

## PROPER POST HARVEST HANDLING OF FRUITS IN MINIMIZING BEFORE THE TABLE

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### Abstract

*Time of harvest, methods of harvest, equipments and tools used in harvesting contribute to the wholesomeness of harvested fruits. This research work examined proper post harvest handling of fruits in minimizing losses before the table. Post harvest is a stage of crop production immediately after harvest, sorting, cleaning, grading, preservation, transporting, packing, processing and marketing. The implication revealed that farmers, marketers as well as consumers will benefit from the new technology of handling of fruits, such as packing house-operation, pre-cooling, post harvest treatment. Therefore, non application of this modern technology in the process of post harvest handling by illiterate farmers, marketers as well as consumers have brought about huge losses of food. Thus, the adoption and use of modern technologies as well method of harvesting have proved to be efficient in the preservation of post harvest handling of fruit. It is recommended that farmers should employ modern harvesting method; improvement is the enhancement made on the post-harvest handling methods to reduce post harvest losses of fruits.*

**Key words: Fruits, Post-harvest Handling, Losses and Prevention**

### Introduction

Fruit is a food that we eat and are important source of vitamins and minerals, fibres which are very important in protecting the body and also help in fighting against nutritional diseases. Fruit is food that can be eaten and it is a sweet fleshy product of a plant or a tree that contains seeds. Also, fruits are seed bearing structure that develops from ovary of a plant. Pabon and Litt (2011) stated that fruits are mature ripened ovaries of a flowering plant. Example of fruits are papaya, (pawpaw), mango, oranges, apricot, beetroot, pineapple, guava, pineapple, among others. The Encyclopaedia Britannica (2023) stated that some fruits are called technical fruits because these types of fruits can be eaten as fruits and vegetables. Examples of technical fruits are pumpkin, cucumber, tomatoes, beans, peanuts, corn grain, and almond among other fruits in this category of fruits. These fruits are consumed by a majority of people. Other categories of fruits found in the study area includes; Grapes, Pineapples, Avocado, Apple, Mangoes, Strawberries, Pawpaw, Water-melon, Oranges, Banana, Guava, Coco-nut among other healthy fruits such as Tomatoes, Cucumber, and Cherries. Fresh Fruits are generally high fibre, water, vitamin c. Regular consumption of fruits is generally associated with reduction of several diseases and functional declined with ageing.

Post harvest handling is a stage of crop production immediately after harvest, including cleaning, sorting, packing, grading, reservation, processing, marketing, preservation, transporting. Therefore, post harvest handling of fruit is the final stage in the process of producing high quality fresh fruits. Being able to maintain a level of freshness from the field to the table of consumption. Post-harvest is done immediately after harvesting crops, which increase the shelf life and maintain its quality Agrifarm (2020). The instant the crop is removed from the ground, or separated from its parent plant, it begins to deteriorate. Postharvest treatment largely determine final quality. The most important goal of post harvest handling are keeping the product cool, to avoid moisture losses and slow down on desirable chemical changes, and avoiding physical damage

such as bruising, to delay spoilage. Sanitation is also an important factor, to reduce possibility of pathogen that could be carried by fresh produce for example as residual from contaminated washing water. Postharvest processing usually continues in a packing house. This can be in simple shade, providing shade and running water, or a large scale, sophisticated mechanized facility with conveyor belts, automate sorting and packing section, walk in cooler and the like. In mechanized harvesting, processing may actually begin as part of the actual harvest process with initial cleaning, sorting performed by the harvesting machinery (Simson and Straus 2010).

All fresh horticultural crops are high water contents and are subjected to removal of mature desiccation (Wilting, shrivelling) and the mechanical injuring. Onyedinefu (2023) estimated that 20%-30% of fresh horticultural produce are lost after harvest and these losses are considered as economic waste. The researcher assumed that among the fruits that is often loss is the tomatoes as can be seen in the illustrated figure 1 below



**Fig 1: Fresh and Damaged Tomatoes**  
Source: Onyedinefu (2023)

Due to huge losses of fruits in the time of harvest, the overall output of the fruit is reduced which affects the product availability throughout the year and this is leading to food scarcity in most part of the states. Ogundele Femi (2022) linked the losses caused by the difficulty in handling post-harvest with food shortage. The author also observed that where there are no facilities for storage of harvest produce, farmers and consumers alike suffer economically.

#### **Post Harvest Management of Fruits/Treatment**

Postharvest management of fruits is carried out to preserve a substantial amount of fruits for future usage. Strategies employed in ensuring that a greater portion of the fruit are preserved involved postharvest activities such as;

1. cleaning
2. washing
3. selection
4. grading
5. disinfection
6. drying
7. Storage.

These eliminate undesirable elements and improve product appearance, as well as ensuring that the product complies with established quality standards for fresh and processed products. Postharvest practices include the management and control of variables such as temperature and relative humidity, the selection and use of

packaging, and the application of such supplementary treatments as fungicides. According to Omorogbe (2021) the aim of postharvest management is to maximize the proportion that will be available for consumption. The researcher found that about 5% to 25% of fruits could be wasted without effective postharvest management of fruit produced annually. Thus, managing postharvest of fruits will increase its availability for consumers. Musa (2020) found that the goal of postharvest management is to ensure that the fruit is kept fresh all season. This made possible by preservation and processing and packaging techniques.

Agricultural produce are often treated with agricultural chemicals after they are harvested. This practice is known as 'post-harvest chemical treatment'. The objective of post-harvest chemical treatments is to address pest and disease problems that may arise during the transport and storage of a commodity. Mitch Denton (2022) found that post-harvest treatment and handling of fruits and vegetables is a critical step in ensuring that the produce arrives at its destination in the best possible condition. There are many things to consider when treating and handling fresh produce, from the temperature to the packaging.

After harvest, fresh produce needs to be handled with care to maintain freshness, nutrient content, taste and quality. Fruit is fragile and perishable, so poor storage postharvest can result in losses. The field of postharvest practices addresses issues of handling, sorting, grading, washing, storing, transportation, and temperature control for crops after harvest. Post-harvest treatment is important in preventing fresh produce losses, maintaining quality, preserving nutrient content, and earning higher market prices.

#### (A) Packinghouse Operations

It is important to minimize mechanical damage by avoiding drops, rough handling and bruises during the different steps of pack operation. Secondly, the pack house operations are to be carried out in shaded area. Shade can be created using locally available materials like, shade cloth woven mats, plastic taps or a canvas sheet hung from temporary poles. Shade alone can reduce air temperature surrounding the produce by 8- 17°C. The packing house operation includes the following steps:

- i. **Dumping:** The first step of dumping is known as dumping. It is carried out gently by using water or dry dumping can be carried out by immersing the produce in water. The advantage of dumping is that it reduces mechanical injury bruising, abrasions on the fruits, since water is gentler on produce. The dry dumping is carried by soft brushes fitted on the sloped ramp or moving conveyor belts it will help in removing dust and dirt on the fruits.
- ii. **Pre-sorting:** This process is achieved through the removing of injured, decayed, misshapen fruits. This technical approach will save energy and finance. This is because; culls will not be handled, cooled, select or reduce in large quantity packed or transported. Removing decaying fruits is an important aspect of the packing house operations because it assists the former to limit the spread of infection to other healthy fruits during handling.
- iii. **Washing and Cleaning:** Washing with chlorine of 100 milligrams per litre of solution (100ppm = 100mg/litre) is appropriate for use for the control of inoculums (material used for inoculation) substance or vaccines build up during pack-house operations.
- iv. **Sizing/Grading:** This is one of the ways packing house operation is carried out. This carried out manually or by automatic grading grading-lines. Size grading can be carried out subjectively (virtually) with the use of standard size gauges. According to Dhatt and Mahajan(2007) found that round produce units can be easily graded by using sizing rings for sizing/grading.

#### (B). Pre-Cooling of Horticulture Produce

Pre-cooling of the produce of the produce soon after their harvest is one of the important components of the cooling chain, which ultimately affect the shelf life of the produce. The main purpose of pre-cooling is to immediately remove the field heat from the produce. The pre-cooling could be summarized in the following:

**i. Room Cooling:** Pre-cooling involves room cooling which is one of the methods that could be employed to achieve the purpose of pre-cooling. Room cooling is adopted because it is cost effective, and it is also found to match with the method of cooling that is, slow cooling operation of the system. The approach

involves the operator of the room to simply load produce into the cooling room which allow air to circulate on the cartons as well as the sack bins or bulk load. The process allows for force air cooling thereby making it possible for uniform cooling of the products in the cooling room.

**ii. Hydro Cooling:** The use of cold water is an old effective cooling method used for quick cooling of a wide range of fruits before packing. For the packed commodities it is less used because of difficulty in the movement of water through the containers and because of high cost involved in water tolerant containers. This method of cooling do not only avoids water loss but may even add water to the commodity. The hydro-cooler are normally of two types consisting of showering and immersion respectively.

**iii. Vacuum Cooling:** Vacuum cooling takes place by water evaporation from the produce at low air pressure. In this method, air is pumped out from a larger steel chamber in which the produce is loaded from pre-cooling. Removal of air results in the reduction of pressure of the atmosphere around the produce which further lowers the boiling temperature of its water. As the pressure falls, the water boils quickly removing the heat from the produce. Vacuum cooling cost about 1% weight loss mostly water for each 60C of cooling

**v. Package Icing:** The term package icing means the direct placement of slush, flaked, or crushed ice over the product in shipment containers. The ice keeps a high relative humidity around the product. According to Dharti and Mahagani (2012) liquid icing distributes the ice throughout the container in order to achieve a better contact with the product. The authors assumed that packaged icing can be used only with water tolerant, non -chilling sensitive products and with water tolerant packages such as waxed fibreboard plastic or wood.

**(C). Postharvest Treatment:**

- i. Washing with Chlorine Solution:** This treatment can be used in wash water to help control inoculum build up during packing operation. In order to achieve the best result, it advisable to adopt a wash water of between 6.5 and 7.5 ph.
- ii. Ethylene Treatment:** This is a colourless flammable gas found in coal gas or obtained from petroleum and used to ripen fruits or as an anaesthetics. This is a key hormone which coordinates physical and biochemical changes associated with ripening of climacteric fruits. Ethylene gas is commercially used to ripen fruits after they have been picked. Fruits, such as tomato, banana, and pear are harvested just before ripening has started (typically in a hard, green, but mature stage). Ethylene is a gas released by some fruits and vegetables that causes produce to ripen faster. Some fruits and vegetables are more sensitive to ethylene than others.
- iii. Thermal Treatment:** Thermal treatment is any waste treatment technology that involves high temperatures in the processing of the waste feedstock. Commonly this involves the combustion of waste materials. Thermal treatment is a process by which heat is applied to the waste to sanitize it. The primary function of thermal treatment is to convert the waste to a stable and usable end product and reduce the amount that requires final disposal in landfills.

**Thermal treatment involves the following procedures:**

- a. Hot water treatment:** This method allows the farmer to dip the produce into hot water before marketing or storage. The purpose is to enable the farm produced to be controlled from various postharvest diseases. It will also improve on the peel of the fruits.
- b. Vapour Hot Treatment (VHT):** This treatment has proved very effective in the controlling of infections of fruits and flies in fruit. In order to achieve the goal of this treatment, the farmer would need to stack the boxes in a heating room and the produce are heated and humidified by injection of steam during which time the temperature and exposure are adjusted to kill all stages of insects such as the eggs, larva, pupa and the adult insects. This type of treatment is appropriate for citrus fruits such as mangoes, papaya and pineapple at 430c in saturated air for the period of 8hours and then holding the temperature for further 6hr. This temperature is mandatory for export of mangoes.
- c. Fumigation:** The fumigation of SO<sub>2</sub> is successfully used for controlling postharvest diseases of grapes. This is achieved by placing the boxes of fruits in a gas tight room and introducing

the gas from a cylinder to the appropriate concentration. However, special sodium *metabisulphite* pads are also available which can be packed into individual boxes of a fruit to give a slow release of  $SO_2$ . The primary function of treatment is to control the *Botrytis Cinerea*. The  $SO_2$  fumigation is used to prevent discoloration of skin of litchis.

- d. **Irradiation:** Irradiation is the process by which an object is exposed to radiation. Ionizing irradiation can be applied to Fresh fruits to control micro organisms and inhibit or prevent cell reproduction and some chemical changes. It can be applied by exposing the produce (fruits) to radiations.

The irradiation is a safe technology for fruit preservation and storage. Hence, it is highly recommended for use for modern fruits farmers.

**4. Waxing:** Fruit waxing is a process of coating fruits with an artificial or edible wax to improve their shelf life and texture. By definition, fruit waxing implies to artificial application of a very thin film of wax or oil or other material to the surface of the fruits or vegetables as an addition to or replacement for the natural wax coating. It is carried out during a postharvest handling. It is one of the methods for food/fruits preservation in post-harvesting. Paraffin wax is melted and poured over the product, which creates a barrier from bacteria and oxygen, and as it cools, it forms a protective seal. According to Dhan and Mahajan (2012), fruits waxing improve the cosmetics earache and appearance and prolong the storage life of fruits and vegetables. Sin Categoría (2020) observed that the wax used in some fruits such as oranges is intended to protect the food and provide a shiny appearance. The author found that Fruits and vegetables, such as oranges, are covered by a layer of natural wax. Its main function is to help resist moisture loss, improve fruit firmness and slow down the natural degradation of food. The fruits, once harvested, are still “alive”, which means that they continue with the ripening process. The waxy coating that forms on the skin protects them. In some cases, waxing is applied to fruits such as citrus in post-harvest treatments to extend the shelf life and preserve them from fungi and bacteria. They are coating agents, completely harmless substances.

**5. Fruit Packaging:** Throughout the entire handling system, packaging can be both an aid and a hindrance to obtaining maximum storage life and quality. Packaging of fresh vegetables and fruits is the scientific method of holding the products so, as to prevent it from physical damage, chemical changes and further microbial contamination in addition to display the product in a more appealing manner to the consumer. Packaging must satisfy basic objectives. These are: Contain product and facilitate handling and marketing by standardizing the number of units or weight inside the package; Protect product from injuries (impact, compression, abrasion and wounds) and adverse environmental conditions (temperature, relative humidity) during transport, storage and marketing; Provide information to buyers such as variety, weight number of units, selection or equal grade, producer’s name, country and area of origin. Frequently included are recipes nutritional values, but codes are or any other relevant information on traceability. In addition a well –designed package needs to be adapted to the conditions or specific treatments required for the product. If hydro-cooling or ice-cooling is required, the package must be tolerant wetting without losing strength. For a product with a high respiratory rate, the packaging should have sufficiently large openings to allow good exchange. When produce dehydrates easily, the packaging should be designed to provide a good barrier against water loss, and the use of semi permeable material makes it possible to generate special atmospheres inside packages. This helps in maintaining produce freshness.

There are three types of packaging. They are as follows:

- i. Consumer units or pre-packaging
- ii. Transport packaging and
- iii. Unit load packaging or pallets.

Fresh fruits are generally packed in bamboo baskets, plastic crates, plastic bags or sacks for transportation, in many developing countries. Often, they are transported in an unpackaged form from the farm. After harvest,

fresh fruits and vegetables are generally transported from the farm to either a packaging house or distribution centre. At the retail levels fresh produce is sold in an unpackaged form, or it is tied in bundles. The type of market handling of fresh produce greatly reduces its shelf life if it is not sold quickly. The application of proper postharvest technologies would however extend postharvest shelf life, retain fresh quality and reduce losses. The following are the benefits of fruits packaging. These are: It provides protection from dust; It reduces microbial contamination from the surrounding environment and from consumer contact; It helps to maintain the freshness of produce; It extends the postharvest shelf life; It increases the sale of fresh produce. (D).

### **Field Operations**

Most immature fruits are graded on the basis of size and colour. Immature soft-rind squashes, for example, may be harvested at several sizes or stages of development, depending upon market needs. Fruit that is too developed is of inferior internal quality and shows undesirable colour change after harvest. This also applies to other immature fruit vegetables such as cucumbers. The harvest index for mature fruit depends on several characteristics, and proper harvest maturity is the key to adequate shelf life and good quality of the ripened fruit.

Most fruit vegetables are harvested by hand. Some harvest aids may be used, including pickup machines and conveyors. Harvesting at night, when products are the coolest, is common for sweet corn and is gaining in use for rock melon. Products reach their lowest temperature near daybreak. Night harvest may reduce the time and costs of cooling products may result in better and more uniform cooling, and helps maintain product quality.

### **General Guide to Fruits Packaging**

According to Simson and Sraus (2010) there are general guide for fruits packaging: These are as follows: Packaging Materials and Container must be non-toxic but comparable with the specific food/fruits; There must be sanitary protection; Moisture and fat protection; Gas and odour protection; Light protection; Resistance to impact; Transparency; Ease of opening; Pouring features; Ease of disposal; Size, shape, weight limitation; Appearance printability; Low cost; and special features

### **Film Packing of Postharvest Produce**

Film packaging is one of the main processes in post-harvest fruits handling.

Packaging film is a thin plastic layer used to preserve, protect, market and distribute various food items. It provides protection for loss of nutrients, colour, aroma, taste, and maintaining the functional properties of food. Packaging films also help protect food from the harmful effect of microorganisms.

Film packaging consists of multiple film layers used to pack goods. Flexible films are used for soft packaging, and are normally produced by extrusion. Flexible film packs are made up of several layers, which in turn are made up of different types of polymer. Flexible film is used in the vacuum packaging of food. Packaging films have to be edible for it to be useful for fruit packaging.

Edible films are a thin layer of material coated or wrapped around a food product to act as a barrier to the surrounding environment. In addition, edible films can serve as carriers of natural or chemical antimicrobial agents, antioxidants, enzymes, vitamins or minerals. Edible films and coatings have received considerable attention in recent years because of their alternative potential to minimize or replace the use of certain synthetic films, which could minimize packaging waste and reduce environmental pollution.

Edible coating provides a dried thin layer of edible materials on the surface of food item for controlling the exchanges of moisture, gases, and solutes with the environment. Edible coating technology has been commercially utilized by the produce industry to extend shelf-life of fresh fruits and vegetables. Sufficient barriers to water and O<sub>2</sub> and CO<sub>2</sub>, uniform adhesion on the produce surface, and appealing appearance and other sensory qualities are essential for fresh produce coatings. The study by Yanyun Zhao (2019) found that the adoption of this technology is commendable because of its quality assurance and food safety for fruit consumption. Common examples of film packaging as identified by Ahiduzzaman (2021) include bags,

pouches, shrink films, tubes, sleeves, and carded packaging. Three types of film are generally used, polyethylene terephthalate, polycarbonate, and polypropylene. For some purposes these are comparable, but polypropylene has a lower loss angle, and polycarbonate has a smaller change of capacitance with temperature.

### Preparation of Fresh Market Fruits

Preparation includes all unit operations such as sorting, grading, postharvest treatments, pre-cooling, and packaging. Preparation of fruits before marketing, if followed properly, fetches premium price for the producers and better quality for the consumers. Ahmad & Mohammed (2015) advised that in order to reduce postharvest losses to a greater extent and increases marketing period of the fruits it is important that farmers would need to promptly prepare their fruits for the market by ensuring that the fruits are fresh for consumersto purchase. Regardless of the destination, preparation for the fresh market comprises of four basic keys operations. These are:

- i. removal of unmarketable materials
- ii. sorting by maturity size
- iii. grading
- iv. packing.

Any working arrangement that will reduce handling will lead to lower cost and reduce quality losses; market preparation is preferably carried out in the field.



**Figure 2: Picture of Fresh Fruits**

Source: <https://bit.ly/2Nxv5NI>

### Challenges of Handling Fresh Fruits

Satisfying the consumer is the ultimate goal of postharvest handling. In order to understand the challenges in handling of fresh fruits it helps to trace those items in the home back through retail outlets, food service providers, distribution centres, transport, and packing, harvest, and production practices. Robert and Stanley ((2022) examined the difficulty involved in handling fresh fruit during postharvest of fruits. According to the authors, the challenges in handling within a value chain include marketing equitably, handling items in stores, ensuring food safety, developing quality management plans, coping with constrained handling, minimizing physiological stress, and understanding transitions at purchase and harvest.

### Movement of Fresh Produce (Fruits)

Gbenga (2022) underscores the importance of postharvest losses of fruits due to circumstances beyond the farmer's control. The authors found some challenging factors affecting the health-related characteristics of the fruits that are eaten. The movement of fresh produce is considered as one the main challenges facing fresh fruits handling. Clarifruit (2023) identified three factors caused by movements of fresh fruits. These are as follows:

1. **Maintaining Temperature Control:** Managing temperature is one of the most critical challenges associated with the movement of fresh produce. Fresh produce needs to be transported and stored at specific temperatures to ensure quality control, and prevent waste. If produce is stored or transported at the wrong temperature, it can lead to premature ripening, rotting, and the loss of flavour and nutritional value.

2. **Considering Shelf Life of Fruits:** Fresh fruits are not clothes and books, they have a relatively short shelf-life, and the quicker they can be transported and delivered, the less waste, and the more options for marketing companies, wholesalers, and retailers. This requires efficient logistics and transportation networks to ensure that produce is delivered to its destination in a timely manner. Anything from poor handling to incorrect packaging can negatively impact shelf life.

### 3. Challenges of Shipping Fresh Fruits

Fresh fruits pose a number of challenges during transit that makes it much harder to transport than other goods. Fruits have a strict shelf life, and the clocks start ticking as soon as the fruits are harvested. Therefore, an efficient supply chain must be established, so it is very important to employ a trusted logistic to help facilitate a smooth and reliable transportation.

Fresh fruits produce is highly sensitive to temperature fluctuation, and even the slightest increase can accelerate ripening leading to premature spoilage. Therefore, refrigerated trucks known as Reefers or open space trucks with cover roofs must be employed consistently for cool temperature. The fresh fruits must be transported in a special plastic crates of baskets to allow proper ventilation.

### Minimization of Losses In Postharvest Handling of Fruits

Losses can be minimized by the following:

- i. Physically avoiding the entry of insects and rodents and maintaining the environmental condition to avoid growth of micro organism.
- ii. **Accessing finance :** small scale farmer should invest in postharvest facilities and equipments like the packing house or a threshers, help them to reduce losses
- iii. **Linking farmers to markets:** farmers are less willing to invest in equipments and activities that can reduce their fruits losses, if they cannot make profits. Linking farmers to marketers to buy fruits directly from them. That means a steady stream of buyers while reducing fruits losses.
- iv. **Cold Storage:** heat deteriorates fruits when there is a lack of cold chain equipment and infrastructure. Cooling equipments can substantially reduce losses of fresh produce.
- v. **Strengthening Transport:** farmer need to extend transport infrastructure to the next mile and can have a bit impact on fruit losses. This can help them to access markets or consumers who are in the remote rural area.
- vi. **Training farmers:** training them on postharvest handling and storage skill including timing of harvest, crop drying and moisture management.

### Conclusion

This study was concerned about providing an update on post-harvest handling of fruits. The necessity for postharvest handling of farm produce such as fruits is premised on the notion that there are huge losses of fruits in the time of harvest and the overall output of the fruit is reduced. Whereas, the management and treatment of postharvest produce when achieved both the farmer and consumer alike would benefit because handling using modern technologies keeps the shelf life of fruit fresh and make the fruit edible through the season. The study found that there are various techniques employed to preserve the freshness of fruits and make them available in the market without the reduction of their life span. Some of the methods for treating postharvest fruit found in study are those of packing house operation, pre-cooling of the produce, package icing, postharvest treatments. The application of each and or all of the listed treatments would go along in ensuring that fruits during postharvest are reserved for future use. Therefore, this study concludes that the knowledge about the update of postharvest handling is very important for farmers and consumers. This is because, the application of the methods especially the available treatments of postharvest of fruit will reduce the economic waste that is encountered yearly by farmers, retain the nutritional value of the fruits and the preservation of the freshness of the fruits for consumers.

## Recommendations

Base on the review of this paper, the following recommendation are made:

1. Farmers should acquire the update information on postharvest handling of fruits. This will enable the farmers to reduce losses associated with waste during post harvesting of fruits.
2. Marketers should use the best practice of postharvest of fruits handling such as pre-cooling, thermal treatment, and irradiation and packing house operation among other methods of preservation.
3. Transporters should use sound vehicles with cooling system and fittings of pallets to protect postharvest fruit while they are being conveyed to their destination. The use of clean and well ventilated vehicles covered at the top for the safety of the fruit must be considered by the transporting company. It is important that transporters should convey the fruits during cool of the day to avoid the scorching of the sun on the fruits. This will Fensure that the shelf life of the produce is preserved for consumer benefits and increase of economic value chains.

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