

Nutritional Benefits of Carambola: A Star-Studded Fruit

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SUMMARY

Star fruit (*Averrhoa carambola*), a popular fruit in many parts of the world, is considered to have many beneficial nutritional and medicinal effects. However, harmful nephrotoxic and neurotoxic effects have also been described. In this review, we have discussed the reported beneficial effects of star fruit, explored the potential mechanisms for such beneficial effects, and outline factors that may affect the safe level of consumption. The level of ingestion at which the beneficial effects transition to nephrotoxicity and neurotoxicity is still to be accurately ascertained. Furthermore, the relationship between the amount of star fruit ingested and the severity of toxicity is not certain and warrants further study.

INTRODUCTION

Carambola, also known as star fruit, is believed to be native to Southeast Asia, particularly in the region that includes Indonesia, Sri Lanka, Malaysia, and the Philippines. It has been cultivated in these areas for centuries. The fruit is now grown in various tropical and subtropical regions around the world, including parts of India, Bangladesh, Thailand, China, the Caribbean, Central and South America, Florida in the United States, and some parts of Australia. Carambola is a tropical fruit tree that thrives in warm climates with well-drained soil and plenty of sunlight. It has become popular in many countries due to its unique star-like shape when sliced, and its sweet and tangy flavor. The fruit is not only enjoyed fresh but is also used in various culinary applications, juices, and desserts.

Benefits of Carambola

The nutritional and medical properties of star fruit include antioxidant, hypoglycemic, hypotensive, hypocholesterolemic, anti-inflammatory, anti-infective, and antitumor effects. However, majority of these findings are extrapolated from in vitro or animal studies. On the other hand, star fruit ingestion has also been shown to cause nephrotoxicity and neurotoxicity. Future studies should focus on the level of ingestion and conditions at which the beneficial effects become toxic.

Selection of Varieties:

Carambola, also known as star fruit, comes in several varieties, although the most common one found in markets is the "Averrhoa carambola." Within this variety, there are two main types: sweet and tart. The flavor of the fruit can vary depending on factors such as ripeness and growing conditions.

1. **Sweet Variety:** This type of carambola is characterized by a mild, sweet taste. The flesh is usually crisp and juicy, and the overall flavor is reminiscent of a combination of apple, pear, and citrus notes. The sweetness makes it a popular choice for eating fresh or adding to salads and desserts.
2. **Tart Variety:** Some carambola varieties have a more tart or sour taste. The tartness can range from mildly tangy to quite sour. While not as commonly found in markets, tart varieties may be preferred in cooking or for those who enjoy a more acidic flavor profile.
3. **Golden Star Fruit:** This is a specific cultivar known for its bright yellow color. It's often sweeter than the green variety, with a taste resembling a mix of citrus, apple, and pear.
4. **Green Star Fruit:** The green variety is more common and has a slightly milder taste. The fruit is typically harvested when it's still green, and as it ripens, it turns yellow. The flavor may vary between sweet and tart, depending on ripeness.

When selecting carambolas, choose fruit that is firm, glossy, and free from blemishes. The taste can vary, so it's a good idea to try different varieties to discover your preferred flavor profile. Remember that the fruit is edible from tip to tip, including the slightly waxy skin. Carambola, or star fruit, is a tropical fruit that thrives in warm and subtropical climates. Here are some key considerations for selecting a site to grow carambola:

Climate:

- **Temperature:** Carambola requires a warm climate with temperatures between 25°C to 30°C (77°F to 86°F). It can tolerate brief periods of cooler temperatures but is sensitive to frost.
- **Frost-Free Areas:** Choose a location that is frost-free, as carambola is a tropical fruit and cannot withstand frost.

Sunlight:

- **Full Sun:** Carambola plants thrive in full sunlight. Choose a site with at least 6 to 8 hours of direct sunlight each day.

Soil:

- **Well-Draining Soil:** Carambola prefers well-draining soils to prevent waterlogging. Sandy loam or loamy soils are generally suitable.
- **pH Level:** The soil should have a slightly acidic to neutral pH level, ranging from 5.5 to 7.0.

Watering:

- **Consistent Moisture:** While carambola is relatively drought-tolerant, it benefits from regular watering, especially during dry periods.
- **Avoid Waterlogged Soil:** Ensure proper drainage to prevent waterlogged conditions, which can lead to root rot.

Wind Protection:

- **Windbreaks:** Carambola trees can be somewhat susceptible to wind damage, especially in exposed locations. Planting windbreaks or selecting a site with natural wind protection can help.

Space:

- **Adequate Spacing:** Provide enough space between carambola trees to allow for proper air circulation and sunlight exposure. This helps prevent diseases and ensures healthy growth.

Elevation:

- **Low to Mid Elevation:** Carambola is typically grown at low to mid elevations. It may not perform well in very high altitudes.

Site Selection:

- Select well-drained, sandy loam soil with good organic content.
- Ensure proper sunlight exposure for at least 6-8 hours a day.

Land Preparation:

- Plow the field and incorporate well-rotted organic manure.
- Ensure proper drainage to prevent waterlogging.

Planting:

- Plant carambola trees during the rainy season.
- Maintain a spacing of 5-6 meters between trees.

Irrigation:

- Provide regular and consistent irrigation, especially during dry periods.
- Avoid waterlogging as it can lead to root rot.

Nutrient Management:

- Apply balanced fertilizers with emphasis on potassium.
- Regularly monitor nutrient levels and adjust fertilization accordingly.

Pruning:

- Prune the trees to shape them and remove dead or diseased branches.
- Maintain an open canopy for better sunlight penetration.

Weed Control:

- Keep the orchard free from weeds, as they compete for nutrients.
- Mulching can help in weed control and moisture retention.

Carambola, like many fruit crops, is susceptible to certain pests and diseases. Here are some common pests and diseases that can affect carambola:

Pests:**Fruit Fly (*Bactrocera* spp.):**

- **Damage:** Fruit flies can cause damage by laying eggs in the fruit, leading to larvae infestation.
- **Control:** Use traps, baits, and insecticides. Harvest fruit promptly to reduce the risk of infestation.

Scale Insects:

- **Damage:** Scales feed on plant sap, weakening the tree and causing yellowing of leaves.
- **Control:** Introduce natural predators, such as ladybugs. Insecticidal soaps or horticultural oils can be used for control.

Aphids:

- **Damage:** Aphids feed on plant sap, leading to distorted growth, curling of leaves, and the transmission of plant viruses.
- **Control:** Beneficial insects like ladybugs and parasitic wasps can help control aphid populations. Insecticidal soaps may also be used.

Mites:

- **Damage:** Mites can cause stippling and discoloration of leaves, reducing overall plant health.
- **Control:** Predatory mites and insecticidal soaps are common control methods.

Carambola Whitefly (*Aleurodicus dispersus*):

- **Damage:** Whiteflies feed on plant sap, leading to yellowing and distortion of leaves.
- **Control:** Natural predators like parasitic wasps can help control whitefly populations. Insecticidal soaps may also be effective.

Diseases:**Anthracnose (*Colletotrichum* spp.):**

- **Symptoms:** Anthracnose causes dark lesions on leaves, stems, and fruit, leading to premature fruit drop.
- **Control:** Fungicides, proper sanitation, and pruning infected plant parts can help manage anthracnose.

Powdery Mildew:

- **Symptoms:** White powdery growth on leaves, leading to leaf distortion and reduced photosynthesis.
- **Control:** Fungicides, proper spacing for good air circulation, and resistant cultivars can help manage powdery mildew.

Bacterial Canker (*Xanthomonas axonopodis*):

- **Symptoms:** Canker causes sunken lesions on fruit, stems, and leaves, with oozing of bacterial exudate.
- **Control:** Copper-based sprays and proper sanitation are common control measures.

Root Rot (*Phytophthora* spp.):

- **Symptoms:** Yellowing, wilting, and eventual death of the plant due to root rot.
- **Control:** Well-drained soil, proper watering practices, and fungicides can help prevent root rot.

Crown Gall (*Agrobacterium tumefaciens*):

- **Symptoms:** Swollen galls or tumors on the roots and lower trunk.
- **Control:** No cure for infected plants, so prevention involves planting disease-free material and avoiding wounds to the plant.

Implementing good cultural practices such as proper irrigation, maintaining plant health, and regular inspection can help prevent and manage both pests and diseases in carambola orchards. If issues arise, it's advisable to seek advice from local agricultural extension services or plant health experts for region-specific recommendations.

Harvesting:

- Harvest fruits when they are fully ripe but still firm.
- Use sharp pruning shears to avoid damage to the tree.

Post-Harvest Handling:

- Handle fruits carefully to prevent bruising.
- Pack fruits in well-ventilated containers for transportation.

Marketing:

- Explore local markets and establish connections with fruit vendors.
 - Consider value addition, such as making carambola-based products.
- Always adapt these practices to local conditions and seek guidance from agricultural extension services for specific recommendations in your region.

Carambola, also known as star fruit, can be processed into various products to extend its shelf life and create value-added products.

Here are some common methods of processing carambola:**Fresh Consumption:**

- Carambola is often enjoyed fresh, sliced and eaten as a snack or added to fruit salads.
- For fresh consumption, choose ripe fruits with a bright yellow color and firm texture.

Juicing:

- Carambola juice is a popular and refreshing beverage.
- Wash and cut the fruit, removing any seeds. Blend the carambola with water and strain the mixture to extract the juice.
- Sweeten the juice if desired and refrigerate.

Carambola Jam or Jelly:

- Carambola can be used to make jams or jellies.
- Cook chopped carambola with sugar, pectin, and lemon juice until it reaches the desired consistency. Jar the mixture for preservation.

Carambola Syrup:

- Create a sweet syrup by simmering carambola slices with sugar and water.
- Strain the mixture to remove solids, resulting in a flavorful syrup that can be used in various culinary applications.

Carambola Chutney:

- Prepare a savory carambola chutney by combining the fruit with ingredients like onions, ginger, garlic, vinegar, and spices.
- Cook the mixture until it thickens, creating a condiment that pairs well with meats or as a side dish.

Carambola Puree:

- Blend carambola into a smooth puree that can be used in beverages, desserts, or sauces.
- Freeze the puree for longer shelf life or use it as an ingredient in various recipes.

Candied Carambola:

- Slice carambola thinly and simmer in a sugar syrup until the slices become translucent.
- Allow the candied carambola to cool and use it as a garnish for desserts or as a sweet snack.

Dehydrated Carambola Chips:

- Slice carambola thinly and dehydrate the slices to create crispy fruit chips.
- Dehydrated carambola chips can be enjoyed as a snack or used as a topping for salads and desserts.

Carambola Wine or Vinegar:

- Ferment carambola to make homemade wine or vinegar.
- Follow the fermentation process for either beverage, and once ready, strain and bottle.

Freezing:

- Carambola can be sliced and frozen for later use in smoothies or as a frozen treat.
- When processing carambola, it's essential to use ripe and high-quality fruit.
- Additionally, follow proper food safety and preservation techniques to ensure the quality and safety of the processed products.
- Experiment with different recipes and methods to discover unique and delicious ways to enjoy carambola.

CONCLUSION

Star fruit extracts have demonstrated several potential beneficial medicinal properties including antioxidant, hypoglycemic, hypocholesterolemic, anti-inflammatory, cardiovascular, antitumor, and immune-boosting effects both in vitro and in vivo studies.

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