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Dr. NL Gowrishankar
Department of Pharmacognosy;
Prime College of Pharmacy,
Palakkad, Kerala, India

Shantha Sheela N
Department of Pharmacognosy;
Prime College of Pharmacy,
Palakkad, Kerala, India

Farsena A
Department of Pharmacognosy;
Prime College of Pharmacy,
Palakkad, Kerala, India

Raheesul mubashireen
Department of Pharmacognosy;
Prime College of Pharmacy,
Palakkad, Kerala, India

Rameesa K
Department of Pharmacognosy;
Prime College of Pharmacy,
Palakkad, Kerala, India

Shahna sharin VP
Department of Pharmacognosy;
Prime College of Pharmacy,
Palakkad, Kerala, India

Sinara NS
Department of Pharmacognosy;
Prime College of Pharmacy,
Palakkad, Kerala, India

Correspondence
Shantha Sheela N
Department of Pharmacognosy;
Prime College of Pharmacy,
Palakkad, Kerala, India

A complete review on: *Averrhoa carambola*

Dr. NL Gowrishankar, Shantha Sheela N, Farsena A, Raheesul Mubashireen, Rameesa K, Shahna Sharin VP and Sinara NS

Abstract

Plants are very complex organisms that produce medicinally important natural products. From the centuries, herbal medicines have been used to treat various diseases and now they had become an item of global importance with both medicinal and economic implications. Selecting the right scientific and systematic approach to biological evaluation of plant products, based on their use in traditional medicine is the key to ideal development of new drugs from plants. One such plant is *Averrhoa carambola*, a multipurpose drought resistant evergreen tree commonly known as 'kamrakh' and commonly known as starfruit, because of its peculiar shape. It is used as well-known remedy for the treatment of a number of manifestations in ayurvedic as well as folklore system of medicine and preparation of its fruit and leaves are used to pacify impaired kapha, pitta, skin diseases, pruritis, worm infestations, diarrhea, vomiting, hemorrhoids, intermittent fever, over-perspiration and general debility. It is also a good source of potassium, copper, as well as folate and panthothenic acid. The ascorbic acid levels of the star fruit is believed to be responsible for its sweet or sour taste. It is considered as one of the best Indian cooling medicine. The medicinal properties of *Averrhoa carambola* includes Anti-inflammatory, Analgesic, Hypotensive, Anthelmintic, Antioxidant, Antiulcer, Hypocholesterolemic Hypolipidimic, Antimicrobial and Antitumor activities

Keywords: Complete, review, *Averrhoa carambola*, medicinally, natural

Introduction

Herbal medicine is the oldest form of healthcare known to mankind. Plants have always been an exemplary source of drugs and many of the currently available drugs have been derived directly or indirectly from them. Herbal medicines have often retained popularity for historical and cultural ingredients and are used primarily for treating mild and chronic ailments. Natural products and especially those derived from higher plants have historically played a pivotal role in the discovery of new pharmaceuticals. Modern allopathic system has developed many sophisticated and costly diagnostic methodologies which at the times have made it quite exorbitant and beyond the reach of common man. Many modern synthetic drugs may harm more than they help in curing diseases by its serious effects. So Population in developing countries depends mainly on the indigenous traditional medicine for their primary healthcare needs ^[1]. *Averrhoa carambola* generally called starfruit is an attractive, slow growing evergreen tree that belongs to Oxilidaceae family ^[2]. The word *carambola* comes from the Sanskrit word Karmaranga meaning "food appetizer". Starfruit is a star shaped tropical fruit with sweet and sour flavor ^[3]. The starfruit gets its name from the shape of a cross section of the fruit. *A. carambola* fruits possess good nutrition value, as they contain very low fat, are high in vitamin B and C content, and also a source of potassium and fiber ^[4]. In traditional medicine, the fruit was used for treating ailments such as cough, food poisoning, sore throat and malarial splenomegaly; the root for treating arthralgia, chronic headache, epistaxis and spermatorrhea; the leaves for treating boils, colds, gastroenteritis, oliguria, postpartum edema, pyoderms and traumatic injury, while the flowers for treating fever, malaria and subcalorism ^[5]. *A. carambola* fruit exhibited significant central and peripheral analgesic activities. The insoluble fibers of the starfruit make slow the absorption of carbohydrates which significantly reducing the blood glucose level. The fiber can also act to prevent cardiovascular disease by reducing serum triglyceride and total cholesteol levels ^[6].

For the present work, leaves of *Averrhoa carambola* collected from the village area near to Palakkad district of Kerala and botanically identified and authenticated by Dr. Maya C. Nair, professor, department of Pharmacognosy, Govt. Victoria College. A voucher specimen of the collected sample (RRSSF001) was deposited in department of Pharmacognosy For future reference.

Origin and Distribution

The starfruit is believed to have originated in Ceylon and the Moluccas. But it has been cultivated in southeast Asia and Malaysia for many countries. It commonly grown in the provinces of Fukien, Kuangtung and Kuangsi in Southern China, in Taiwan and in India. It is rather popular in the Philippines and Queensland, Australia and moderately so in some of the South pacific island, particularly Tahiti, New Caledonia and Netherlands New Guinea and in Guam and Hawalii [7]. The plant is found throughout India, particularly on Gujarat and Maharashtra states. It is also cultivated throughout the tropics and may be native of Malaysia [8].

Starfruit Plant Varieties

Nineteen varieties of starfruit are registered under the Department of Agriculture, Malaysia. However, out of these 19 varieties, only two varieties are popular as the best commercial clones, namely 'Belimbing Besi' (B10) and 'Belimbing Madu' (B17) [8]. Besides Malaysia, the United States (USA) also cultivates starfruit plants for its fruits. Taiwan has its own collection of starfruit plant accessions, such as In Malaysia, *A. carambola* is a commercial cultivar and its fruits are widely marketed in all the states and exported mainly to the Europe. In Malaysia, four states namely, Selangor, Negeri Sembilan, Pahang, and Johor are cultivating starfruits [9]. 'Mih Tao', 'Dah Pon', 'Tean Ma' and in Thailand, 'Fwang Tung' [10].

Classification [1]

- Scientific Name: *Averrhoa carambola*
- Kingdom: Plantae – Plants
- Subkingdom: Tracheobionta -Vascular plants
- Superdivision: Spermatophyta
- Division: Magnoliophyta – Flowering plants
- Class: Magnoliopsida – Dicotyledons
- Subclass: Rosidae
- Order: Geraniales
- Family: Oxalidaceae – Wood-Sorrel family
- Genus: *Averrhoa* Adans. – averrhoa
- Species: *Averrhoa carambola* L. – carambola

Triabal use of *A. carambola* [2]

S. No	Plant part	Tribal use
1	Root	The root is used to treat arthralgia, chronic headache, epistaxis and spermatorrhea. The roots with sugar are considered to be an antidote for poison.
2	Bark	A preparation of the inner bark with sandalwood and <i>Alyxia</i> sp. is applied on prickly heat.
3	Leaves	The crushed leaves or shoot are applied externally in the treatment of chickenpox, ringworm, tinea, cold and headache.
4	Flower	The boiled flower used as an Antihelminthic, in fever, subcalorism and malaria. The flowers are added to salads in java.
5	Fruit	The ripe fruits or its juice may be taken to counteract fever. A slave made of fruit is employed to relieve eye afflictions. It is also recommended as diuretic in kidney and bladder complaints. In Ayurveda the ripe fruit is considered as digestive, tonic and causes biliousness.
6	Seeds	A decoction of the crushed seed acts as a galactagogue and emmenagogue and is mildly intoxicating. The powdered seeds serve as sedative in case of asthma and coli.

Botanical Description [7]

Averrhoa carambola tree is a slow growing, short trunked with a much branched, bushy, broad, rounded crown and reaches up to 6-9m in height. It grows on its best if the climatic condition is wet, humid and distinct dry. It thrives in subtropical and tropical climate. It likes a well-drained, clay-loam soil with a pH of 5.5-6.5 and can withstand some water logging. It can tolerate drought conditions or salt.

Vernacular Names [1]

- Sanskrit: Karmaranga
- English: Starfruit, Chinese gooseberry
- Hindi: Kamrakh, Karmal
- Bengali: Kamranga
- Assamese: Kordoi/ rohdoi
- Gujarati: Kamrakh
- Marathi: Karambal
- Telugu: Ambanamkaya
- Tamil: Thambaratham/Tamarattai
- Malayalam: Caturappuli
- Sinhala: Kamaranga
- Filipino: Balimbing, saranate
- Indonesian: Belimbing
- Malay: Belimbing

Nutritive Composition [1]

It is a good source of potassium, copper, as well as folate and pantothenic acid. Consuming 100g of this fruit can provide,

Table 1

Calories	35.7g
Proteins	9.38g
Carbohydrate	0.38g
Dietary fibre	0.80g-0.90g
Fat	0.8g
Calcium	4.4-6.0mg
Iron	0.32-1.65mg
Phosphorous	15.5-21.0mg
Potassium	2.35mg
Carotene	0.003-0.552mg
Tartaric acid	4.37mg
Oxalic acid	9.6mg
α -ketoglutaric acid	2.2mg
Citric acid	1.32mg
riboflavin	0.019-0.03mg
niacin	0.294-0.38mg
tryptophan	3mg
methionine	2mg
Lysine	26mg
Thiamine	0.03-0.038mg



Fig 1: Star fruit tree

Bark [2]

The bark is light brown, smooth or finely fissured.

Leaves [2]

Its deciduous leaves, spirally arranged, are alternate, imparipinnate, with 5 to 11 nearly opposite leaflets, ovate or ovate oblong, 1 ½ to 3 ½ in (3.8-9cm) long. The leaves are soft, medium green and smooth on upper surface, finely hairy and whitish on the underside. The leaflets are sensitive to light and more or less inclined to fold together at night or when the trees is shaken or abruptly shocked.

Flowers [4] the flower is small and is purplish in colour. It has 5 sepals, 5 petals and 5 stamens. The ovary is located under the style. The formed all along the trunk, branches and twigs. Fruits [1] the fruits are green when small and unripe but turn to yellow or orange when matured and ripe. The odour of the fruits resembles oxalic acid and their taste varies from very sour to mildly sweetish or sweetish. The flesh is light yellow to yellow, translucent and very juicy without fiber. The fruits are fleshy with an oblong shape, longitudinally 5-6 angled, 5-15cm long and up to 9cm wide. The fruits are crunchy, having a crisp texture and when cut in cross-section are star shaped, hence its name. Seeds [1] There may be up to 12 flat, thin, 5 mm long seeds or none at all. The brown colored seeds are enclosed by a gelatinous aril and lose viability in a few days after removal from the fruit. Star fruit is easily propagated from fully developed seeds.



Fig 5: star fruit fruits



Fig 6: star fruit seeds



Fig 2: star fruit bark



Fig 3: star fruit leaves



Fig 4: star fruit flowers

Cultivation [3]

Climate

The carambola should be classed as tropical and subtropical environments because mature trees can tolerate freezing temperatures for short periods and sustain little damage at 27° F (-2.78°C). In an interior valley of Israel, all trees surrendered to the usual hot and dry winds. The carambola needs moisture for best performance and ideally rainfall for its growth. Older trees are more tolerant of frost, but growth stops at 55 to 60 °C and prolonged exposure to temperatures. Annual rainfall 180cm or some what more.

Altitude

Starfruit thrives best up to an elevation of 4,000 feet (1,200m).

Soil

Carambola are not too particular as to soil, it grows well on sand, heavy clay or limestone and in rich loam. It prefers a moderately acid soil (PH 5.5 - 6.5) and is sensitive to water logging.

Propagation and management [3]

The most important methods for propagation of star fruit is

1. Air-layering
2. Grafting

Air-layering/ marcotting/ gotee

A healthy one-year old branch acutely positioned is selected from a healthy mother tree. Two rings are cut at 3-4 cm apart around the branch. The bark between the rings is completely removed and the exposed cambium layer is gently scraped off from the wood. The cut is wiped with clean cloth or tissue paper. The edge of the bark towards the shoot is applied with root-promoting hormone (IBA). A ball of moist soil mix (2:1) is placed around the cut and the soil ball is wrapped up in a transparent polythene sheet and secured tightly with string at both ends of the wrapper. After several weeks the roots will

develop sufficiently in the soil ball within the polythene wrap. The rooted branch/ branches are cut off from the mother tree at 3-4cm below the wrap and then kept in hardening area after 6 - 12 months in the nursery are planted out at a spacing of 4m x 6m

Grafting

Bud grafting

Prepare the budding patch on the stem of rootstock at 10-15cm height above the soil surface. The two vertical cuts are made with this knife separately followed by two horizontal cuts at the top and bottom of the former cuts. The bark in the cut patch or window is carefully removed exposing the wet cambium layer. An identical cut is performed to remove the bud from the scion with the bud carefully centered. While removing the bud patch from the scion stock slight rotation of the bud patch around the bud stick will assure the "eye" of the bud to remain attached to the bud patch. Carefully place the bud patch with the new bud in the cut patch or window ascertaining complete contact at both the top and bottom of the cut patch or window. Small openings along the sides of the cut patch or window are not important or critical. The newly placed bud patch should be securely tied the graft can be checked for its success of grafting which can be easily recognized by the developing bud from the patch. The budding tape or Para film is carefully removed from the graft and the top of the seedling is cut off at 10cm above the graft. The exposed cut of the stem is applied with melted paraffin or fungicide mix to prevent rotting of the stem. Finally, the bud grafted plants are transplanted into bigger size polyethylene bags and kept the nursery until they are one-year old before planting in the field.

Wedge Grafting

Firstly, we have to get ready with a rootstock plant of 6-8 months old. The stem of the rootstock is cut at 10-15 cm height from the soil surface. A center cut of 3-5cm (v-shaped cut) is made through the stem. In the meantime a shoot scion of similar length with the rootstock containing at least 3 buds taken from a very productive and healthy mother plant. The cut end of the shoot must be shaped like a wedge or inverted V-form. This shoot is then inserted into the cut of the rootstock and the graft must be tied firmly with budding tape or elastic band. The grafted seedling is then covered with a translucent polythene cover moistened in the inside with water sprays. The seedling is then kept under a shelter. New buds usually appear 15-20 days later. The plastic cover is then removed and the grafted seedlings are moved to the hardening area for several weeks before they are transplanted into the field [3].

Treemanagement [12]

When young, *A. carambola* is delicate and requires careful attention. Because it is a fast growing tree, it requires pruning and thinning of excess fruit at an early stage. Good crops are harvested from grafted varieties when they are 2-3 years old. Yields of up to 900 kg/year are common for 10-year-old trees.

Germplasm management [12]

Seed storage behaviour is intermediate. The lowest safe mc is 12.3% further desiccation reduces viability. Cool temperatures damage the seeds. Viability can be maintained for 6 months with partially dried seeds at 5°C. There are approximately 15000 seeds/kg. Mature trees can be top worked by bark grafting [12].

Reproduction [13]

A. carambola is an angiosperm, which undergo reproduction via alteration of generations. *A. carambola* tree's are dioecious, meaning that a male and female *A. carambola* tree is needed to create a new tree. *A. carambola* pollination is not air born, but instead it is pollinated by insects. The two main insects that are responsible for the pollination of *A. carambola* are honey bees and sting-less bees. These bees are attracted to the *A. carambola* tree's because of its sweet nectar and the color of the Flowers.

Adaptation [12]

A. carambola live in tropical climates, but they have adapted to sub-tropical environments as well. Mature *A. carambola* can tolerate temperatures as low as 2.78°C for a short period of time. *A. carambola* optimal soil medium is a think layer of rich loam, but it also has also adapted to several other soil mediums. *A. carambola* tree's have been able to grow on think layers of limestone, sand, and even clay. *A. carambola* tree's originated at relatively low elevations, but have adapted to thrive in elevations of up to 1,200m, as seen in Asia [12].

Irrigation [3]

The *A. carambola* needs moisture for best performance. This means regular watering during the summer months and must be watered even in winter during dry spells.

Harvesting [8]

In India, *A. carambola* are available in September to October and again in December to January. In Malaya, they are produced all the year. In Florida, scattered fruits are found through the year but the main crop usually matures from late summer to early winter. Some trees have fruited heavily in November to December, and again in March to April. There may even be three crops. Weather conditions account for much of the seasonal variability. The fruits naturally fall to the ground when fully ripe. For marketing and shipping they should be hand-picked while pale-green with just a touch of yellow. Trees that receive adequate horticultural attention have yielded 100 to 250 or even 300 lbs (45-113-136 kg) of fruit.

Storage [3]

A. carambola generally stored at room temperature for maximum of two to five days. You can also store them in the refrigerator for up to 2 weeks and can also store in freezer for 10 to 12 months.

Conclusion

Averrhoa carambola fruit is widely distributed throughout India. The plant appears to have a broad spectrum of activity on several ailments. The phytoconstituents are reported to be present in the plant are mainly flavonoids, alkaloids, tannins and saponins, which are responsible for the actions. It is an excellent plant due to its multifaceted medicinal properties like Anti-inflammatory, Analgesic, Hypotensive, Anthelmintic, Antioxidant, Anti-ulcer, Hypocholesterolaemic and Hypolipidemic, Antimicrobial and also show the Anti-tumor activity. In addition *Averrhoa carambola* food value with numerous culinary uses.

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