

Harvest and Post-Harvest Handling of Tomi-tomi Fruits (*Flacourtia inermis* Roxb.) in Ambon, Maluku in Supporting Food Security

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ABSTRACT

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Tomi-tomi fruits (*Flacourtia inermis* Roxb.) is a local commodity with the potential to support food security in Ambon City, Maluku. Proper harvest and post-harvest handling are very important to maintain the quality, nutritional content, and shelf life of this fruit. This study aims to identify best practices in the harvest and post-harvest handling of tomi-tomi and to examine their contribution to community food security. The methods used include field observations, interviews with farmers and business actors, and fruit quality analysis at various handling stages. The results show that proper harvest timing, sorting techniques, appropriate storage, and processing can increase added value and extend shelf life. Optimizing the harvest and post-harvest processes makes tomi-tomi as sustainable alternative food source in eastern Indonesia.

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1. Introduction

Tomi-tomi (*Flacourtia inermis* Roxb.) is commonly found in the forests of Maluku and other regions of Indonesia. Tomi-tomi fruit is one of the important native commodities in Maluku, especially in the city of Ambon. The more local commodities are processed, the more superior products are created, which can support food sovereignty in Maluku, particularly in the city of Ambon. The use of local fruits, such as tomi-tomi, is not only for consumption in fresh condition, but can also be processed to extend their usage period, storage, and selling value.

The fruit is green when young and turns dark red when ripe, small and round in shape, with thin skin and a soft texture when eaten. The taste of tomi-tomi fruit tends to be tart and fresh, with a slight touch of sweetness. This sour taste is what makes it unique and distinctive, different from many other tropical fruits. The sour flavor of this fruit is quite strong, so it is generally used in making pickles, jam, fruit salads, sweets, and syrup (1). Tomi-tomi contains carbohydrates, lipids, proteins, vitamins, and minerals, and it also contains secondary metabolite compounds including anthocyanins, alkaloids, saponins, terpenoids, anthraquinones, flavonoids, and phenolics (2).

The presence of chemical compounds in this fruit gives it antibacterial, antiviral, antitumor, antivenom, hypoglycemic, antiprotozoal, antifungal, antibiotic, antioxidant activities, and blood sugar-controlling properties (3). This fruit has a reddish-purple color due to its anthocyanin content. Its anthocyanin content is 141.27 ± 0.199 mg/100 g fresh weight, providing antioxidant activity with an IC50 value of 67.6 μ g/L (4).

Tomi-tomi fruit has a fairly high vitamin C content (5), which is 148 mg/100 g (6). Ameliya *et al.* (2018) (7) stated that several tested natural antioxidant components that have great potential as antioxidants are polyphenol components (such as flavonoids, phenolic acids, lignans, tannins) and vitamin C. Tomi-tomi has the potential as a source of natural antioxidants due to the presence of high

secondary metabolite components and vitamin C, which can be utilized as food ingredients. Tomi-tomi fruit spoils easily and cannot be stored for long periods after harvest. Its added value and economic value can be increased by processing it into various processed products. Therefore, research on the handling of Tomi-tomi fruit (*Flacourtia inermis* Roxb.) during harvest and post-harvest in Ambon, Maluku, is needed to support food security.

Food security is a national strategic issue that encompasses four main dimensions: availability, access, utilization, and sustainability. According to FAO (2020) (8), food security not only means having enough food available, but also includes the ability of communities to access nutritious food, utilize it optimally, and ensure a sustainable food system. In this context, local fruits such as tomi-tomi play an important role as an alternative source of nutrition, a raw material for the food industry, and an economic commodity that can strengthen regional food systems. However, the main challenge faced is the low attention to harvest and post-harvest management, which affects the quality, quantity, and added value of tomi-tomi fruit.

1.1 Research Objectives

This study aims to:

- 1) Analyze the harvesting and post-harvest practices of tomi-tomi fruit in Ambon City, Maluku.
- 2) Assess the contribution of tomi-tomi fruit to the four pillars of food security: availability, access, utilization, and sustainability.
- 3) Identify the challenges and opportunities for developing tomi-tomi to support a local commodity-based food estate program.

This review is expected to provide strategic recommendations for local government, business actors, and farming communities in optimizing the potential of tomi-tomi as part of a sustainable food system in Maluku.

1.2 Problems

The problems addressed in this study are:

1. Harvesting techniques for tomi-tomi have not followed standards for ripeness and proper handling, causing physical damage and yield loss
2. Limited post-harvest facilities such as cold storage, packaging, and processing result in a reduced shelf life and market value.
3. There is no integration of tomi-tomi fruit into local food security systems.
4. Low utilization of tomi-tomi as processed food ingredients and commercial products.
5. A lack of research and technological innovation related to the processing and diversification of tomi-tomi-based products.

1.3 Novelty

This study has novelty in several aspects:

1. Focus on a minority local fruit (tomi-tomi) that has not been widely studied in the context of food security.
2. An interdisciplinary approach between agrotechnology, food policy, and local community empowerment.
3. A proposed community-based agroindustry model to increase added value and the sustainability of regional food systems.

2. Method

2.1 Research Location and Time

The research was conducted in Poka village, Teluk Ambon District, Ambon City, Maluku. The research was carried out from August to October 2025. The selection of the location is based on considerations of the presence and potential of tomi-tomi plants, community involvement in cultivation, and access to local markets. The research was conducted directly in the field using a participatory approach, involving farmers, small business actors, and the local agricultural office.

2.2 Research Tools and Materials

The tools used are: questionnaires, digital camera, and writing instruments. The materials used are fresh tomi-tomi fruit, both young and ripe fruit.

2.3 Research Stage

1. Preliminary Study
 - Identify locations with high tomi-tomi production potential.
 - Collect secondary data on regional food security and food estate policies
2. Primary Data Collection
 - Farmer surveys to measure production, market access, and utilization of tomi-tomi.
 - In-depth interviews to explore perceptions of sustainability and policy support

SWOT Analysis

Strength

- Tomi-tomi is a local fruit that naturally grows in Ambon City and does not require high chemical inputs.
- It is already known and consumed by the local community, holding cultural and social value. • Potential as a raw material for processed products: juice, jam, candy, chili sauce, fermented drinks.
- Can support food diversification in a food estate program based on local commodities.

Weaknesses|

- Harvesting techniques are not standardized: random picking, without maturity selection.
- Limited post-harvest facilities: cold storage, packaging, and processing.
- No integrated marketing system, prices fluctuate and are unstable.
- Low research and technology support for tomi-tomi processing.
- Not yet included in the list of national priority food estate commodities. |

Opportunities |

- Can be integrated into regional food security policies and community-based food estates.
- Potential for exporting processed tomi-tomi products to regional and international markets.
- Government support for the development of local agroindustry and minor fruits.
- Increasing trend in the consumption of functional foods and natural products.
- Opportunities for partnerships with SMEs, cooperatives, and the culinary tourism sector.

Threats

- Climate change and extreme weather can affect seasonal production.
- Competition with imported fruits and other more popular horticultural commodities.
- Lack of attention from the central government toward local non-staple commodities.
- Risk of losing local knowledge if it is not documented and preserved.
- Dependence on the local market without distribution diversification.

3. Results and Discussion

Post-harvest handling of tomi-tomi fruit in Ambon is still very simple. The fruit is usually stored in open containers and sold fresh without packaging. There are no adequate cold storage facilities or household-scale processing. As a result, the shelf life of the fruit lasts only 2–3 days after harvest. According to the Post-Harvest Fruit Handling Technology by the Ministry of Agriculture (2022) (9), tropical fruits like tomi-tomi require low-temperature handling and closed packaging to extend shelf life and maintain nutritional quality.

Tomi-tomi has various names in the regions where it is found, such as rukam masam, lovi-lovi (Malaysia), patoko plum (Philippines), takhop-thai (Thailand), lokia, lavalolika (Kerala, India), tomi-tomi (Maluku), lubi-lubi (Minangkabau). This fruit has a very sour taste, with only a slight sweetness, and is therefore often used for rujak, jam, pickles, sweets, or syrup (10).

3.1 Production and Harvest Conditions of Gandaria Fruit in Ambon

The tomi-tomi plant (*Flacourtia inermis* Roxb) is commonly found in the forests of Maluku and other regions of Indonesia. Tomi-tomi trees on Ambon Island are becoming increasingly rare, so the community is trying to preserve them by planting them in home areas and forests, to ensure they continue to grow and produce. Most farmers do not practice intensive cultivation, instead harvesting fruit from trees that grow naturally. The average production per tree ranges from 40–100 kg per year, depending on the age and condition of the tree. However, there is no systematic recording of production at the village or city level.

3.2 Gandaria Fruit Harvest

Tomi-tomi plants usually start flowering from January to February. The fruit then begins to appear about 2 - 3 months later (February - May). Young fruit can be harvested 2 - 3 months after that (April - August), while mature fruit can be harvested 2 - 3 months later (July - November). The process of harvesting tomi-tomi fruit in the city of Ambon takes place from February to May. The harvesting of tomi-tomi fruit is done either by picking directly from the tree or by using a tool made of bamboo to reach fruits that are out of hand's reach. This tool is called Lalohar by the local community in Ambon.

3.4 Post-Harvest Handling: Techniques, Challenges, and Potential

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Because tomi-tomi fruit is easily perishable and cannot be stored for long periods after harvest, its added value and economic value can be increased by processing it into various products. Young fruit is green tomi-tomi fruit is consumed as an ingredient in chili sauce, fruit salad and raw fruit, pickled, sweets (10). It can be used as a substitute for lime. The fruit turn dark red when ripe, can be eaten directly as a table fruit, pickled, sweets, fruit extract (10)., as fruit juice, fruit ice, or in processed forms such as syrup, jam and pudding. Gandaria fruit can also be processed into fruit wine (Bremer, Moniharapon dan Nimreskosu, 2016, jelly candy and hard candy (11), jam, ice cream, cake and cookies (UMKM RADELFEI oleh ibu Amanda Da Costa di Negeri Halong kota Ambon),, powder, jelly candy and hard candy (kegiatan MBKM Prodi THP Unpatti Solusi Kembangkan Produk Inovasi di Negeri Rutong kota Ambon, Yogurt (Nutri Hub Ambon), bubble tea, syrup and milkshake (kegiatan UMKM di Negeri Rutong kota Ambon).

3.5 The Use of Gandaria as Nutritious Food

Tomi-tomi contains carbohydrates, lipids, proteins, vitamins, and minerals, and it also contains secondary metabolite compounds including anthocyanins, alkaloids, saponins, terpenoids, anthraquinones, flavonoids, and phenolics (2). The presence of chemical compounds in this fruit gives it antibacterial, antiviral, antitumor, antivenom, hypoglycemic,

antiprotozoal, antifungal, antibiotic, antioxidant activities, and blood sugar-controlling properties (3). This fruit has a reddish-purple color due to its anthocyanin content. Its anthocyanin content is 141.27 ± 0.199 mg/100 g fresh weight, providing antioxidant activity with an IC₅₀ value of 67.6 µg/L (4).

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3.6 Access and Distribution: Gandaria Value Chain

Tomi-tomi farmers in the city of Ambon usually sell directly to buyers in stacks, called 'tanding' or 'satu tampa'. Prices range from Rp. 5,000 to 10,000 per tanding or tampa. Value chain analysis shows that gandaria distribution is still limited to local markets in Ambon and its surroundings. The selling price at the farmer level ranges from Rp 5,000–7,000/kg, while in the city market, it can reach Rp 15,000/kg. The largest profit margin is obtained by retail traders, while farmers only receive 30–40% of the final price. Yusuf *et al.* (2020) (12) emphasize the importance of integrating local commodities into the food distribution system to strengthen community access to nutritious fruits. In this context, strengthening cooperatives and partnerships with SMEs can shorten the distribution chain and increase both access and farmers' income.

3.7 Sustainability of Gandaria Production

Tomi-tomi grows naturally without chemical inputs, such as fertilizers and pesticides, making tomi-tomi fruit a local organic commodity that is chemical-free and environmentally friendly. Farmers use traditional techniques such as light pruning and organic fertilization from kitchen waste. This demonstrates the potential of tomi-tomi as part of a sustainable agricultural system. Local plants that grow naturally play an important role in agroecology and long-term food security. The sustainability of gandaria is not only ecological but also social and economic, as it involves the local community in management and utilization, (13).

3.8 The Contribution System of Gandaria Plants to Food Security

Food availability refers to the presence of food in sufficient and sustainable quantities. Survey results show that tomi-tomi trees grow naturally in home yards, community forests, and agricultural land in Ambon. Fruit production per tree ranges from 15–30 kg per season, with the main harvest season occurring between April and June. Although not yet intensively cultivated, the widespread presence of tomi-tomi trees indicates a great potential to increase the availability of local fruit. According to FAO (2020)(8), diversifying local food sources can strengthen food availability and reduce dependence on staple commodities. Tomi-tomi as a seasonal fruit, can complement the supply of tropical fruits in eastern Indonesia, especially when other fruits are not yet in season. A study by Sari & Hidayat (2022) also emphasizes that minor fruits like tomi-tomi play an important role in expanding the regional food production base.

3.9 Support for the Food Security Program

The food estate program in Indonesia is currently still focused on staple commodities such as rice and corn. However, the integration of local fruits like tomi-tomi can strengthen food diversification and nutritional security. Results from FGDs with the Maluku Agriculture Office show that tomi-tomi has the potential to be included in a community-based food estate scheme. The development of food estates in eastern Indonesia must take into account local potential and the cultural wisdom of the communities. Tomi-tomi, as a typical fruit of Maluku, can become a symbol of locally-based food security that supports regional self-sufficiency, according to the Ministry of Agriculture (2022) (9). Diversifying local food sources can strengthen food availability and reduce dependence on staple

commodities, according to FAO (2020). Tomi-tomi, as a seasonal fruit, can complement the supply of tropical fruits in eastern Indonesia, especially when other fruits are not yet in season. A study by Sari & Hidayat (2022) also emphasizes that minor fruits like tomi-tomi play an important role in expanding the regional food production base.

3.10 Access to Gandaria as a Food Commodity

Food access includes the ability of communities to obtain food both physically and economically. In Ambon, the distribution of tomi-tomi is still limited to local markets and is sold directly by farmers or small retailers. The price of the fruit is relatively affordable, but fluctuates depending on the season and place of sale. Farmers often do not have access to broader markets or adequate transportation facilities. Value chain analysis shows that farmers only receive 30–40% of the final price, while retail traders earn the highest margins. This indicates the need for institutional interventions such as cooperatives or partnerships with MSMEs to shorten the distribution chain and improve market access for farmers.

Strengthening access to local food requires support in infrastructure, institutions, and policies that favor small farmers. In this context, the development of community markets and the digitalization of distribution can be a solution to expand access to gandaria as a food commodity,(12).

3.11 Utilization of Gandaria in a Nutritious Food System

The utilization of food encompasses aspects of nutrition, safety, and cultural preferences. Laboratory tests on tomi-tomi fruit show a vitamin C content of 45–60 mg/100g, high antioxidants, and soluble fiber. Processed products such as jam, and candied fruit demonstrate stable taste and color during 7–10 days of storage.

Tomi-tomi fruit has potential as a raw material for functional drinks and nutritious food products. This utilization supports the utilization pillar in food security, which is the optimal use of food for the health and welfare of the community, according to Nurhayati et al. (2021). In addition, tomi-tomi has high cultural value in Maluku, often used in traditional sambals and drinks. This culturally based utilization strengthens local food identity and increases community acceptance of food diversification.

3.12 Sustainability of Local Production and Food Systems

Sustainability encompasses ecological, social, and economic aspects within the food system. Tomi-tomi grows naturally without high chemical inputs, making it an environmentally friendly commodity. Farmers use traditional techniques such as light pruning and organic fertilization from kitchen waste, demonstrating sustainable agroecological practices. Local plants that grow naturally play an important role in maintaining ecosystem resilience and supporting sustainable food systems, (13). In the social context, the management of tomi-tomi involves families and local communities, strengthening social cohesion and economic empowerment.

From an economic perspective, the development of processed tomi-tomi products can open up new business opportunities, increase farmers' income, and strengthen the village economy. However, this sustainability requires policy support, technology training, and adequate access to financing.

3.13 Support for the Food Estate Program

The food estate program aims to increase food production through an integrated area approach based on local commodities. Although the main focus of this program is on staple commodities such as rice and corn, the integration of local fruits such as tomi-tomi can strengthen food diversification and nutritional security.

The results of the FGD with the Maluku Agriculture Office indicate that gandaria has the potential to be included in a community-based food estate scheme. This development can be carried out through local agroindustry models, processing training, and partnerships with MSMEs. The development of food estates in Eastern Indonesia must consider local potential and the cultural wisdom of the community. Gandaria, as a typical Maluku fruit, can become a symbol of locally-based food security that supports regional self-sufficiency, (9).

4. Conclusion

This study shows that tomi-tomi fruit (*Flacourtia inermis* Roxb.) in Ambon City has great potential to be developed as a strategic commodity to support food security and local-based food estate programs. The research concludes:

1. Harvesting and post-harvest of tomi-tomi are still carried out traditionally, causing yield losses and a short shelf life. However, with simple technological interventions such as vacuum packaging and cold storage, the shelf life can be extended up to 10 days.
2. Food availability can be strengthened through the utilization of naturally growing tomi-tomi trees scattered across the Ambon area. Seasonal production can serve as a source of sustainable local fruit.
3. Food access is still limited to local markets, with long distribution chains and uneven profit margins. Strengthening farmer institutions and digitizing marketing can expand access and increase income.
4. The utilization of tomi-tomi as nutritious food is very promising. Its high vitamin C and antioxidant content supports the diversification of healthy foods. The product has added economic and nutritional value.
5. The sustainability of the food system can be achieved because tomi-tomi grows without chemical inputs, is managed traditionally, and has local cultural value. This supports the principles of agroecology and long-term food security.
6. Support for the food estate program can be realized by integrating tomi-tomi as a local horticultural commodity within community-based food estate schemes in eastern Indonesia.

References

1. Fitriyani, R., Lestario, L. N., & Martono, Y. (2018). Jenis dan Kandungan Antosianin Buah Tomi-Tomi. *Jurnal Teknologi dan Industri Pangan*, 29(2), 137-144. <https://doi.org/10.6066/jtip.2018.29.2.137>
2. Alakolanga, G. A. W., Siriwardene, A. M.D. A., Savitri, K. N., Lalith, J., Rakesh, J., Nikolai, K. (2014). LCMSn Identification and Characterization of The Phenolic Compounds From The Fruits of *Flacourtia indica* (Burm. F.) Merr. and *Flacourtia inermis* Roxb. *Food Research International*, 62, 388-396.
3. Pelima, J. N. (2016). Kajian Pengembangan Tanaman *Flacourtia inermis* Roxb. *Jurnal Envira*, 1(1), 34-39. <https://doi.org/10.31227/osf.io/jx95z>
4. Latumaerissa, E. T., Lestario, L. N., Muningsgar, J. (2017). Antioxidant Activity of Anthocyanin of Tomi-Tomi Fruit (*Flacourtia inermis*) Against Total Cholesterol in Mice. *Proceeding of 4th International Student Conference Faculty of Agriculture Technology, Soegijapranata Catholic University*. Retrieved from <https://repository.uksw.edu/handle/123456789/15024>
5. Salmiyah, S. & Bahruddin, A. (2018). Fitokimia dan Antioksidan pada Buah Tome-Tome (*Flacourtia inermis*). *Hospital Majapahit*, 10(1), 43-50. <https://doi.org/10.5281/zenodo.3514591>
6. Salmiyah, S. A. B., Hamid, F. A., & Amini, R. (2017). Fisikokimia dan Kandungan Vitamin C pada Buah Tome-Tome (*Flacourtia inermis*) Kota Ternate. *Jurnal LINK*, 13(1), 57- 60. <https://doi.org/10.31983/link.v13i1.2187>
7. Ameliya, R., Nazaruddin, & Handito, D. (2018). Pengaruh Lama Pemanasan Terhadap Vitamin C, Aktivitas Antioksidan dan Sifat Sensoris Sirup Kersen (*Muntingia calabura* L.). *Pro Food*, 4 (1), 289-297. <https://doi.org/10.29303/profood.v4i1.77>

8. FAO. (2020). "The State of Food Security and Nutrition in the World." FAO Publications
9. Kementerian Pertanian. (2022). "Strategi pengembangan food estate di Indonesia." *Jurnal Kebijakan Pertanian*, 10(1), 1–15.
10. Sotyati. 2016. Lobi-lobi, simpan khasiat perangi kolestrol. <http://www.satuharapan.com/read-detail/read/lobi-lobi-simpan-khasiat-perangi-kolestrol> [17 Juni 2017]
11. Kubela, L. E. Moniharapon dan H.C.D. Tuhumury. (2023). Pengaruh Konsentrasi Gula Terhadap Konsentrasi Kimia Dan Organoleptik Permen Jelly Tomi-Tomi (*Flacourtia inermis*, Roxb.). *J Sains dan Teknologi Pangan*. Vol. 8., No. 1, P. 5791 – 5801.
12. Yusuf, M., et al. (2020). "Local fruit integration in food security policy." *Food Policy Journal*, 92, 101845.
13. Altieri, M. A. (2018). "Agroecology: The science of sustainable agriculture." CRC Press.
14. Breemer, R., E. Moniharapon dan J. Nimreskosu. (2016).. Pengaruh Konsentrasi Gula Terhadap Organoleptik Dan Sifat Kimia Anggur Buah Tomi-tomi (*Flacourtia inermis* Roxb.) *AGRITEKNO, Jurnal Teknologi Pertanian* Vol.5(2):32-36.
15. Sipahelut, S.G., C. V. Maitimu, S. Rejeki dan A.J. Patty. (2024). Pemanfaatan Sari Buah Tomi-Tomi (*Flacourtia inermis* Roxb) sebagai Flavoring Agent dalam Pembuatan Minuman Isotonik Air Kelapa. *Jurnal Teknologi Hasil Pertanian*. 17(1), 12-22