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Antioxidant Rich *Averrhoa carambola*: A Recent Technology in Star Fruit Production

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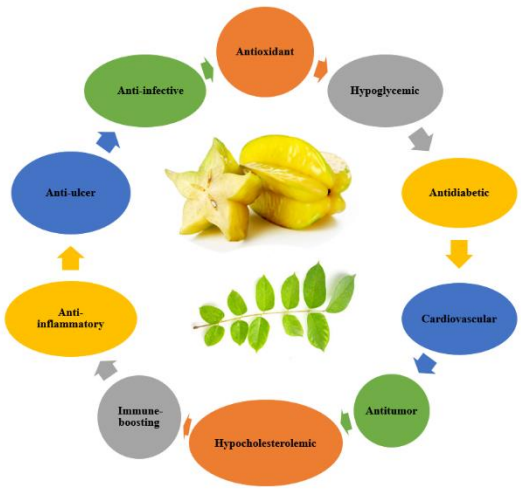
Star fruit is originated from Indonesia, Malaysia and Southern China and the fruit size will be small to medium. A star shaped fruit with sweet and sour flavour. It grows in tropical and subtropical region. Carambola belongs to the family oxalidaceae as it contains oxalic acid. The fruit is a berry which has four to six fins. Star fruits are widely growing in Southern China, Taiwan, Philippines, Queensland, Australia, Malaysia, Thailand, Israel, Florida, Brazil, Indonesia, in some of the South Pacific Islands. In India it is commonly found in warm region, mainly in the southern states near the west coast, extends from Kerala to West Bengal. Ripened fruit is used as a source of food, used as garnish, served in salads. Carambola contains secondary metabolites and has medicinal properties. Wood of the tree is used for construction purpose. The ripe fruit counteract hemorrhages and the dried fruit cure fever. It is used as a diuretic in kidney and bladder. Fresh carambola contains 91% water, 31 kcal of energy, 4% sugars and 2.8% dietary fiber per 100 g of fruit. Carambola is rich in antioxidant (Vitamin C) and they exists as polyphenolic compounds. The majority of the antioxidant (70%) in carambola is present in tissue of the fruit.

Beneficial effect of Star fruit



Soil and climate

In India it grows at an elevation of 1200 MSL. Trees can tolerate freezing temperature upto 26^0 F for short time period. Mature trees are tolerant to frost but the growth gets affected when exposed to prolonged high temperature.

It comes good in well drained sand and heavy clay soil. It cannot withstand flooding. Soil PH should be moderately acidic in nature (pH 5.5 - 6.5).

Table 1 : Two classes of Star fruit

Parameters	Class I	Class II
Fruit size	Small	Large
Taste	Sour	Sweet
Flavour	Rich	Mild
Oxalic acid content	More	Less

Commercial varieties

Golden Star, Mih Tao, Dah Pon, Tean Ma, Newcomb, Thayer and Arkin

Propagation

The common method of propagation is layering and grafting.

Air-layering

A healthy well developed one-year old branch is selected from a healthy mother plant. Two rings are made 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 edge of the bark towards the shoot is applied with IBA (root-promoting hormone). 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 3-4 cm below the wrap and then kept in hardening area after 6 - 12 months in the nursery are planted out at a spacing of 4 m x 6 m.

Wedge Grafting

Rootstock of 6-8 months old plant should be selected. The stem of the rootstock is cut at 10-15 cm height from the soil surface. A centre cut of 3-5 cm (v-shaped cut) is made through the stem. At the same time 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.

Planting

A spacing of 20 feet (6 m) is recommended and if the soil is in good condition, then adapt 30 feet (9 m) spacing. Trees respond well to 0.5 kg of N, P, K, Mg in the ratio of 6:6:6:3 applied 3 to 4 times per year. If chlorosis occurs it can be corrected by adding iron, zinc and manganese.

Irrigation

Star fruit needs moisture for its better growth. Regular watering during the summer months and moderate irrigation is given during dry season.

Preharvest factors affecting fruit quality

Carambola is susceptible to mechanical damage by the wind. Due to this wind damage scars are encountered on fruits and branches. Windbreaks such as Australian pine (*Casuarina equisetifolia*) can be grown as a border crop. One drawback of harvesting carambola is that the extended harvest season which delays flowering and new fruit set for the succeeding crop. However, selective pruning of branches reduces wind scarring and thinning the young fruit promotes the trees to produce in the off-season.

Postharvest handling factors affecting quality

Temperature management

The low temperature threshold for carambola is 5°C to avoid chilling injury during subsequent handling and shipping. Storing carambola at 5°C and 85 to 95% RH effectively counteracts moisture loss, maintaining fruit firmness over a longer time.

Physical damage

Carambola is typically harvested at the one-quarter yellow stage, while the fruit are still firm, to reduce mechanical damage. However, fruit harvested as immature (< one-quarter yellow) are more susceptible to development of chilling injury symptoms, and they require more time to reach peak ripeness.

Weight loss

Carambola have a naturally waxy surface that slows water loss through the skin; however, significant water loss occurs at the stem end of the fruit. Storage under high relative humidity (RH) conditions (85 to 95%) slows water loss and shrivelling at the stem end by reducing the vapour pressure differential between the fruit and the surrounding atmosphere.

Physiological disorders

Chilling injury

Chilling injury mostly affects the fruit crops grown in tropical and subtropical region. The symptoms develops when fruits are stored above the

freezing temperature. The symptoms of chilling injury are epidermal tissue browning and/or pitting, uneven ripening, failure to ripen, water soaking, off-flavour development, and an increased susceptibility to decay pathogens. When the fruits are transferred from low to high temperature, the symptoms gets exposed. Chilling injury is not common in carambola stored at 10°C.

Harvesting and yield

The harvesting of fruits occur from June to February depending on the flowering cycle. In India, carambola is available in September and October and again in December and January. Trees will reach maturity at different times during the period. Yellow colour developed in the grooves of the star shaped fruit and the fruits are harvested by hand. Carambola is picked at firm stage. To reduce the mechanical injury, the fruits are harvested earlier. Hand harvesting is practiced. Yields upto 136 kg of fruits/tree.

Postharvest handling

At the packinghouse the fruits are sorted, graded and sized manually. To slowdown the desiccation process, the fruits are wrapped in wax-impregnated paper prior to packing. To minimize mechanical injury during transportation, corrugated fiber board cartons are fitted with a foam bottom lining, into which fruit are place-packed, stem-end down, into individual cells.

Storage

Carambola ripening can be slowed down using controlled atmosphere storage. Fruit stored in 2 to 4% oxygen and 8% carbon dioxide at 7°C maintained better color, firmness and flavor than those stored in air.

Processing

Fresh-cut processing transforms produce into a value-added product line that is more appealing and convenient to consumers. Cut fruit surfaces are more prone to enzymatic browning and it is a major concern for fresh-cut produce. The extent and rate of browning is time and temperature-dependent. Ascorbic acid application decreases the incidence of oxidative browning on fruit slices during storage period. Vacuum packaged carambola fruit slices maintained acceptable quality up to four weeks at 5°C although once sliced, fresh-cut produce should be stored from 1 to 3°C.

Conclusion

Star fruit is an excellent plant due to its multifaceted nutritional properties such as analgesic, hypotensive, anthelmintic, hypolipidemic and antimicrobial activity. To overcome vomiting, the extract of fruit and leaves is consumed. Leaves cures headache. Crushed leaves and shoots encounter the eruption of chicken-pox and ringworm. The flowers are given as a vermifuge. The powdered seeds serve as a sedative in cases of asthma Hence, the carambola is an essential fruit for a healthier life.

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