NATIONAL HORTICULTURAL RESEARCH INSTITUTE
Federal Ministry of Agriculture and Food Security

GUIDE TO EFFECTIVE POST-HARVEST HANDLING AND PROCESSING OF TOMATO

MANUAL

INTRODUCTION

Tomato is an important vegetable with a rich nutritional profile, economic significance, and versatility in culinary applications. It has huge potential to contribute to food security, income, and employment generation. Tomatoes are highly perishable, and losses occur both in quality and quantity between harvest and consumption. These losses have been estimated to be as high as 60% along the value chain. Losses mostly occur during the peak season of tomato production. The factors responsible for these losses include: poor handling practices, improper processing techniques, inadequate marketing and storage facilities, as well as poor transportation processes. To minimize post-harvest losses, and encourage effective processing, the National Horticultural Research Institute has developed approaches and strategies as highlighted below.

MANAGEMENT PRACTICES FOR TOMATO

Management practices of tomatoes can be divided into harvest and post-harvest practices. Harvest practices are methods used during crop collection to ensure quality and optimal yield. However, post-harvest practices are activities carried out after harvesting to maintain produce quality and reduce losses. These include pre-cooling, proper packaging, appropriate storage, careful transportation, market handling, and processing.

1. HARVEST PRACTICES

Appropriate tomato harvest management practices are very important to ensure the quality, safety, and yield of the produce. Proper management at this stage not only maximizes the quantity and qyality of harvested produce but also minimizes losses due to damage. Key effective harvest management practices include:

- ✓ Harvesting at the right stage of maturity to enhance quality and shelf life. The stage of maturity varies depending on the intended use.
  - ➢ Tomatoes grown for distant markets are recommended to be picked when at the matured green, or breaker stage (Figure 1a and b), to allow enough time to prepare the fruits for ripening before sale.
  - ➢ Tomato fruits for immediate consumption or sale should be harvested at the matured red stage (Figure 1c).
  - ➢ Tomato for long-distance transport should be harvested at the matured green stage to minimize post-harvest losses (Figure 1a).

- ➢ Tomato for seed production, and processing should be harvested when 90% of the tomato's surface is red, to ensure high quality seeds and products respectively.

✓ Hand-pick tomatoes from the stalk during harvest to prevent damage to the delicate fruits (Figure 1d)

✓ Avoid harvesting when wet to prevent disease spreading on harvested fruits.

✓ Pick tomatoes in the morning and evening to reduce water loss, heat stress and slow down senescence.

Fig. 1a: Matured green stage

Fig. 1b: Breaker stage

Fig. 1c: Matured red stage

Figure 1d: Harvesting of tomatoes by hand-picking

2. POST-HARVEST PRACTICES: PRE-COOLING

- ➢ Cooling after harvest is important because it slows down metabolic processes and inhibits microbial growth.
- ➢ It is very important to place tomatoes in a cool place after harvesting, hence, a Zero-Energy Cooling Chamber (ZECC) (Figure 2a) is recommended for cost-effective and easy temperature control.
- ➢ It is necessary to keep the clay partitions and the surrounding wall of the ZECC (Figure 2b) wet to ensure a temperature range of 10-15°C is maintained in the cooling chamber.
- ➢ ZECC helps preserve the quality and extend the shelf life of tomatoes from 18 to 31 days after harvest.

Figure 2a: Zero-energy cooling chamber

Figure 2b: Internal clay-based partitions of a typical ZECC

3. PACKAGING

Packaging is crucial for maintaining produce quality both during transportation and handling. The recommended packaging options for fresh tomatoes are:

A. **Plastic crates:** The crates (Figure 3a and b) offer multiple benefits, some of which include: protection against compression, easy cleaning, ease of stacking, and reusability. They are cost-effective and can be used for up to 5-6 years.

B. **Wooden crates:** These crates (Figure 3c and d) can also be utilized for effective packaging of fresh tomatoes. Just like plastic crates, they offer protection, they are also stackable and reusable (Figure 3c and d). They are often cheaper than plastic crates, but have a shorter lifespan.

Figure 3a: Plastic crates

3b: A plastic crate filled with tomatoes

Figure 3c: Empty wooden crates

Figure 3d: A wooden crate filled with tomatoes

4. STORAGE

- ✓ Store harvested tomatoes in the shade to prevent rapid temperature increase which accelerate ripening and spoilage.
- ✓ Store tomatoes in a cool, aerated and dry place.

5. TRANSPORTATION

- ✓ Proper transportation is crucial for post-harvest handling of tomatoes.
- ✓ Ensure that transportation trucks are not overloaded, as this increases the risk of damage during transit (Figures 5a and b).

- ✓ Do not sit on stacked tomatoes during transportation.
- ✓ Do not expose tomatoes to the sun during transit (Figure 5c).
- ✓ Transport tomatoes in crates and ensure crates are arranged in a way that allows air to circulate in between the stacks or piles, without experiencing vibration (Figure 5d).
- ✓ Minimize delays in the transfer of tomato crates from one part of the market to another.

Figure: 5a: Over-loaded tomatoes in bags and baskets

Figure: 5b: Over-loaded tomatoes in baskets

Figure: 5c: Tomatoes exposed to the sun during transportation

Figure 5d: Recommended mode of stacking tomatoes during transportation

6. RECOMMENDED PRACTICES FOR TOMATO MARKETING

Adequate practices in tomato marketing are crucial to reduce post-harvest losses and maximize profit. Highlighted below are recommended practices:

- ✓ Tomato at the wholesale market
  - ➢ Tomato is best protected in plastic crates.
  - ➢ The plastic crates should be placed under the shade.
- ✓ Tomato marketers, especially the retailers, should adhere to the following:
  - ➢ Sort and grade tomatoes in a cool and clean environment (Figure 6a and b).
  - ➢ Tomato fruits should be sorted into different grades based on size, shape, colour, firmness, and quality (Figure 6c and d).
- ➢ Tomatoes should be washed in water to remove dust, dirt, and adhering particles.

Figure 6a: Unsorted tomatoes

Figure 6b: Tomatoes prepared for sorting and grading

Figure 6c: Tomatoes graded as good quality

Figure 6d: Tomatoes graded as poor quality

Figure 6e: Attractive displayed tomato

- Tomatoes are best displayed in plastic or wooden crates to protect and extend their shelf life.
- An attractive display (Figure 6e) is good for increased profit.
- Tomato crates should be displayed under shade to minimize shrinkage as thinning of the flesh.
- After sales, keep tomatoes in a clean and aerated storage room, free from rodents.
- It is essential to recommend that consumers keep fresh ripe tomatoes in the refrigerator and use them within a few days of purchase.

7. TOMATO VALUE ADDITION

Value addition is the process of transforming raw ingredients or basic food produce into more desirable and higher-priced products through processing, packaging, or enhancement of their characteristics. Maintaining the conditions for producing high-quality processed tomato products involves paying close attention to every stage of the process, from the selection of good raw tomatoes to processing and storage. Following these essential conditions will ensure that processed tomato products meet the expected overall quality. Tomato can be processed into pulp, paste, juice, dried slices, ketchup, and sauce. To obtain the best possible processed tomatoes, the varieties recommended for processing should be firm, more fleshy and ripe. Adequate hygienic conditions must be maintained during processing.

The following sections details processing steps involved in the production of tomato paste (Figure 7a), tomato juice (Figure 7b) as well as dried tomato slices and powder (Figure 7c).

A. PRODUCTION OF TOMATO PASTE

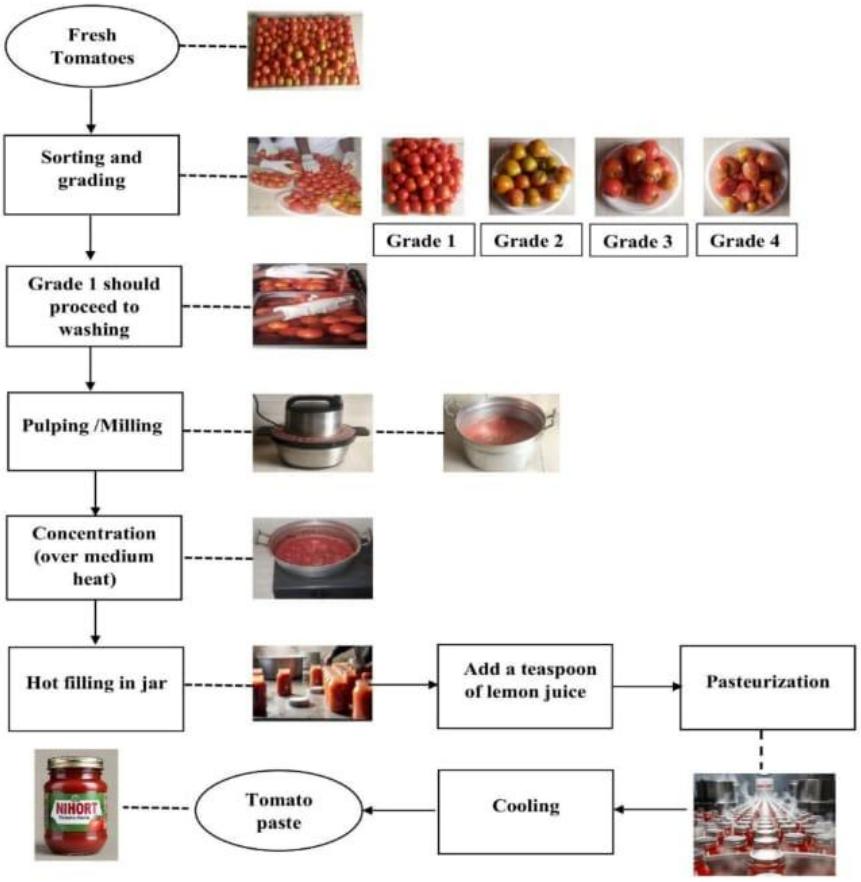

Figure 7a: Flow diagram for tomato paste production

B. PRODUCTION OF TOMATO JUICE

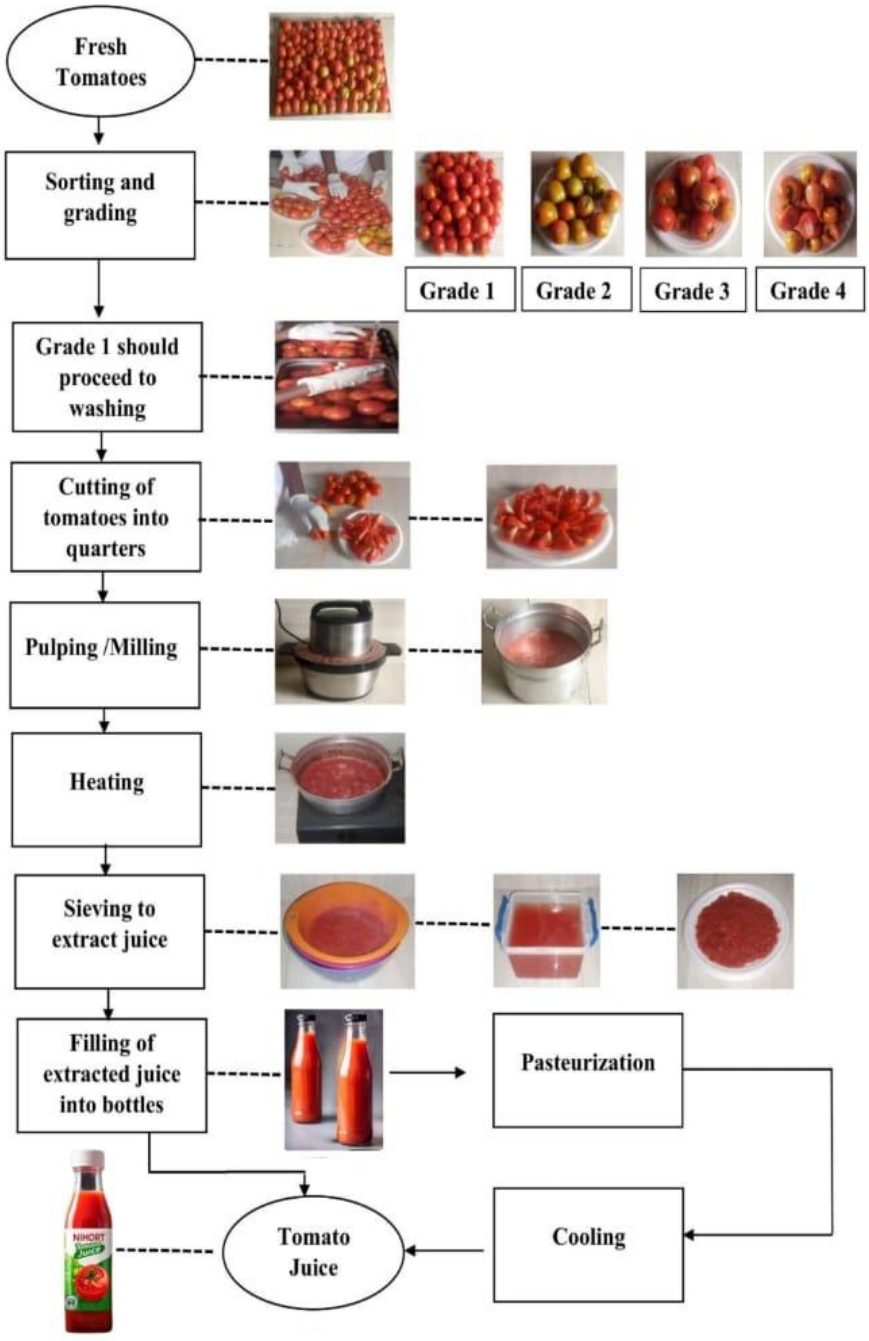

Figure 7b: Flow diagram for tomato juice production

C. PRODUCTION OF DRIED TOMATO SLICES AND TOMATO POWDER

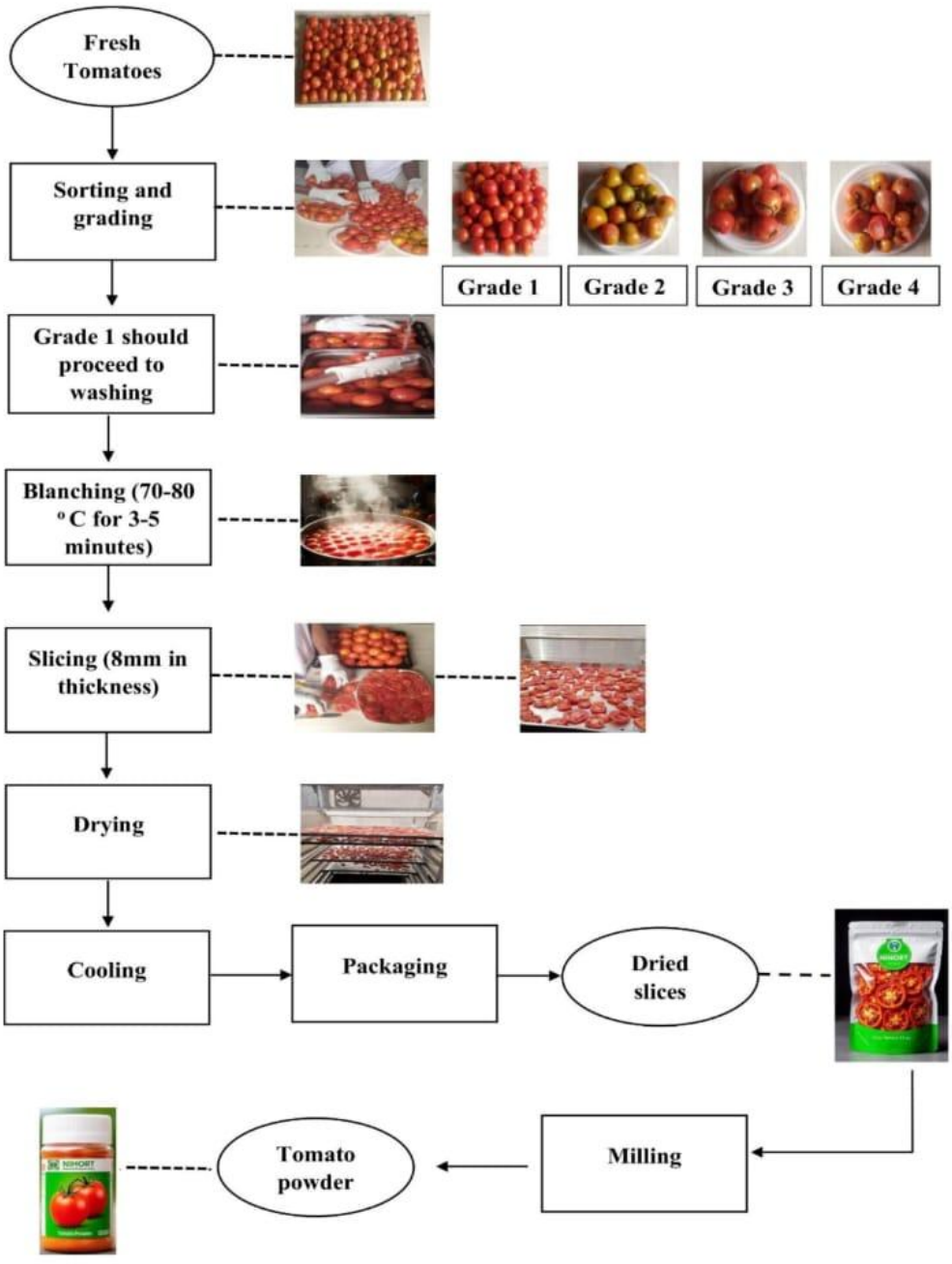

Figure 7c: Flow diagram for dried tomato slices and tomato powder production

8. DRYING PROCEDURE FOR TOMATO SLICES USING A HYBRID SOLAR DRYER

A hybrid solar dryer is built to utilize both heat from the sun and occasionally an alternative energy source such as electric heater, gas burner, charcoal etc. to dehydrate agricultural materials. To use a hybrid solar for the production of dehydrated tomato slices, the following steps are recommended to be followed.

A. Raw materials preparation

- Choose fresh, ripe, and firm tomatoes for the process.
- Clean the tomatoes thoroughly under running water to remove dirt and debris.
- Sanitize using a food-grade sanitizer solution (e.g. 10% vinegar solution) for 2-3 minutes to reduce microbial load.
- Remove the stems and any green stalk on the fruit and cut tomatoes into uniform slices of 5-6 mm thickness using a sharp knife or mechanical slicer.
- Remove seeds if desired (this is an optional step depending on end-use requirements).

B. Pretreatment prior to drying

- Prepare citric acid solution (0.5% concentration) and dip the tomato slices in the solution for 5 minutes.
- In other cases, when there is no access to citric acid, steam-blanch the slices for only 5 minutes. These operations helps prevent browning and preserves colour.
- Drain excess solution or residual moisture in a sieve before loading into the solar dryer.

C. Dryer preparation

- Wash or wipe all drying trays with clean cloth prior to use.
- Allow the trays to dry before loading products into the dryer (Figure 8a).
- Ensure the circulation fan and hybrid heater is working perfectly.
- Clean the outer dryer surface with a soft clean cloth to allow adequate reception of solar insolation.
- Ensure all vents are clean and unobstructed.

D. Loading of products into the dryer

- Tomato slices should be arranged in single layers on each drying tray (Figure 8b).
- Ensure adequate spacing between the slices for proper airflow and even drying.

Figure 8a: Cleaned hybrid solar dryer

- Start the drying early in the morning to maximize solar radiation usage.
- Position the dryer to receive optimal sun exposure (Figure 8c).

Figure 8b: Hybrid solar dryer positioned to receive optimum sun exposure

Figure 8c: Hybrid solar dryer loaded with tomato slices in single layers and adequate spacing

- Monitor the temperature and adjust the alternative heat source.
- If required, ensure the dryer maintains a temperature range of between 55-60°C.
- Rearrange trays by switching the position to ensure uniform drying.
- On each drying tray, turn by flipping products' surfaces using clean, dry and protected hands or utensils to avoid moisture entrapment.
- Monitor weather changes and adjust the backup heater accordingly. The total drying time should be between 18-24 hours of active drying, depending on the weather conditions.
- After the first 18 hours of active drying, check the moisture content every 2 hours (Figure 8d).
- The final moisture content should be between 12-15% on a wet basis when fully dried.
- Verify the texture to ascertain proper dryness (it should be leathery and crispy but not brittle when fully dried (Figure 8e).

F. Quality assessment and post-drying operations

- Assess texture uniformity before packing products to avoid wet spots.
- If wet spots are found, return the spots and the products close to it to the dryer.
- When fully dried, pack the dried tomato slices into a tray for cooling.
- Allow dried tomatoes to cool to room temperature.
- After proper cooling, pack immediately in airtight containers or moisture-proof bags (like the one presented in Figure 8f) and store in a cool (below 25°C), and dry place, away from direct sunlight.

Figure 8d: Feeling the texture of tomatoes to verify their dryness level

Figure 8e: Properly dried tomato slices

Figure 8f: Packaged dehydrated tomato slices

9. ECONOMICS OF TOMATO VALUE ADDITION

Tomato processing, aside from minimizing post-harvest losses, is a veritable source of income for the stakeholders involved. It is therefore important to ascertain the cost and returns involved in the processing of tomatoes. The value-added products this section focuses on are: dried tomato slices, tomato powder, and tomato paste.

The total cost involved in processing tomatoes into value-added products, as well as its anticipated returns, are indicated below.

A. Dried tomato slices

Processing tomatoes into dried slices is profitable. It is anticipated that for every naira invested into dried tomato slices production, ₦0.38k will be returned as profit (Table 1), indicating that the enterprise is feasible.

Table 1: Cost outlay for processing 1 tonne of fresh tomatoes into dried slices

Item	**Amount (₦)**
Total cost (fresh tomatoes, cooking gas, packaging materials, and labour).	169,000
Revenue	
1000 kg of fresh tomatoes produces 70 kg of dried tomato slices at ₦3,333/kg.	233,310
Net profit	64,310
Benefit Cost Ratio (BCR)	1.38
Return on Investment (ROI)	0.38

B. Tomato powder

Processing of tomatoes into powder is profitable. As presented in Table 2, it is anticipated that for every naira invested into tomato powder production, ₦0.62k will be returned as profit indicating that the enterprise is feasible.

Table 2: Cost outlay for processing 1 tonne of fresh tomatoes into powder

Item	Amount (₦)
Total cost (fresh tomatoes, cooking gas, packaging materials, and labour)	181,296
Revenue	
1000 kg of fresh tomatoes will produce 63 kg of tomato powder at ₦4,666/kg	293,958
Profit	112,662
Benefit to Cost Ratio	1.62
Return on Investment	0.62

C. Tomato paste

Processing of tomatoes into paste is profitable. It is anticipated that for every naira invested into tomato paste production, ₦1.20k will be returned as profit (Table 3), indicating that the enterprise is feasible.

Table 3: Cost outlay for processing 1 tonne of fresh tomatoes into paste

Item	Amount (₦)
Total cost (fresh tomatoes, cooking gas, packaging materials, and labour)	138,780
Revenue	
Revenue (1000 kg fresh tomatoes gives 150 kg of tomato paste) @ ₦2,000/kg	300,000
Profit	161,220
Benefit to Cost Ratio	2.16
Return on Investment	1.16

Please note that the cost of inputs and outputs for the products are based on the prevailing market prices and they are subject to changes depending on the current market situation.

Chief Editor: **Professor Mohammad Lawal Attanda**

Editors: **Babalola S.O, Oyedele O.O, Olajide-Taiwo F.B**

Contributors:

Adeoye I.B, Aderibigbe O.R, Ademoyegun O.T, Olatunji O.A., Fasuan T. M., Owolade S.O, Amao I.O, Oduntan A.O, Amoran A. Igberaese P, Akinrinola A.O, Adesegun E.A., Adebiyi O.E, Olawolu O.E, Okoyo M.E, Ikheloa O.O, Mustapha B.O.

Year of Production: 2025

All correspondences should be addressed to:
The Executive Director/CEO, National Horticultural Research Institute,
Private Mail Bag 5432,
Jericho Reservation Area, Idi-Ishin, Ibadan.
E-mail: info@nihort.gov.ng Website: www.nihort.gov.ng
Tel: 08022255504