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POST HARVEST MANAGEMENT OF FRUIT CROPS

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Introduction

Post harvest technology is inter-disciplinary "science and technique" applied to agricultural produce after harvest for its protection, conservation, processing, packaging, distribution, marketing, and utilization to meet the food and nutritional requirements of the people in relation to their needs. After they are harvested, the value of fruits and vegetables is added in successive stages up to the point when someone eats them. The aim of postharvest management is to maximize this added value. This ultimately should benefit the whole community, whether through increased export earnings or extending the availability of fresh produce through the year. Conversely losses hurt everyone. Obviously, disease and oversupply contribute to this, but there are many other reasons for the losses. Postharvest management can influence all them, with the two most important areas being temperature management. Many factors contribute to postharvest losses in fresh fruits and vegetables. These include environmental conditions such as heat or drought, mechanical damage during harvesting and handling, improper postharvest sanitation, and poor cooling and environmental control. Efforts to control these factors are often very successful in reducing the incidence of disease. For example, reducing mechanical damage during grading and packing greatly decreases the likelihood of postharvest disease because many disease-causing organisms (pathogens) must enter through wounds and packaging.

Reasons for post harvest losses in fruits

1. **Physiological loss in weight**
   Weight losses of fresh fruit from many physiological activities like transpiration, respiration, etc. which is depend upon the Temperature, RH %, Air circulation.
2. **Spoilage**
   The phenomenon in which a substrate become unsuitable for use by the action of micro organism , enzymes, damage by insect and mechanical damage.
3. **Rotting**
   The fruit had fallen from the trees and lay rotting on the ground by animal, fungal and bacterial action.
4. **Shrinkage / Shriveling**
   The fruit become smaller from exposure to heat, moisture or cold.
5. **Changes in physical, chemical and biological characteristic of fruits**

In fruit respiration, transpiration, metabolic transformation, ethylene production etc. process done and changes in flavour, aroma, chlorophyll, taste.

The objectives of post-harvest technology

- To extend the shelf life of fresh horticultural commodities
- To understand the biological and environmental factors involved in deterioration fruits
- Use post-harvest technology procedures which will delay senescence and maintain the best possible quality
- To reduce food losses, improve the quality and increase the shelf life of fruits

Post-harvest management of quality

Maturity

- Maturity at harvest is the most important factor that determines storage life and final fruit quality.
- Immature fruits are more subject to shriveling and mechanical damage and are of inferior quality when ripe.
- Overripe fruits are likely to become soft and mealy with insipid flavor soon after harvest.
- Any fruit picked either too early or too late in its season is more susceptible to physiological disorders and has a shorter life than fruit picked at the proper maturity
- All fruits, with a few exceptions (such as European pears, avocadoes and bananas), reach their best eating quality when allowed to ripen on the tree.
- However, some fruits are usually picked mature but unripe so that they can withstand the post harvest handling system when shipped long distance.
- Most currently used maturity indices are based on a compromise between those indices that would ensure the best eating quality to the consumer and those that provide the needed flexibility in marketing.

Ripening

- Ripening is the composite of the processes that occur from the later stages of growth and development through the early stages of senescence and that result in characteristics aesthetic and/or food quality, as evidenced by changes in composition, color, texture or other attributes.
- Fruits can be divided into two groups: fruits that are not capable of continuing their ripening process once removed from the plant are known as non-climacteric fruits.
- This group includes berries (such as blackberry, raspberry and strawberry), cherry, citrus (grape fruit, lemon, lime, mandarin and tangerine), grape, litchi, muskmelons, pineapple, pomegranate and watermelon.
- Fruits that can be harvested mature and ripened off the plant are known as climacteric fruits.
- This group includes apple, pear, quince, persimmon, apricot, nectarine, peach, plum, kiwifruit, avocado, banana, mango, papaya, cherimoya, sapota, guava and passion fruit.
- Once fruits are ripened, they require more careful handling to minimize bruising.

Harvesting

- Method of harvesting (manual or mechanical) and time of harvesting (morning or evening), both these aspects are important.
- Generally farmers harvest its fruits with crude methods like pulling-twisting the fruits and dropping on the ground cutting with scissors and collecting in crates/bags.
- Use of traditional scissors in harvesting leave a sharp projected pedicel on fruits, tends to puncture other fruits during collection, packaging, transportation and storage.
- Punctured fruits get secondary infection of several pathogens like bacteria, fungi and moulds.
- This infection causes quick post-harvest deterioration in quality and quantity.
- These precautions at harvesting minimize post-harvest losses and help to maintain the quality upto consumers.
- Harvesting should be completed during the coolest time of the day, usually in the early morning.

Pre-cooling

Methods of pre-cooling

Pre-cooling of the produce soon after their harvest is one of the important components of the cool 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.

Room cooling

It is low cost and slow method of cooling. In this method, produce is simply loaded into a cool room and cool air is allowed to circulate among the cartons, sacks, bins or bulk load.

Hydro cooling

Dumping produce into cold water, or running cold water over produce, is an efficient way to remove heat, and can serve as a means of cleaning at the same time. In addition, hydro-cooling reduces water loss and wilting. Use of a disinfectant in the water is recommended to reduce the spread of diseases. Hydro-cooling is not appropriate for berries, potatoes to be stored, sweet potatoes, bulb onions, garlic, or other commodities that cannot tolerate wetting. Water removes heat about five times faster than air, but is less energy-efficient. Well water is a good option, as it usually comes out of the ground with temperatures in the 50–60º F range. Mechanical refrigeration is the most efficient method for cooling water. A thermal storage immersion hydro-cooler system can be fabricated economically to suit various volume requirements. Used stainless-steel bulk farm milk coolers may be an option. If hydro-cooling water is re-circulated, it should be chlorinated to minimize disease problems.

Forced air cooling

Fans are used in conjunction with a cooling room to pull cool air through packages of produce. Although the cooling rate depends on the air temperature and the rate of air flow, this method is usually 75–90 per cent faster than room cooling. Fans should be equipped with a thermostat that automatically shuts them off as soon as the desired product temperature is reached. water cooling followed by refrigerated storage appeared to offer no advantage over refrigerated storage immediately after harvest.

Vaccum cooling

Produce is enclosed in a chamber in which a vacuum is created. As the vacuum pressure increases, water within the plant evaporates and removes heat from the tissues. This system works best for leafy crops, such as lettuce, which have a high surface-to-volume ratio. To reduce water loss, water is sometimes sprayed on the produce prior to placing it in the chamber. This process is called *hydrovac* cooling. The primary drawback to this method is the cost of the vacuum chamber system.

Top icing

Icing is particularly effective on dense products and palletized packages that are difficult to cool with forced air. In top icing, crushed ice is added to the container over the top of the produce by hand or machine. For liquid icing, slurry of water and ice is injected into produce packages through vents or handholds without removing the packages from pallets and opening their tops. Icing methods work well with high-respiration commodities such as sweet corn and broccoli. One pound of ice will cool about three pounds of produce from 85º F to 40º F.

Sorting

Sorting is to be done to sort out the over sized and under sized fruits, immature, blemished and bruised fruits, diseased and insect damaged fruits and those with sap injury before final grading. It is done to remove injured, decayed, misshapen fruits. It will save energy and money because culls will not be handled, cooled, packed or transported. Removing decaying fruits are especially important, because these will limit the spread of infection to other healthy fruits during handling.

Grading

Fruits should be graded according to size, weight, color, length and diameter as per demand in market. Grading is done manually or mechanically. Minimum weight and size specifications for the required market should be followed. Graded fruits have good demand in the market and have high prices.

Packaging

- Packaging is a fundamental tool for the post harvest management of highly perishable commodities like fruits.

The important packaging requirements:

- Protection against bruising and physical injury
- Protection against microbial contamination and deterioration
- Provide ventilation for respiration and exchange of gases
- Protect against moisture/weight loss
- Control the ethylene concentration in the package

Alternative packages

A variety of the package materials are available in our country today.

Corrugated fibre board (CFB) boxes

- CFB boxes are widely used as shipping containers for fresh produce because number of advantages over wooden containers.

Advantages:

Excellent cushioning property. Low cost to strength and weight ratio. Smooth and non-abrasive surface. Good printability on the outer surface of the board. Recyclable quality

can be manufacture as tailor made design. Easy to set up and collapsible for storage. Ventilation could be provided as breathing holes in the boxes.

Combination boxes:

They are manufactured with combination of plywood and corrugated fibre board, which have also been tried and they have a high stack load capacity.

Corrugated polypropylene board box:

It is a recent introduction in market, which is made of the corrugated polypropylene board for the purpose of multichip package. These are hygienic, sturdy, light in weight, water resistant and have a high bursting strength.

Plastic crates:

The plastic crates made of either HDPE or PP by injection moulding process has got extensive use for the packaging of fresh fruits.

Molded pulp trays

Molded pulp trays are now successfully being used for the packaging of apples. Another suitable alternative to the molded pulp trays would be plastic thermoformed trays. These trays with the cavities to hold an individual fruit help in holding the delicate fruit individually and avoid bruising injury.

Stretch wrapping:

Use of the cling plastic films for the stretch wrapping of high value fruits like pomegranate, oranges etc. may be considered for the retail marketing.

Modified atmosphere packaging

MA packaging is the process of modifying the atmospheric gaseous level (reduction of O_2 and elevation of CO_2) around the fruit inside film packaging. The modified concentration helps in reducing respiration rate and softening of produce. Retards the incidence of fungal infection. Limit the effect of ethylene in accelerating senescence.

Storage

Proper storage of fresh fruits for extended periods is very much essential for the proper utilization of fruits in the season of glut. In tropical climate, with a high temperature and humid weather, the storability of fruits is very much reduced with heavy losses. Researchers have shown that by adopting the low temperature storage immediately after harvest, the metabolic activities, like rate of respiration, ethylene release, build up of the respiration heat, thermal decomposition and microbial spoilage could be reduced with the retention of quality and freshness for a longer period.

Types of storage:

Room storage

On farm storage is required in remote and inaccessible areas of India, to reduce losses in highly perishable fresh horticultural produce. The high cost and high energy requirements of refrigeration, and the difficulty of installing and running refrigerated facilities in remote areas of India, precludes the use of refrigerated storage in many parts of India. Low-cost, low-energy, environmentally friendly cool chambers made from locally available materials, and which utilize the principles of evaporative cooling, were therefore developed in response to this problem. These cool chambers are able to maintain temperatures at 10–15oC below ambient, as well as at a relative humidity of 90%, depending on the season. Fruits and

vegetables are stored in plastic crates within the chamber. The shelf life of the fruit and vegetables maintained in the cool chamber was reported to be increased from 3 days at room temperature, to 90 days.

Cold storage

The adoption of cold chain systems has been pivotal to trade in fruits and vegetables in developed countries. The maintenance of low temperatures at different stages of handling helps in reducing losses and in retaining the quality of fruits and vegetable. High cost and the lack of abundant uninterrupted power supplies, make it impossible to develop cold chain systems in India. Consideration should, however, be given to the development of alternative cooling systems based on evaporative cooling techniques. Systems of this type would at least reduce postharvest deterioration and extend the shelf life of fresh fruits and vegetables.

Controlled atmosphere storage (CA storage)

It is a deviation from the normal atmospheric gas composition. This deviation strictly controlled with specific gaseous concentrations of nitrogen, CO_2 and O_2.Usually reduction in O_2 and elevation of CO_2 concentrate. Should be supplemented by proper temperature and relative humidity. Retard ripening, senescence and physiological changes. Helps in reducing chilling injury. Direct or indirect effect on post-harvest pathogens. Also useful to control certain insects.

Pusa zero energy cool chamber

The present trend world over is to develop a simple low cost cooling system for storage of fruits and vegetables. In order to overcome the problem of on farm storage, low cost environment friendly Pusa Zero energy cool chambers have been developed. The greatest importance of this low cost cooling technology lies in the fact that it does not require any electricity or power to operate and all the materials required to make the cool chamber are available locally, easily and cheaply. Even an unskilled person can install it at any site, as it does not require any specialized skill. Most of the raw materials used in cool chamber is also re-usable. The cool chamber can reduce the temperature by 10 – 150^0 C of ambient temperature and maintain high relative humidity of above 90 per cent throughout the year that can increase the shelf life and retain the quality of fresh horticultural produce. Pusa Zero energy cool chamber can retain the freshness of the fruits and vegetables for a short period. Small farmers can easily construct these chambers near their houses or fields to store their harvest for a few days before dispatching them to the wholesale market. In this way, the farmers can avoid the clutches of the middlemen and will not be forced to make any distress sale. In India 90 per cent of horticultural produce is sold in fresh form.

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