GOLDEN BENEFITS OF DRINKING KOKAM-COLA

Parle Milind* and Dhamija Isha

Pharmacology Division, Dept. Pharm. Sciences, Guru Jambheshwar University of Science and Technology, Hisar, Haryana, India

*Corresponding Author Email: mparle@rediffmail.com

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ABSTRACT

Kokam fruit can be viewed as a wonder berry that has a pleasant, tangy-sweet taste and a myriad of health benefits. This exotic fruit is a native of Sahyadri Mountain range of Western India. Kokam (*Garcinia indica*), grows on ornamental fruit trees and does not require irrigation, spraying or fertilizers. Since Kokam tree is disease- and pest-free, it provides a sustainable source of livelihood for several families and small rural farmers. Kokam fruit is a popular condiment used in several states of India for making vegetarian and non-vegetarian preparations, including the popular 'solkadhi'. Kokam has culinary, medicinal as well as industrial uses. Most commonly used part of the plant is the fruit of Kokam. Kokam is loaded with B-complex vitamins, and minerals like potassium, manganese and magnesium, which help control heart rate and blood pressure, offering protection against stroke and coronary heart diseases. This versatile super fruit has long been used to combat digestive problems such as indigestion, flatulence, acidity and constipation. It enjoys popularity as a cool and refreshing drink in the sweltering summer heat. Kokum- cola would thus make a better cold-drink than coca-cola. Kokam fruit possess useful anti-oxidant, chelating, anti-cancer, anti-inflammatory, anti-bacterial, anti-fungal, cardio-protective and anti-ulcer activities. This review article encompasses the phytoconstituents, traditional uses and medicinal properties of Kokam.

KEY WORDS: *Garcinia indica*, Anti-oxidant, Anti-tumor, Anti-ulcer Hypolipidemic.

INTRODUCTION

Kokam (*Garcinia indica* choisy) trees are found in humid tropical regions of Western Ghats of India. Most useful part of the plant is the fruit of Kokam. This fruit is of commercial importance owing to its enormous medicinal properties. Genus *Garcinia* of the Clusiaceae family includes around 200 species of trees or shrubs, of which *Garcinia indica* is the most common. Kokam is a berry with fleshy endocarp whose seeds, rind, juice and pulp have a myriad of health benefits. Kokam fruit is a popular condiment used in several states of India for making vegetarian and non-vegetarian 'curry' preparations, including the popular 'solkadhi'. A healthy soft drink is made from Kokam to relieve sunstroke, due to its heat neutralizing property. Kokam fruits are squeezed in sugar syrup to make a soft drink, named as 'Amrutkokam', which is quite popular during summer season. In Ayurveda, Kokam is traditionally used for edema, rheumatism, delayed menstruation, constipation, bowel complaints, intestinal parasites, skin rashes and burns. Kokam juice is used as a weight loss supplement, since it is anorectic. It is used as hepato-tonic, cardiotonic, anti-tumor and as a cure for bleeding piles. This plant is also pharmacologically studied for chelating, free radical scavenging, anti-bacterial, anti-fungal, anti-cancer, anti-inflammatory, anti-obesity and anti-ulcer activities. The rind is processed for preparation of syrup, amsul, Kokam powder etc. 'Kokam' is found in Maharashtra, Goa and the South West regions of India.

Botanical Description

Kingdom	: Plantae
Subkingdom	: Viridiplantae
Division:	Magnoliophyta
Subdivision	: Angiospermeae
Class	: Magnoliopsida
Subclass	: Dilleniidae
Order	: Malpighiales
Family	: Clusiaceae

Subfamily	: Clusiaceae
Tribe	: Garcinieae
Genus	: <i>Garcinia</i>
Species :	<i>Garcinia indica</i> Choisy
Binomial name:	<i>Garcinia indica</i>

Vernacular Names

English :	Brindonia tallow, Goa-butter, Indian berry, Kokam, Red mango
Gujarati :	Kokam
Hindi :	Bhirand, Kokam, Kokam, Ratambi.
Kannada :	Murgala, Punarpuli
Konkani :	Birond, Birondi, Ratambi
Malayalam :	Kokkam, Punampuli
Marathi :	Bhirand, Kokam, Kokambi, Amsol, Katambi, Ratamba
Punjabi :	Kokam
Sanskrit :	Vrikshamla, Amlabija, Amlashaka, Chukraphala, Raktapuraka
Tamil :	Murgal
Telugu :	Puranapuli

International Synonyms

French :	Brindonnier
German:	Cocum, Kokam
Italian :	Cocum
Japanese :	Garushinia indica
Spanish :	Cocum
Tibetan :	Da tri ga, Da tri gi

Geographical Distribution

Kokam is a tropical evergreen tree of moderate to large size. It is found at an altitude of about 800 meters from sea level. It is a slender tree with drooping branches. It grows to a height of 15-20 m. The canopy is dense with green leaves. It is a native of the Western Ghats region of India. It is distributed throughout Konkan, Goa, North & South Kanara, North

Malabar, Coorg & Wynad as well as in West Bengal and Assam. It is an androdioecious tree producing male and bisexual flowers on separate plants.

Soil and climate: It flourishes well in a hot humid climate, under partial shade. The soil should be well-deep, with good water holding capacity. However, the tree can also be grown on sandy, clay, loamy and lateritic soils, which can hold

moisture. The Kokam tree tolerates water-logged conditions as well as drought conditions to some extent. It grows well along river banks and sea shores. Warm and moderate humid zones are most favorable for cultivation of Kokam. The optimal conditions for this plant are 20 to 35°C temperature range, 60 to 80 percent humidity and good rainfall ranging from 2500 to 4000 mm. Extreme acidity is detrimental to the tree.

Figure 1: Kokam Tree

Figure 2: Kokam Leaves with flower buds

Figure 3: Kokam Flower

Figure 4: Kokam Fruit (immature)

Figure 5: Kokam Fruit (mature)

Figure 6: Kokam Seeds

Figure 7: Kokam Butter

Figure 8: Kokam Drink

Leaves: These are elliptic, obvate - oblong, lanceolate, rounded, acute or abruptly acuminate, narrowed at base. Deep green shining leaves are up to 6-8 cm long and 2-3 cm broad.

Flowers: These are pale yellow in color, borne either singly or in clusters. The flowers may be fascicled and umbelled. Flowers usually have 4 to 5 sepals, which form the outer layer of the unopened flower bud. Four to five imbricate petals are generally present. In the male flowers, the stamens exist either free or joined to form a ring or lobular mass that surrounds a rudimentary ovary. In the female flowers, the staminodes are free or joined together. The female flower has a largely conspicuous but varied stigma, which is sub-sessile. The trees flower annually in the month of November to February.

Fruits: The fruit is brownish or brownish-gray, marbled with yellow, and is crowned by the 4-parted, stalkless stigma. There are 6 to 8 seeds in it, and the pulp is juicy, white, delicious in taste and odor. It is about the size of an orange. The berry encapsulated by a tough rind, sits on top of the calyx. An average Kokam tree bears hundreds of fruits, during summer. When they are tender, they are green in color. The beautiful purple color is attained on maturation.

Seeds: The seed is about one fourth of total weight of fruit. Seeds contain about 23-26% oil, which remains solid at room temperature and is known as Kokam butter.

Phytoconstituents

Garcinia is a rich source of active compounds including g Garcinol, xanthochymol, isoxanthochymol and Hydroxycitric acid. These are flavonoids, benzophenones, xanthenes, lactones and phenolic acids ¹. The fruits contain citric acid, acetic acid, malic acid, ascorbic acid, hydroxycitric acid and

garcinol. The major constituent of Kokam rind is g Garcinol, a polyisoprenylated benzophenones, isogarcinol and camboginol. Garcim-1, Garcim-2 and cambogin are the chief oxidative products of g Garcinol, along with isogarcinol, gambogic acid, mangostin, clusianone, macurin, oblongifolin (A, B, C), guttiferone (I, J, K, M, N). The rind of ripe Kokam fruits consists of hydroxyacetic acid and hydroxycitric acid. It also contains 2.4% pigment as a mixture of two anthocyanins namely, cyanidin-3-sambubioside and cyanidin-3-glucoside in the ratio 4:1. Studies have shown that the fresh rind of Kokam contains 80% moisture, 2% protein, 2.8% tannin, 5% pectin, 14% crude fiber, 4.1% total sugars, 1.4% fat, 2.4% pigment, 22% hydroxycitric acid, 0.06% ascorbic acid ². Kokam leaves are reported to contain L-leucine, 75% moisture, protein 2.3g, fat 0.5g, fiber 1.24g, carbohydrates 17.2g, iron 15.14mg, calcium 250mg, ascorbic acid 10mg and oxalic acid 18.10mg per 100g ³. Hydroxycitric acid lactone and citric acid are present in leaves and rinds in minor quantities ⁴. Kokam seeds are rich in glycerides of stearic acid (55%), oleic acid (40%), palmitic acid (3%), linoleic acid (1.5%), hydroxyl capric acid (10%) and myristic acid (0.5%). Heart-wood contains euxanthone, biflavonoids - volkensiflavone and morelloflavone.⁵

Pharmacological Activity

Anti-bacterial activity

Hexane and benzene extracts of the rinds of Kokam and its active constituent g Garcinol possess powerful anti-bacterial activity of its own. It also potentiated the effects of clarithromycin on *H. pylori*. Even the Kokam leaf extract possessed inhibitory activity against pathogenic bacteria *Salmonella typhi*, *Salmonella paratyphi A* and *Salmonella typhimurium*. Aqueous extract of Kokam rind is reported to have highest antibacterial activity against *Bacillus subtilis*, followed by *Escherichia coli*, *Enterobacter aerogenes* and

Staphylococcus aureus. The phytoconstituents garcinol, isogarcinol and xanthochymol exhibited inhibitory effect on the growth of methicillin resistant *S. aureus*^{6,7}.

Anti-fungal activity

Varalakshmi demonstrated antifungal activity of aqueous extract of Kokam rind against *Candida albicans* and *Penicillium* sp⁶. Chloroform extract of Kokam rind inhibited the growth of *Aspergillus flavus* and production of aflatoxin¹.

Anti-ageing activity

Kokam pigments are useful in skin disorders for skin care, due to UV light absorbing properties. Kokam exhibits anti-hyaluronidase and anti-elastase activities, which favors skin care⁸.

Neuroprotective effects

Methanolic extract of Kokam fruit exhibited significant neuroprotective potential against 6-OHDA, indicating its anti-parkinson's activity in rats. Garcinol also reduced the expression of LPS-induced inflammatory mediators, iNOS and COX-2 and prevented nitric oxide accumulation in LPS-treated astrocytes⁹. It was also found to have anti-cholinesterase property¹⁰. Cyanidin-3-glucoside prevent the neurite outgrowth and the expression of neurofilament proteins demonstrating its neuroprotective potential.

Anti-ulcer activity

Aqueous and ethanolic extract of Kokam rind elicited ulcer protective activity against indomethacin induced ulcerogenesis and HCl/ethanol induced gastric lesion. Garcinol on oral administration convincingly reduced gastric ulcers induced by indomethacin and water immersion¹¹.

Hypoglycemic activity

The whole fruit extract of Kokam significantly lowered fasting blood glucose levels in streptozotocin induced hyperglycemic rats in acute as well as chronic study. The acute administration of aqueous extract at 400 mg/kg significantly improved oral glucose tolerance, revealing its anti-hyperglycemic activity. Garcinol purified from *Garcinia indica* rind was reported to have potent glycation inhibiting activity, as it suppresses protein glycation in a bovine serum albumin/fructose system.¹²

Anti-obesity activity

The methanolic extract of the dried fruit of Kokam showed remarkable anti-hyperlipidemic activity in rats, using cholesterol induced hyperlipidemic model. Significant decrease in total cholesterol, triglycerides, LDL-C, VLDL-C levels and increase in HDL-C was reported by Darji¹³. Many studies have shown that intake of Hydroxycitric acid present in Kokam reduces appetite, inhibits lipogenesis and reduces body weight¹⁴. In vitro studies demonstrated increase in adipocytokine secretion and up-regulation of adipocyte specific gene expression without activation of PPAR γ on treatment of rat adipocytes with cyanidin 3-glucoside. Furthermore, in vivo studies also showed increase in gene expression of adiponectin in the white adipose tissue¹⁵. Lipase inhibitory property and anti-obesity activity of isogarcinol was also shown.

Anti-inflammatory activity

Kokam rind aqueous and ethanolic extract was investigated for its anti-inflammatory potential, by using carrageenan

induced paw edema model. Both the extracts showed powerful reduction in inflammation, in acute study. Moreover, significant reduction in lysosomal enzymes acid phosphatase and alkaline phosphatase confirms its anti-inflammatory activity¹⁶.

Anti-oxidant activity

Selvi reported the free radical scavenging property of chloroform extract of Kokam rind by using DPPH assay and β -carotene linoleate assay¹. Marketed concentrated syrup, cold and hot aqueous extract of Kokam also exhibited free radical scavenging activity¹⁷. Methanolic extract of Kokam fruit showed potent antioxidant activities comparable to standard ascorbic acid. Garcinol was found to have superoxide anion scavenging activity in phenazine methosulphate/NADH- nitroblue tetrazolium system. It also showed free radical scavenging activity comparable to DL- α -tocopherol in DPPH assay¹². Scavenging of ultraviolet B-induced hydroxyl and superoxide radicals by Cyanidin-3-glucoside in the cultured JB6 cells was illustrated by Ding et al., 2006¹⁸.

Anti-neoplastic activity

Garcinia indica fruit rind extract exhibited dose dependent cytotoxic activity by inhibiting cultured Balb/c 3T3 mouse fibroblasts. Previous reports showed that garcinol elicited inhibitory effect on Azoxymethane (AOM) - induced colonic aberrant crypt foci (ACF). Moreover, garcinol also improved liver glutathione-S-transferase and Quinone reductase levels, reflecting hastening of detoxification mechanisms. Garcinol showed significant suppression in 4-NQO induced oral carcinogenesis. It also diminishes tongue carcinoma. Garcinol prevented DNA damage, by scavenging the hydroxyl radical and inhibit carcinogenesis. Furthermore, garcinol and its derivatives, cambogin, garcim-1, and garcim-2 showed potent growth-inhibitory effects on the neoplastic colon cancer cells, as well as in normal immortalized intestinal cells. Antiproliferative effects of garcinol was elicited in HeLa cells, human colorectal cancer cell line¹⁹, human leukemia HL-60 cells, human breast cancer cells, prostrate and pancreatic cancer cells²⁰. Isogarcinol and xanthochymol induce apoptosis through activation of caspase-3 in neoplastic cells. In vivo studies predicted reduction in number of non-malignant and malignant skin tumors per mouse in skin carcinogenesis model by Cyanidin-3-glucoside¹⁸. Cyanidin-3-glucoside provided protection to Caco-2 colon cancer cells against the peroxyl radical (AAPH)-induced oxidative damage and reduce its cytotoxicity²¹.

Cardio-protective activity

Cyanidin-3-glucoside of Kokam enhanced eNOS expression and increased the NO production, improving endothelial dysfunction, harmonizes blood pressure and may possibly prevent atherosclerosis²².

Uses of Kokam

Traditional uses

Kokam is a favorite home-remedy useful as a:

- Digestive (Fruit)
- Antacid (Kokam Rind and leaves)
- Anti-dysentery (Fruit, Rind and leaves)
- Anti-diarrheal (Fruit, Rind and leaves)
- Anti-piles (Fruit, Rind and leaves)

- Anti-ulcer (Rind)
- Anti-colic (Rind and leaves)
- Anti-obesity (Fruit)
- Anthelmintic (Fruit)
- Anti-asthmatic (Fruit)
- Cardiotonic (Fruit)
- Hepatoprotective (Fruit)
- Anti-tumor (Fruit)
- Anti-hyperplasia (Leaves)
- Wound healer (Kokam butter)
- Analgesic (Rind, Fruit)
- Anti-inflammatory (Rind)
- Anti-dermatitis (Rind)
- Anti-perspirant (Rind)
- Astringent (Leaves, fruits and roots)
- Demulcent (Kokam butter)
- Emollient (Kokam butter)

Therapeutic uses

- The hydroxycitric acid present in the Kokam fruit fights cholesterol and curbs lipogenesis and thereby, help in weight loss.
- Kokam fruits contain rich amounts of anti-oxidants that bind with free radicals and prevent oxidative damage to body cells. They also promote cell regeneration and repair.
- Kokam juice is mainly popular during scorching summer, as it has a cooling effect on the body. Kokam juice is a healthier and far more refreshing option as compared to commercial bottled drinks. It protects the body against dehydration and sunstroke. It also helps in bringing down fever and allergic reactions.
- Kokam seeds contain a high percentage of oil that freezes to form Kokam butter. Kokam butter is extensively used in the pharmaceutical and cosmetic industry, as it works wonders on dry, chapped, sensitive, irritated or burnt skin. Due to its soothing and healing properties, it is also applied directly to wounds and infected areas on the skin.
- Kokam butter is rapidly gaining popularity over cocoa butter as an intensive skin moisturizer.
- Kokam has anti-helminthic properties.

Industrial uses

- Kokam fruit appears to be a promising industrial raw material for commercial exploitation, due to its chemical constituents.
- Kokam fat has been reported to be used in chocolate and confectionary preparations. It is also used in manufacture of soaps, candles and ointments.
- Amsul, the unsalted Kokam as well as salted Kokam is marketed. Lonavala Kokam, Pakali Kokam, Khane or edible Kokam and Khoba Kokam are some of the trade varieties.

Culinary Uses

- Dried Kokam fruit rinds are widely used in seasoning, as they impart a sweetish-tangy flavor to the food.
- The Kokam is extracted by soaking the rind in hot water. This juice is either consumed alone or mixed with spices.
- Dry rind of Kokam is used as a substitute of tamarind, vinegar and lime juice. It gives sour taste to curries and gravies.

- The Kodum puli is endemic to the western seaward regions of South India. It is added to chutneys and pickles as well.
- Kokam is also known as 'Fish Tamarind' as it is added to the fish curry to make it sour especially in the Konkaneese preparation and the cuisines of Travancore in Kerala.
- The intrinsic acidic property of Kokam checks the unpleasant flavor of the fish.
- It is used for food coloration, due to anthocyanins, which provide a dark purple color.

Key Points

- Kokam is a sour fruit that resembles tamarind.
- Kokum- cola is a medicinal cold-drink far superior to coca-cola.
- Kokam Tel is used in foot massage.
- Fresh Kokam fruit is a rich source of B-complex vitamins, such as thiamine, niacin and folates.
- Spiced and sweetened Kokam forms favorite dish, during marriage feasts and functions in Uttara Kannada District of Karnataka.
- Monomeric anthocyanin content of Kokam was 2400 mg/100 g of fresh fruit, which was quite high as compared to other fruits and vegetables, thereby reflecting its powerful cardioprotective activity.

CONCLUSION

Kokam fruit can be viewed as a wonder berry that has a pleasant, tangy-sweet taste and a myriad of health benefits. This exotic fruit is native of Sahyadri Mountain range of Western India. Kokam (*Garcinia indica*), grows on ornamental fruit trees and does not require irrigation, spraying or fertilizers. Since Kokam tree is disease- and pest-free, it provides a sustainable source of livelihood for several families and small rural farmers. The *Garcinia indica* tree's major health benefits are derived from garcinol, a substance found in the fruit rind, seeds and other parts of the tree. Garcinol is able to kill the *H. pylori* bacteria that can cause ulcers and evidence suggests that garcinol could be useful as an anti-cancer agent. Kokam fruit helps in reducing body weight by virtue of its anorectic property, appetite suppressant activity and cholesterol lowering effect. Kokam seed butter has non-greasy moisturizing properties that are being used in many cosmetics, creams, conditioners and soaps. Kokam Tel is used in foot massage. Kokam fruit is a popular condiment used in several states of India for making vegetarian and non-vegetarian preparations, including the popular 'solkadhi'. Kokam has culinary, medicinal as well as industrial uses. Kokam is loaded with B-complex vitamins, and minerals like potassium, manganese and magnesium, which help control heart rate and blood pressure, offering protection against stroke and coronary heart diseases. This versatile super fruit has long been used to combat digestive problems such as indigestion, flatulence, acidity and constipation. It enjoys popularity as a cool and refreshing drink in the sweltering summer heat. Kokam fruit possesses useful anti-oxidative, chelating, free radical scavenging, anti-cancer, anti-inflammatory, anti-bacterial, anti-fungal, cardioprotective and anti-ulcer activities.

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