarcinol; xanthochymol) from the latex of G. gummi-gutta in large quantities (37.0% and 5.5% respectively). Camboginol (m.p. 132°C) was obtained in 37% yield from the latex of G. gummi-gutta by a simple crystallisation from pet-ether. Silica gel column chromatography of the remaining residue using hexane as the eluting solvent gave cambogin. Cambogin has identical chemical and spectral properties as isoxanthochymol but having exactly opposite specific rotation, clearly indicating the compound as an enantiomer of isoxanthochymol. Later Iinuma, et al has also isolated garcinol and isogarcinol from the barks of G. gummi-gutta. Phytochemical investigation of the fruits of G. gummi-gutta resulted in the isolation and characterisation of the benzophenones garcinol and guttiferones I, J, K, M, N.

3. Xanthones

The xanthones garbogiol and rheediaxanthone A were isolated from the barks and roots of G. gummi-gutta. Oxy-guttiferones M, K2, I and K were isolated from the fruits of G. gummi-gutta. Oxy-guttiferones are tetracyclic xanthones derived from the oxidation of the corresponding polyisoprenylated benzophenones

4. Biflavonoids

In a recent report, the biflavonoids fukugicide, GB-1 and amentoflavone were reported from G. gummi-gutta leaf extracts through a validated LC-MS analysis. However, the biflavonoid content was lowest in G. gummi-gutta among all the screened Garcinia species. The phenolic acid and flavonoids were also lower compared to other Garcinia species.

VALUE ADDITION IN GARCINIA GUMMI-GUTTA (PROCESSING AND PRESERVATION)

Preliminary preparation of the fruits for processing

Raw fruits were cleaned thoroughly with water to remove any adhering dirt and other undesirable substances. They were then cut in to two halves and the seeds along with the seed covering were removed from the fruit. Using a knife, the pulpy seed covering was then separated from the seeds and seeds were discarded while the seed covering was utilized for preparing the products along with the fruit flesh. The fruit halves were then cut in to small cubes.

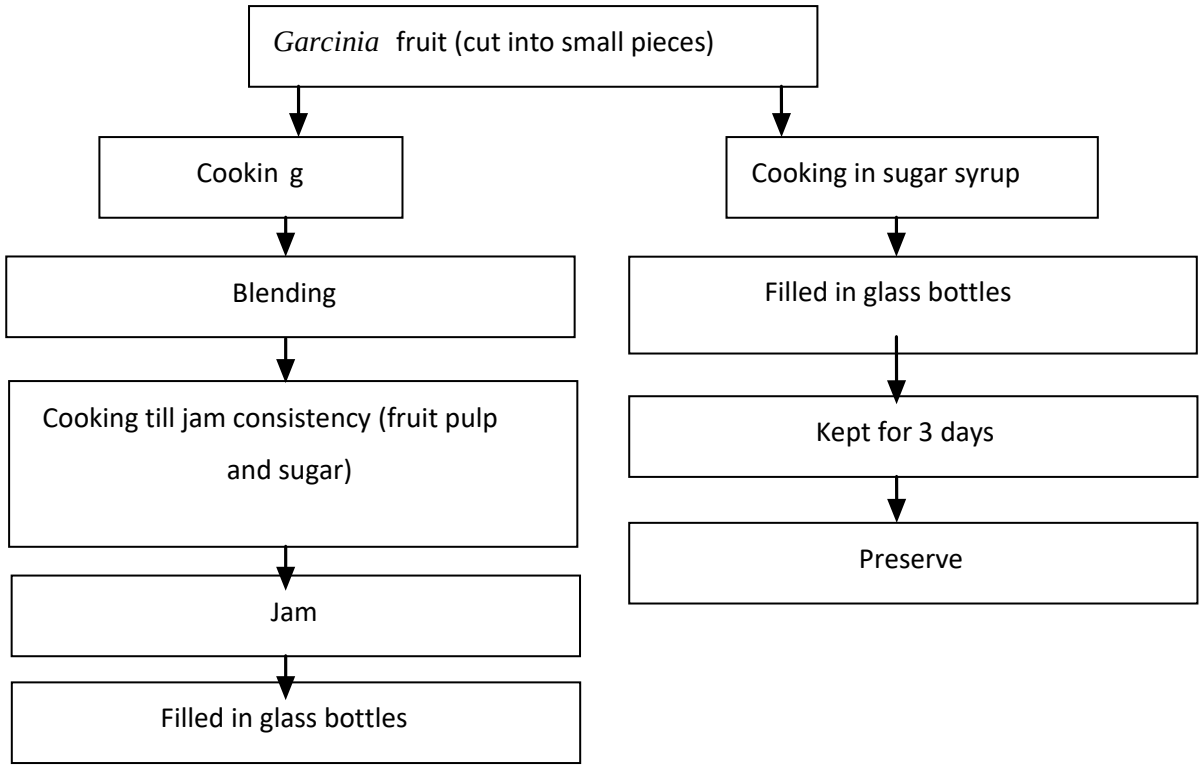
The fruits were used as such for preparing sweetened sugar based products like jam, preserve, beverages etc. For the preparation of pickles and chutneys, the fruit pieces were mixed with a small amount of salt and kept for fifteen minutes. It was done in order to remove the astringency of raw fruit. Excess salt is removed by washing the fruit pieces with water, after fifteen minutes.

Processing and preservation of *Garcinia* using controlled osmotic pressure

Using the principle of controlled osmotic pressure, products like jam, preserve, pickles etc were prepared with *Garcinia*.

Preparation of *Garcinia* jam and preserve

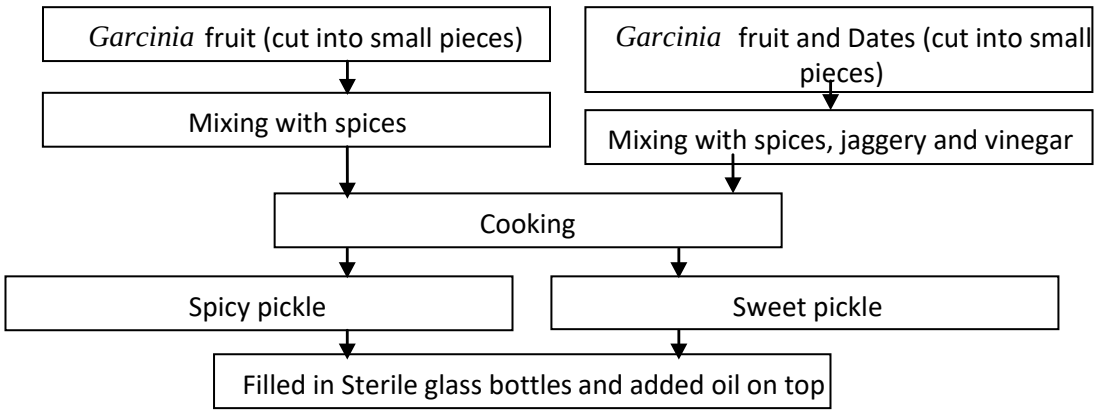
Jam and preserve were the two recipes selected for incorporating *Garcinia*, which employs controlled osmotic pressure using sugar as medium for preservation. For the preparation of both jam and preserve, the fruits of *Garcinia* were at first washed, then cut into small pieces and deseeded.



Preparation of *Garcinia* jam and preserve

Preparation of spicy and sweet pickles using *Garcinia*

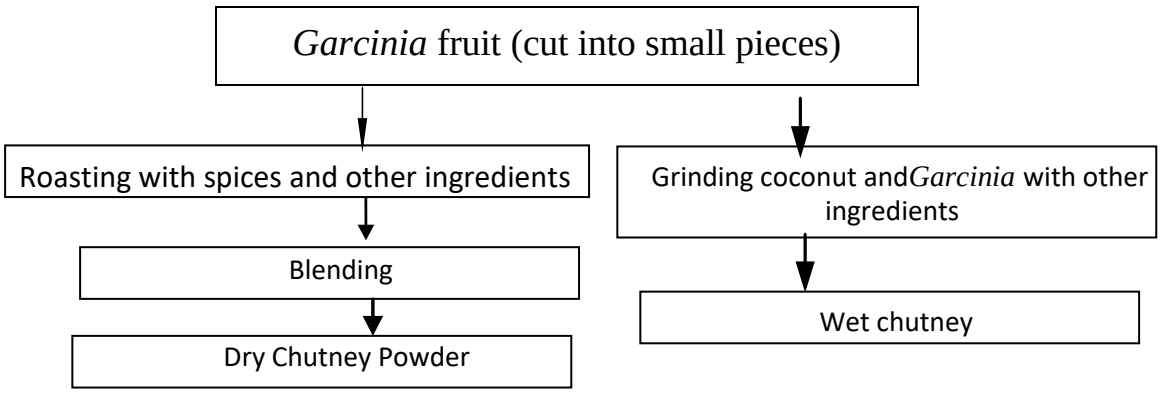
Garcinia fruits were processed into spicy and sweet pickles using salt as a medium for preservation. For the preparation of sweet pickle *Garcinia* was incorporated with good quality dates, to impart sweetness and to add more nutritional value to the product. The steps involved in the preparation of pickles are given below:



Preparation of spicy and sweet pickles

Processing and preservation of Garcinia using dehydration and controlled pH

Garcinia was processed into dry and wet chutney powders by applying the techniques of preservation by dehydration and controlled pH respectively. The major ingredients for preparing dry chutney powder were *Garcinia* (30 per cent), coconut (100 per cent), ginger (2 per cent), garlic (2 per cent) and black gram dhal (2 per cent) without the addition of oil. For preparing wet chutney, coconut as well as vinegar was added along with *Garcinia*. The steps involved in the preparation of *Garcinia* dry and wet chutney powders are given below:



Preparation of fruit beverages incorporating *Garcinia*

Garcinia juice was blended with juices of other fruits to enhance the flavor as well as the nutritive value of the product. A Ready To Serve drink was prepared by using *Garcinia* juice (100 per cent) and watermelon (100 per cent) in equal amounts, blended in adequate proportions of water and sugar. Two types of squashes were prepared using *Garcinia* juice (100 per cent) blended with juices of fruits like oranges (50 per cent) and pineapple (50 per cent). A syrup or sharbat, highly popular as "summer drinks" was also prepared by using *Garcinia* juice, lime juice and ginger.

Nutrient analysis of the developed products per serving

The nutrient content of the developed products per serving was calculated using Nutrient Composition Tables on the basis of their calorie, carbohydrates, proteins, fats, vitamin C and crude fiber content. The percentage contribution by *Garcinia cambogia* in the total content of each nutrient present in each product were also calculated from the nutrient composition of *Garcinia cambogia* and the amount of *Garcinia* used in the preparation of each product.

Evaluation of the shelf life qualities of developed products

Shelf life is defined as the time during which the food products will remain safe; will be certain to retain their desired sensory, chemical, physical and microbiological characteristics. For testing the shelf life of the developed products, the two sets of each prepared product was packed in air tight glass bottles (100g / bottle). The bottles were then kept at room temperature and at refrigerated storage, for a period of 3 months. During the storage period, the bottles were visually examined for detecting any colour change or microbial infestations. At the end of the third month, the samples were removed from their bottles for analysis and were visually examined for the growth of colonies of microbes.

Economic evaluation of the products

The products were then evaluated on the basis of the time taken for preparation, yield ratio, preparation loss and cost of production, to find out the most economic product.

Time analysis

The time taken for preparing 25g of each product was assessed for measuring the easiness with which the products were prepared. It was calculated on the basis of the time taken for preliminary preparations and the time taken for cooking the products.

Analysis of yield ratio

Yield ratios of each product were assessed on the basis of the raw weight of the ingredients and the weight of the edible portion after cooking.

Yield Ratio = Weight of the raw ingredients / Weight of the edible portion

Analysis of preparation loss

The preparation loss of each product during cooking is calculated from the weight of the purchased raw
materials and weight of the edible portion.

$$\text{Preparation Loss} = \frac{\text{(Purchased ingredients weight - Edible portion weight)}}{\text{Purchased ingredients weight (g)}}$$

Cost analysis

The cost for preparing 100g of each product was calculated based on the total cost and weight of
the edible portions of the prepared products.

$$\text{Cost} = \text{Total cost / wt. of the edible portion x 100}$$