



NSPRI

Research in Food Preservation to Reduce Poverty

POST HARVEST HANDLING OF FRUITS AND VEGETABLES

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INTRODUCTION

Fruits and Vegetables are of great importance in human nutrition as they supply vitamins and minerals to the diet, provide variety to the food and make food appetizing.

In their fresh form, fruits and vegetables are highly perishable after harvest, particularly under hot tropical conditions. The heavy losses that occur in these crops are caused primarily by:

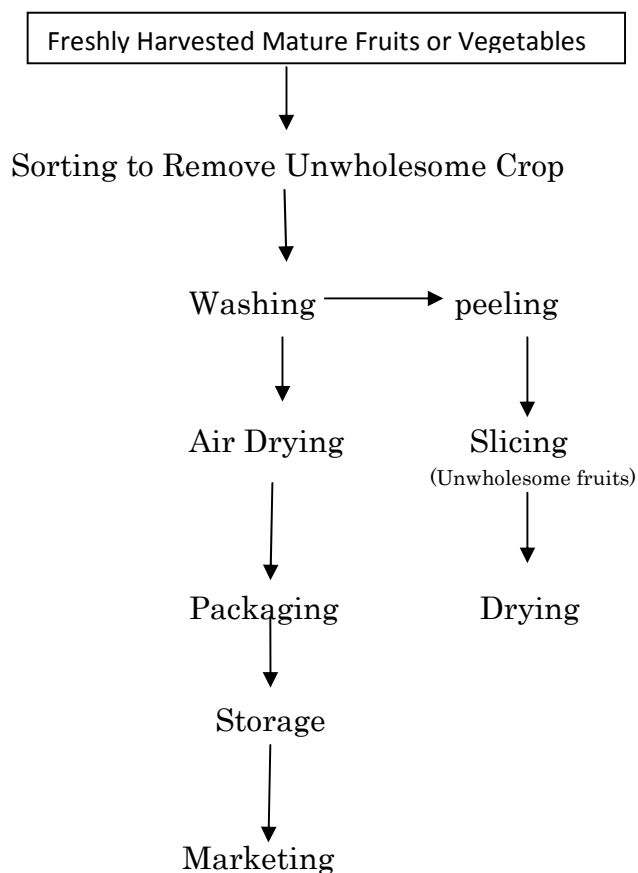
- Loss of moisture
- Metabolic activities
- Pathogenic infections.

Factors contributing to these causes include nature of the crops, handling, and initial quality of the crop, mechanical injury, temperature, humidity and storage atmosphere.

This booklet outlines some methods of reducing losses in fruits and vegetables after harvest with particular emphasis on tropical fruits and vegetables.

GENERAL PRINCIPLES OF HANDLING OF FRUITS AND VEGETABLES TO MAINTAIN FRESHNESS

FLOW DIAGRAM



HARVESTING FRUITS AND VEGETABLES

- Select fruits and vegetables that are known to store well.
- Avoid over aged or immature fruits.
- Avoid mechanical injury to crops
- Harvest with equipment that will protect fruits from free falling
- Remove fruits to a cool shed for sorting. Avoid heaping, for a long time in the farm.
- Harvesting should be done during the cool part of the day. Avoid heat build up within the crops.
- Transport harvested fruits to cool ventilated shed with plastic crates.

FRUIT HARVESTING



- Avoid bruises and impact of fruits on the floor
- Remove woody part of fruit after harvesting and before packaging

SORTING AND CLEANING BEFORE PACKAGING

- For easy sorting of fruits, spread on raised table.
- Sort out unwholesome fruits from the lot.
- Also remove broken sticks and other unwanted materials from the lot.
- Remove over ripe fruits. This could be processed into dried fruits
- During sorting, avoid bruising wholesome fruits.
- Pack wholesome fruits in crates before packing for storage or the market.
- Wash wholesome fruits with chlorinated or potable water and air dry before storage.

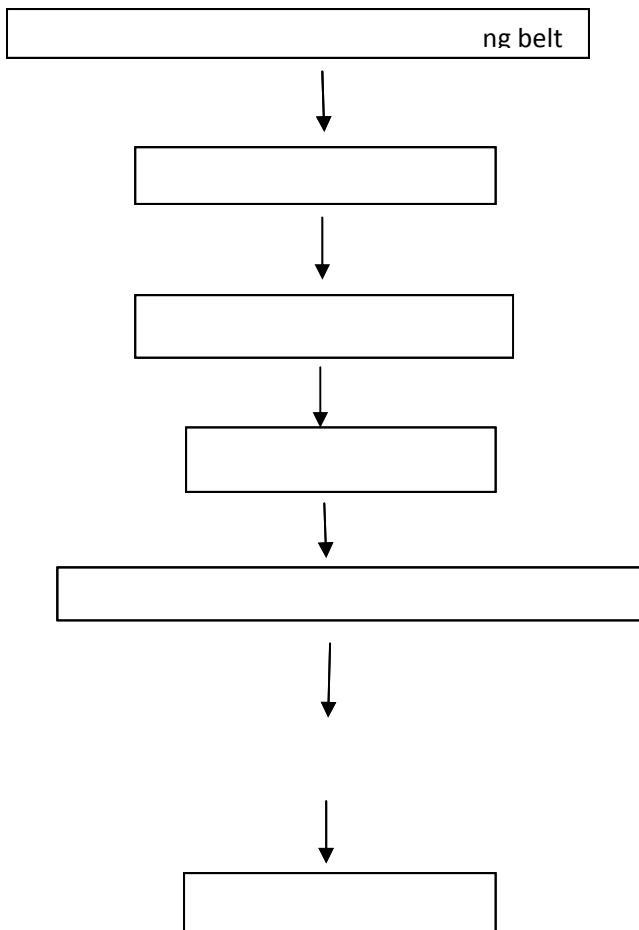
- You can apply fruit wax to protect from dehydration if long distance marketing is being contemplated.

WHOLESOME FRUITS



- Avoid bruising fruits, collect in crates
- Avoid free water on fruits, air dry before crating.

FLOW CHART FOR OPERATION ON THE PACKAGING LINE



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High quality fruits especially export bound commodities can be washed and sorted into different sizes using the sorting line.



Washing and grading of fresh fruits



Oranges on the sorting line



Carrots stored in the cold room

THE VEGETABLE COOL SHED FOR FRUITS AND VEGETABLE PACKAGING

- Fruit shed is valuable because all operations after fruit harvesting is done in them On-farm.
- Construct in a safe premise.
- The shed has a roof made of thatch materials to keep it cool.
- The floor might be cemented or not but must be made in such a way that

it can be washed regularly to keep clean.

- The sides are made of dwarf wall and the rest of the wall made of materials that will allow for cross ventilation.
- Provides shelves on which crated fruits and vegetables can be stored before evacuation for the market
- Provides tables for sorting and crating.
- Can be constructed of farm materials or sawn wood but the roof must be of thatch materials.
- If necessary increase humidity in the shed by wetting the floor on providing waters in flat trays

VEGETABLE SHED



PACKAGING

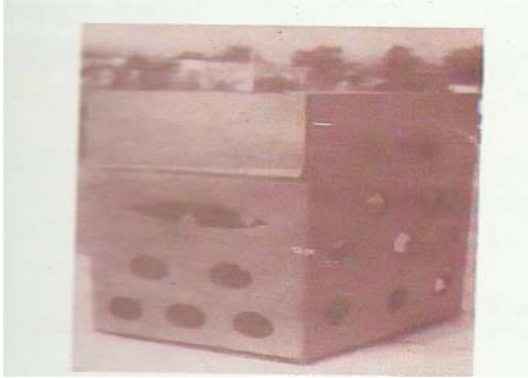
- Proper packaging reduces losses of fruits and vegetables after harvesting, during transportation and marketing.
- It is a very important factor in the post harvest system for fruits and vegetables
- There are packaging materials for individual fruit or vegetable.
- There are ventilated fibre board carton, plywood box, collapsible slatted wooden box, plastic crates and polyvinyl bags, vegetable baskets, jute bags.

- Use shallow crates for onions, pineapples, okra, plantain, orange.
- Jute bags can be used for onions, garlic, dried fruits.
- Avoid the use of polypropylene bags because of heat building up in the fruit within the bags.
- Do not overfill containers and the one on top must not rest on packaged fruits.
- For marketing, few fruits can be packed in polythene bags to maintain freshness.
- Clean and disinfect packaging materials if not disposable.

VARIOUS PACKAGING MATERIALS



Nestable Plastic Crates



Fibre Board carton

- Select packaging materials appropriate to the fruit.
- Do not over load crates.

TRANSPORTATION

- After harvest, do not delay in transporting fruits and vegetables to either the packaging shed, storage shed or the market.
- Transport fruits in well ventilated crates. As much as possible avoid the use of baskets because they are not stackable, can bruise the fruits and are not well ventilated.
- Transport crated fruits in well ventilated vehicles that are covered at the top.
- Load and off-load crated fruits from vehicle carefully.

- Transport fruits and vegetables during the cool part of the day.
- Avoid unnecessary delays on the road. Transport fruits speedily to the destination.
- Clean vehicle before another use.

TRANSPORTATION FACILITIES



Ventilated lorry

- Top cover of the vehicle must be insulated
- Provide enough ventilation.

DRYING FRUITS AND VEGETABLES

- Drying is a processing method for producing more stable fruit and vegetables for domestic consumption or for the market.
- Cut fruits like tomato, onion, plantain, Mango, Okro, pepper etc

into small slices and dry on a clean, raised platform to sun dry.

- For more hygienic product, dry using solar trays, multipurpose dryers or hybrid dryers.
- To preserve fruits and leaf vegetable colours during sun drying, you can cover with coloured calico cloth or dry under shade.
- Leaf vegetable dry faster and there is colour retention when parboiled before drying.
- Bulk dry fruits in a wooden box after drying to equilibrate moisture.
- Package dried fruits and vegetables in polypropylene bags after moisture equilibration.

SOLAR TENT, MULTIPURPOSE AND HYBRID DRYERS



Multipurpose Dryer



Solar Tent



Hybrid Dryer

- For hygienic production of dried fruits and vegetables, use solar trays, multipurpose dryer or hybrid dryer

POST HARVEST HANDLING OF PLANTAIN AND BANANA FRUITS TO MAINTAIN FRESHNESS.

- Slight bruise on the skin of plantain and banana fruits results in blemishes and spoilage.

- The fruits must be handled carefully from the farm to the packing shed.
- Harvest when bunch is still green but mature.
- Don't carry bunch without wrapping with foam or dried plantain leaves to serve as protection against bruising.
- Don't heap bunches but provide flat foam mat to lay wrapped bunches on the floor.
- Speedily remove wrapped bunches from the farm to a central cool shed.
- Harvest and transport bunches during the cool part of the day.
- Carefully cut bunches into fingers in the cool shed and trim sharp edges.
- Wash cut hands in potable water to remove latex and air dry before packaging.

WHOLESOME PLANTAIN



- Remove ripe fruits from the hands before transportation; it will make other fruits to ripen.
- Carpet underlay foam is good as mat and wrapping material.
- Arrange hands carefully in ventilated crates.
- Coating of hands with fruits wax can be beneficial in protecting fruits from dehydration and bruises.
- Load crate into vehicle carefully. Only transport with ventilated vehicles with covered top.
- Perform operation speedily, avoiding fruits robbing on each other.
- You can delay fruit ripening and initiate fruit ripening by special techniques. This will assist in the release of fruits for the market.
- Contact NSPRI for assistance in the methods of delay in fruit ripening and initiation of fruit ripening.
- Store banana or plantain hands in crates under cool shed or in evaporative coolers.

EVAPORATIVE COOLERS



Pot –in- Pot Evaporative Coolers

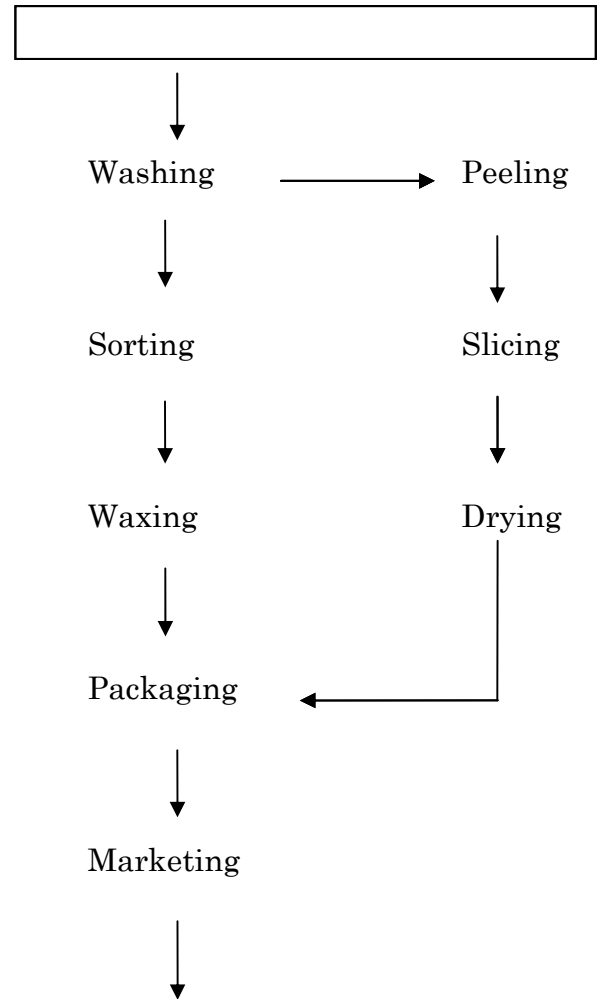


Metal – in- wall evaporative Coolers

- Arrange fingers in crate to decrease shifting during transportation

HOW TO PRESERVE FRESH MANGO FRUITS AND PRODUCE MANGO CHIPS

FLOW DIAGRAM



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VARIETAL SELECTION /HARVESTING

- Mango varieties in Nigeria are Alphonso, Kaite, Julie, Peach, Peter, Indiana e.t.c.
- The variety selected will depend on the requirement of the market and use of which the mango is to be put.
- For fresh mango market, bright yellow pulp variety is in high demand. Avoid varieties with kerosene smell.
- Harvest only mature but green fruits for fresh presentation
- Use mature and about to ripe fruits for processing into dried chips.
- Harvest fruits in the cool part of the day and transport fruits to cool shed in crates.

FRESH MANGO FRUITS



Wholesome Mango Fruits

FRESH MANGO FRUITS IN CRATES



Fresh Mango Fruits in crates (Ready for Transportation)

- Avoid injury to fruits
- Do not mix over ripe fruits with mature green fruits.

HANDLING FRUITS FOR FRESH MARKET

- All operation must be done under cool shed, avoid direct exposure of fruits to sunlight, it will cause forced ripening.
- Remove damaged and diseased fruits from the lot
- Wash fruits with potable water and air dry.
- Wax fruits with fruit-wax or wrap individual fruits in wax paper or aluminum foil.
- Pack in plastic crates if to store under cool environment or in waxed

paper carton with perforations, if to be exported.

- Transport in clean vehicles, ventilated or refrigerated.
- Load and off-load vehicles carefully.
- Fruit waxes are specially produced to delay dehydration and ripening.
- Wax production method can be obtained from NSPRI.

PRODUCTION OF HYGIENIC DRIED MANGO CHIPS

- Dried mango chips can be eaten as snacks or can be rehydrated to produce mango juice, jam or drink.
- Select fruits about to ripe, don't use over ripe fruits.
- Wash fruits and peel
- Slice the pulp into small pieces, you can select shapes of slices as you desire.
- Drying can be done under the sun on a raised platform but to produce chips of exportable quality, you must use solar trays, multipurpose dryers or hybrid dryers (contact NSPRI)

- Dried chips must be packaged in food grade polythene bags and seal to prevent moisture reabsorption after packaging.
- Pack mango sachets in cardboard cartons or light wooden crates for the market.
- Osmotic drying with sugar syrup and the use of sodium dioxide for mango chip drying is to be done under professional supervision.

EXAMPLE OF DRIED MANGO CHIPS



Fresh Mango Fruits



Dried Mango Chips



Packaged Mango Chips

- The peel of mango can be used as animal feed
- Oil can be extracted from the seed of mango.

POST HARVEST HANDLING OF LEAF VEGETABLES

- The various types of edible leaf vegetables are Amaranthus, bitter leaf, water leaf, fluted pumpkin leaf, cochorus etc.
- Leaf vegetables deteriorates fast after harvest. The rate of moisture loss is rapid and to preserve leaf vegetable, moisture must be prevented.
- Therefore leaf vegetables must be harvested in cool period of the day.

- Vegetable basket, which has been moistened, must be used to transport leaf vegetable to a cool shed
- If vegetable basket is not available, use clean moistened jute bag or cloth to wrap bunched vegetable and transport to a cool shed.
- Avoid direct exposure of the leaf vegetable to the sun.

BUNCHED FRESH VEGETABLES



Uncovered Bunched leaf vegetables



Polythene Sheet Covered Bunched Leaf Vegetables

- At the cool shed, cut off the roots of the vegetable, wash with clean potable water, bunch the vegetable and dip the cut end into shallow water in a plastic bucket. Wrap the top of the vegetable with polythene sheet and tie to the bucket to conserve moisture. Open poly sheets and tie to the bucket to conserve moisture. Open poly Sheets daily to wet vegetable and tie back.



Multipurpose Dryer

- To store in refrigerator; cut vegetables and per boil. Allow to cool and place in polythene bags. Remove air as much as possible by pressing on the filled bag before sealing. Then put in the refrigerator.



Packed Dried Vegetable

- For effective storage of leaf vegetable, you can also use the vegetable basket.

- The vegetable basket is made from cane plant (the type used in making cane chair) wrapped with new jute sheet.

- When it is to be used, the basket must be wetted both inside and outside with potable water.



Solar Drying Tent

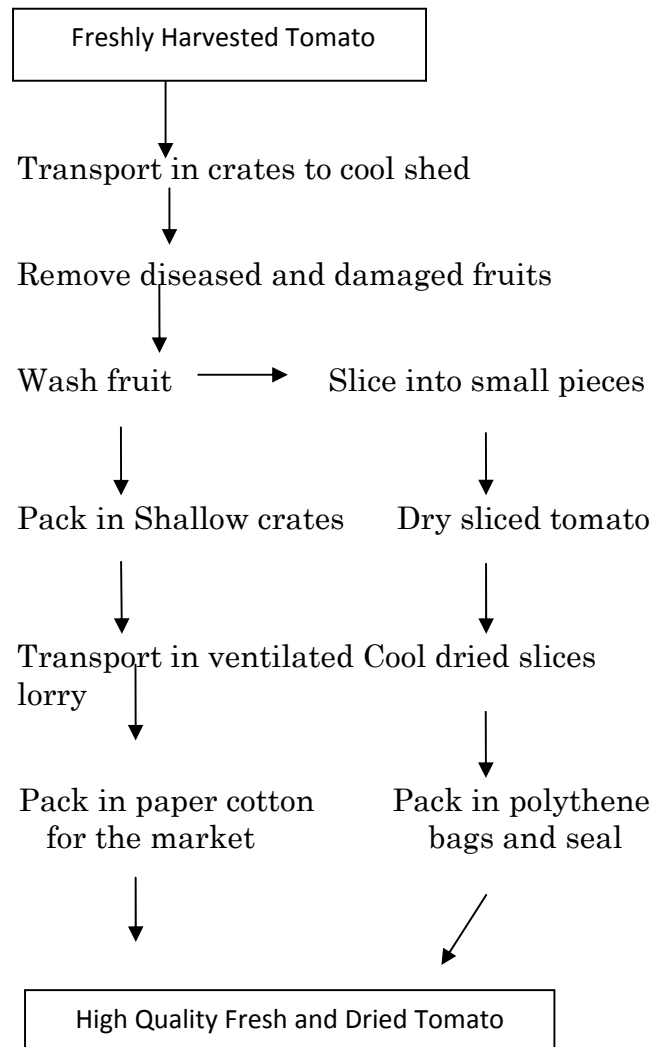
- Arrange the cut vegetable inside the basket and cover. Place in a cool shed and re-wet with potable water when needed.

DRIED VEGETABLE

- For a long storage life, vegetable can be dried and stored.
- To produce dried vegetable, use newly harvested green leaf vegetables.
- Cut vegetable into desirable pieces and parboil.
- Draw water from the vegetable.
- You can dry under the sun or outside under shade. But if more hygienic product is desired, dry the vegetable using solar trays, multipurpose dryer or any type of commercial food dryers.
- When dried, allow to air cool and package in food grade polythene bags, seal and store in cartons.

HIGH QUALITY TOMATO PRODUCTS

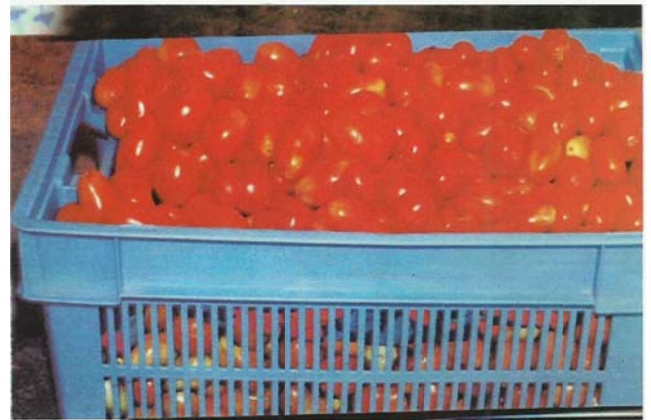
FLOW CHARTS



POST HARVEST HANDLING OF TOMATOES

- The common cultivars of Tomato in Nigeria are the “Roma” and the Early Stone (UTC) which are produced in the Northern part of Nigeria. An acidic variety is grown in the South Western State of Nigeria.
- The Roma and Early Stone have fleshly pulp and less moisture and thicker skin than the South Western variety
- Thick skin makes tomato to store longer and if the skin is not damaged then the varieties can remain wholesome.
- To reduce mechanical injury tomato should be handled carefully.
- Harvest tomato in the cool part of the day
- Harvest mature green fruits.
- Ripe but firm fruits must be kept for processing while the mature green fruits should be stored as fresh.

Tomato fruits in crates



TOMATO IN PLASTIC CRATE

COOL SHED FOR HANDLING TOMATOES

- After harvest, do not heap fruits under the sun in the farm, transport quickly in ventilated shallow plastic crates to the cool shed.
- At the cool shed separate diseased and damaged fruits and discard.
- Transport fruits in plastics crates or wooden crates to the market. As much as possible avoid the use of baskets for tomato transportation.
- As much as possible transport fruits during the cool part of the day in a ventilated lorry covered on top.

DRIED TOMATO

- Tomato to dry must be ripe, red, firm, and fresh.
- Wash tomato and slice into small pieces, about 0.5cm thick.
- Remove the seeds before drying.
- You can dry tomato slices on clean, raised platform under the sun. (See pictures on drying methods for Leaf vegetables. See page 35.
- For large scale drying and more hygienic product, dry tomato slices with solar trays, multipurpose dryer or hybrid dryer.
- Spread dried tomato on clean table to air cool before packaging in air tight polythene bags.
- Dried tomato can be processed further into tomato puree, jam, ketchup and drinks.

For Further Information Contact:

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