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Garcinia: A genus of nutraceutical fruits

Genus *Garcinia* is one of the important genus of fruiting plants belonging to the family Clusiaceae and includes about 200 species found in tropical Asia and Africa. Thirty five species of *Garcinia* are found in India. Out of these, 17 species are endemic. Of these, seven are endemic to the Western Ghats, six in the Andaman and Nicobar Islands and four in the northeastern region of India. Several species of this genus have traditionally been used by the natives of Asia and Africa in their day to day lives.

GARCINIA trees provide spice, fruit, medicine, cooking butter, colour and polishing agents for metallic surfaces such as gold and silver. The fruits of the genus contain p-hydroxycitric acid which has inhibitory effect on lipogenesis and helps in controlling obesity in human beings. *Garcinia* possesses. anticancer and antioxidant properties or can be used as bio preservatives. *Garcinia* has assumed great significance in the biological research arena today providing not only traditionally known products but new ones also. The fruits of *Garcinia* species are used for edible purpose or medicinal purpose. The important species of this genus in India are mangosteen (*Garcinia mangosteena*), Kokum (*Garcinia indica*), Malabar tamarind (*Garcinia gummigutta*), yellow mangosteen (*Garcinia xanthochymus*), etc. the description of these lines is given here.

Mangosteen (*Garcinia mangostana*)

Mangosteen or purple mangosteen is a tropical evergreen tree native of South Eastern Asian countries. It is considered as the finest fruit of the world' or 'queen of fruits' due to exquisite flavour, softness and taste of pulp. It grows mainly in Southeast Asia and tropical South American countries. In India, it was introduced long back but grown in humid tropical areas of Kerala, Tamil Nadu and Karnataka. The area is very limited due to orthodox climatic requirement but the demand of fruits is very high and get very high price in market. The Mangosteen is very slow-growing, erect, medium size tree with ovate-oblong, leathery, thick, dark-green leaves. It grows in frost-free regions with equatorial climate up to an altitude of 400–900 m and receiving 180-250 cm rainfall. Deep, well-drained soil with high content of organic matter is suitable for cultivation. There is no recommended variety in India. Jolo, large leaves and fruits of variable size, small leaves and small fruits are important varieties grown in South Eastern Asian counties. It may be propagated by seed and grafting. Traditionally seed propagation is use to multiply plants as seed is parthinocarpic. Planting is done at 6×6 m distance. The seedling tree starts flowering 8 to 10 years of planting whereas grafted plants start flowering after 7-8 years. The tree flowers in March-April and flowers are pink coloured. Leaf eater, leaf miner, fruit borer and leaf blight, Diplodia fruit rot, brown root disease are major pests and diseases of mangosteen. The fruits mature in after 120-128 days of fruit set, mostly in the month of July-August in south India and tree satrts full fruiting after 15 years and a grown up tree gives 40-60 kg/tree fruits. The immature fruits are yellow green and turn dark-purple to red-purple. The fruits have smooth surface and 3.4 to 7.5 cm diameter. The fruit rind is 6 to 10 mm thick, red, purplish-white on the inside. The pulp is snow-white, juicy, soft flesh, very sweet. The flesh is sweet with distinct flavour.

Mature fruits of mangosteen

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Garcinia: A genus of...

Young tree of mangosteen

This fruit is known as queen of fruits due to exquisitely luscious and delicious taste. Fruits can be stored 2-3 weeks at room temperature and up to 50 days at 4-6°C with 85-90% relative humidity. It is mainly used as fresh fruit but processed products like jelly, paste, syrup and canned fruit segments are also prepared.

Kokum (***Garcinia indica***)

Kokum is native of the Western Ghats in India. It is found growing naturally in evergreen and semi-evergreen forests or in home garden tree in the Western Ghats of Maharashtra, Karnataka and Goa. The major kokum growing areas are in Maharashtra, Goa and Karnataka. It is an evergreen tree reaching to a height of 10-15 m with spreading branches. The ripe fruits are bright red, spherical or globose. The rind is thick and red is colour. Pulp is white, acidic and encases 5 to 8 seeds. The rind contains anti-obesity compounds, anthocyanin etc. It has a sweetish acid taste and is dried and used as a souring agent in traditional dishes in Konkan, Goa and Karwar region and also used for the preparation of syrup, juice, dried flakes, powder, etc. White pulp is also edible. The rind has medicinal purposes, for the treatment of obesity, piles, dysentery, tumors, and heart complaints. Seed contains high amount of oil and seed oil or butter is extracted. The oil is used as an ingredient in cosmetic products. Kokum is generally not used as fresh fruit. It is used for making squash, syrups and dried for use as souring agent in various preparations since long in entire Western Ghats region. Kokum contains anthocyanin, fatty acids, hydroxycitric acid (HCA) and garcinol. Anthocyanins are well known for their antioxidant, anti-inflammatory and anti-carcinogenic activity. Kokum is rich in anti-obesity compound, i.e. Hydroxycitric acid (HCA). It has gained much attention in recent years for use in weight loss and now lot of anti-obesity products are being prepared from *Garcinia*. Apart from the medical value, it is rich in many other nutrients.

Two improved kokum varieties namely Konkan Amruta and Konkan Hatis have been released by Dr. BSKKV, Dapoli. Few promising lines of Kokum have

Flowers of mangosteen

Immature fruits of mangosteen

Fruiting branch of Kokum

Ripe fruits of Kokum

Kokum Butter

Kokum Sharbat

Processed products of Kokum

been identified by CHES (IIHR), Chettalli and IIHR, Bengaluru. Kokum may be propagated by seed, grafting and root suckers. The seedlings start flowering 7 to 8 years of planting whereas grafted plants starts flowering after 3-4 years. Generally kokum plant flowers during December to February depending on the climatic conditions. The fruits are harvested after about 120 days of fruit set. Kokum fruits are ready for harvesting from the month of April to May. Generally a 15 year old seedling plant produces 30-50 kg fruits/ plant. The shelf life of kokum fruits is 4-5 days under ambient temperature. It can be extended up to 28 days if stored at 13°C and 86% relative humidity. The products such as kokum syrup, salted kokum syrup and dried rind are traditionally prepared from rind of fruit and oil is extracted seeds in Konkan region of Maharashtra and coastal region of Karnataka. Dried rind is prepared by sun drying. Kokum butter is obtained from the seed of kokum. It is a solid, stable hard butter. It is used in preparation of cosmetics, bar soaps and skin lotions.

Malabar tamarind (*Garcinia gummigutta*)

Malabar tamarind (*Kachumpuli*), is a native of India, Myanmar and is widely distributed in Western Ghats from Konkan to Kerala. It's fruits are edible but too acidic to be eaten raw. They are dried and are used in traditional food preparations as a condiment in Kerala and Karnataka in place of tamarind or lime. The seed fat is edible, used as a component in ointments, soaps, confectionaries, cosmetics and also for culinary purposes. The gum extracted from stem is used to make good varnish. The fruits are rich in alpha-HCA (hydroxy citric acid), garcinol, xanthones which have lot of nutritional as well as pharmaceutical values. Alpha-HCA (hydroxy citric acid) prevents fat accumulation in body cells and is a potent metabolic regulator of obesity and lowering blood lipids. The fruits also have anti-scorbutic, astringent, demulcent and antiseptic properties. Some health benefits of fruits are lowering of blood pressure, anti-inflammatory properties, anti-microbial, promotes skin regeneration, strengthening

Branch with immature malabar tamarind fruits

of bones, cancer disease, treatment of flu and coughs, alleviates allergies, treatment of arthritis, reduces stress, fights depression, lower cholesterol, regulate blood sugar, increase metabolism, boost energy levels. It has been reported that it has a protective ability against external toxins, such as alcohol. The extract of fruits is used as purgative in traditional medicine. The trees can be found in forested areas and backyard. There is almost no plantation of Malabar tamarind in India. The fruits are collected from forests or home gardens and sold in the market. It is estimated that almost 2500 tonnes of the dried rind is collected from forest and other areas. Malabar tamarind grows well under humid tropical climatic condition. Lot of variability was observed in terms of vegetative,

Mature fruits

Dried flakes

Vinegar

Seed butter

Tablets of malabar tamarind

floral, fruiting and biochemical character of the fruits and some collections were made. So far no variety has been released in India. However few promising lines have been identified at NBPGR RS, Thrissur; IISR, Calicut and CHES, Chettalli. The plant may be propagated by seed, grafting and root suckers. The planting is usually done at 6 × 6 m distance. The seedlings start flowering 8 to 10 years of planting whereas grafted plants starts flowering after 5-6 years. The flowering takes places in the month of March-April and fruits ripe by July–August but this may vary as per the climatic conditions.

The fruit matures in the months of July-August. The fruit colour changes from green to bright yellow at maturity. The colour became dull yellow at ripe stages and fruit became soft. Generally fruit matures in 110-125 days after fruit set. These fruits may be kept for 6-7 days for softening. Generally a 15 year old seedling plant produces 30-40 kg fruits per plant. The fruit is made into dried flakes, powder, vinegar, medicine, etc. The dried flakes are used as a substitute for tamarind in fish and pork curries. The dried flakes have lot of demand in Malnad and Kerala and sold at ₹ 300-800 per kg. The fruit vinegar

View of yellow mangosteen plantation

Immature yellow mangosteen fruits

Tree with mature fruits

has lot of demand in Malnad and sold at ₹ 800-1600 per litre. The seed are used to extract *Garcinia* butter which has demand for cosmetic purposes.

Yellow mangosteen (*Garcinia xanthochymus*)

Yellow mangosteen is native of India, south eastern Asia and is widely distributed in the lower hills of Assam, Bengal, Odisha and Western Ghats from Konkan to Kerala. It is perennial tree with attractive crown that grows up to 8 m in height. The leaves are large and leathery and oblong to lanceolate. The fruit pulp is yellow, edible, and sweet to sour. The fruits are used for making squash, jam, dried flakes, etc. The fruit has lot of medicinal properties and contain several phytochemicals such as xanthones, flavonoides, saponins, tannins, alkaloids, lipids, benzophenones and biflavonoids. Methanol extract of fruit contains benzophenones, guttiferone H and gambogenone. These compounds play major role for prevention of colon cancer and breast cancer. There is almost no plantation of yellow mangosteen in India. It is mostly grown in the backyard garden as semi-wild condition in south and east and North eastern India.

Table 1. Use of *Garcinia* species in folk medicines

Fruit	Use in folk medicine
Mangosteen	Peel and seed in the form of infusions and decoctions are used to treat infections of skin, urinary tract, and gastrointestinel, and act as laxative, anti-scorbutic, and anti-fever agent. Treatment of diarrhoea, abdominal pain, dysentery, suppuration, wound infection, and chronic ulcer and to treat inflammatory and immunological related-diseases, such as acne, food allergies, arthritis, etc.
Kokum	Traditionally, kokum is used in herbal medicines to treat diarrhoea, inflammatory ailments, dermatitis, bowel problems, rheumatic pains and to prevent hyper perspiration. Fruits are used as antihelmintic and cardiotonic. Kokum juice from the rind is used against piles, colic problems, dysentery and diarrhoea, decoction of fruit rinds are traditionally used against diabetes. Kokum butter is used traditionally to heal wounds, fissures in hands and is supposed to restore elasticity of skin and used as a moisturiser. Leaves are used to treat skin ulcers, dyspepsia and hyperplasia.
Malabar Tamarind	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 indispensible ingredient in gargles for weak gums, bowel complaints, constipation, diarrhoea and dysentery. The plant is used in veterinary medicine for mouth diseases in livestock.
Yellow mangosteen	Plant is widely used as a traditional folk medicine for bilious condition, diarrhoea, dysentery, anthelmintic, cardiotonic and as a tonic to improve appetite. In traditional Chinese Dai medicine, it is used for expelling worms and removing food toxins.

Table 2. Phytoconstituents in various parts of *Garcinia* species

Fruit species	Plant part	Phytoconstituents
Mangosteen	Fruit	Protocatechuic acid, p-hydroxybenzoic acid, xanthonoids, such as mangostin; methylparaben, methyl 3,4,5-trihydroxybenzoate, parvifoliol A1, methyl 2,3-dihydroxybenzoate, 4-hydroxybenzoic acid, epicatechin, mangostanin
Kokum	Fruit	Hydroxycitric acid (HCA), (1, 2 dihydroxypropane-1, 2, 3-tricarboxylic acid). HCA lactone, Cambogic acid, mangostin, garcinol, fukugicid, and amentoflavone, malic acid, citric acid and tartaric acid
	Seed	Isoxanthochymol, camboginol, palmitic acid, stearic acid, oleic acid, linoleic acid
	Leaf	D-Leucine, isogarcinol, xanthochymol, isoxanthochymol
	Bark	Polyprenylated acylphloroglucinol derivative, Euxanthone (1,7-dihydroxy xanthone), volkensiflavone and morelloflavone, xanthochymol, isoxanthochymol, camboginol
Malabar tamarind	Fruit	Guttiferones - K, I, J, M and N; oxy-guttiferones M
	Leaf	Cambogic acid, mangostin, garcinol, fukugicide, GB-1 and amentoflavone
	Bark	Rheediaxanthone, guttiferone E and isogarcinol
	Root	Garbogiol, Morelloflavone, Dihydromorelloflavone, Isomorellic acid
Yellow mangosteen	Fruit	Xanthones, biflavonoids and benzophenones, xanthones,benzophenones, flavonoids, depsidones and isocoumarins. Xanthochymol, isoxanthochymol, cambogin, volkensiflavone, morelloflavone, biflavones GB-1 and GB-1a, maclurin, 1,5-dihydroxyxanthone and 1,7-dihydroxyxanthone

Table 3. Processed products from *Garcinia* species

Fruit	Products
Mangosteen	Jam, Squash, Jelly, canning
Kokum	Squash, Dried rind, Rind powder, Seed butter, Gamboges
Malabar Tamarind	Dried rind, Rind powder, Seed butter, Gamboges
Yellow mangosteen	Jam, Chutney, Dried rind, Gamboges

Yellow mangosteen grows well under humid tropical and subtropical climatic conditions. The plant may be propagated by seed, cutting, grafting and root suckers. Planting in done at 6 × 6 m distance. The seedlings start flowering after 7 to 8 years of planting. The flowering takes places in the month of May and continue up to August-September. The fruit matures in the months of November-March. Fruits may be kept for 3-4 days for softening. Generally a 15 year old seedling plant produces 20-30 kg fruits per plant. The fruits are sour and not much preferred for table purpose. The fruit is made into jam, chutney, curries, squash, dried flakes, etc. A kind of cool drink is prepared from fruits. In Malaysia, fruit is used as a substitute for tamarind in curries.

These species have tremendous potential as crops of next generation in Western Ghats and NE regions. There is a lot of potential of these species in pharmaceutical and processing industries. Very limited research works has been done on the production technologies of these indigenous underutilized species.

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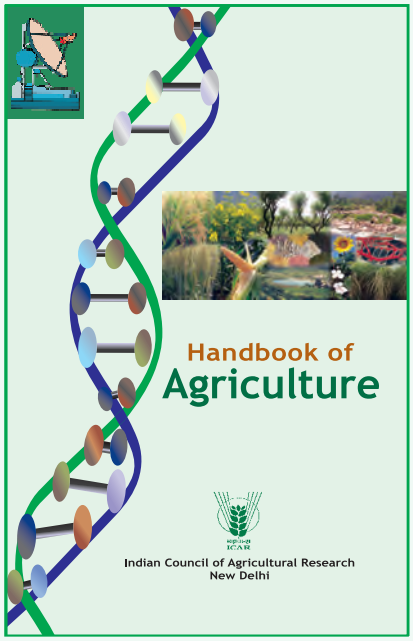

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TECHNICAL SPECIFICATIONS

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