Chapter 1: IMPORTANCE OF POST HARVEST TECHNOLOGY OF HORTICULTURAL CROPS

Horticulture plays a significant role in Indian Agriculture. It contributes 30% GDP from 11.73 % of its arable land area. India is the second largest producer of both fruits and vegetables in the world (52.85 Mt and 108.20 Mt respectively). Fruits and vegetables are of immense significance to man. In India, the fruits have been given a place of honour on being offered to God at every festival and have also been mentioned in our epics like Mahabharata, Ramayana and writings of Sushrutha and Charaka. Being rich source of carbohydrates, minerals, vitamins and dietary fibres these constitute an important part of our daily diet. The dietary fibres have several direct and indirect advantages. Not only this, fruits and vegetables provide a variety in taste, interest and aesthetic appeal. Their significance in human life is being recognised increasingly in Western societies with the objective of minimizing the occurrence of the diseases related with an affluent life style. Their lesser recognized benefits relate to their role in kidney functions, prevention of cancer and cardiac disorders through contribution of ascorbic acid, β-carotene and non-starch polysaccharides besides the biochemical constituents like phenols, flavonoids and alkaloids.

A considerable amount of fruits and vegetables produced in India is lost due to improper post-harvest operations; as a result there is a considerable gap between the gross production and net availability. Furthermore, only a small fraction of fruits and vegetables are utilized for processing (less than 1%) and exported (Fruits – 0.5% and Vegetables – 1.7%) compared to other countries.

Post harvest losses in fruits and vegetables are very high (20-40%). About 10-15% fresh fruits and vegetables shrivel and decay, lowering their market value and consumer acceptability. Minimizing these losses can increase their supply without bringing additional land under cultivation. Improper handling and storage cause physical damage due to tissue breakdown. Mechanical losses include bruising, cracking, cuts, microbial spoilage by fungi and bacteria, whereas physiological losses include changes in respiration, transpiration, pigments, organic acids and flavour.

NATURE AND CAUSES OF POST-HARVEST LOSSES

Losses occur after harvesting is known as post harvest losses. It starts first from the field, after harvest, in grading and packing areas, in storage, during transportation and in the wholesale and retail markets. Several losses occur because of poor facilities, lack of know-how, poor management, market dysfunction or simply the carelessness of farmers.

(a) Extend of post-harvest loss: It is evident that the estimation of post-harvest loss is essential to make available more food from the existing level of production.

A recent joint study conducted by the management consultancy firm, McKinsey and Co. and (The Confederation of Indian Industry (CII), at least 50% of the production of fruits and vegetab1es in the country is lost due to wastage and value destruction. The wastage cost is estimated to be Rs.23, 000 crores each year. Swaminathan Committee (1980) reported the post-harvest handling accounts for 20-30% of the losses at different stages of storage, grading, packing, transport and finally marketing as a fresh produce or in the processed form. According to Chadha (2009) India loses about 35-45% of the harvested fruits and vegetables during handling, storage, transportation etc. leading to the loss of Rs. 40,000 crores per year.

(b) Important sites of post-harvest losses: Important sites where post-harvest losses are noticed in India are —

- Farmer's field (15-20%)
- Packaging (15_2004)
- . Transportation (30-40%)
- Marketing (30-40%)

(c) Estimated loss of fruits

Crop	**Estimated loss (%)**
Papaya	40100%
Grapes	27%
Banana	20-28%
Citrus	20-95%
Avufado	43%
Apple	14%

Estimated loss of Vegetables

Onion	25-40%
Garlic	08-22%
Potato	30-40°
Tomato	5-347%
Cabbage & cauliflower	7.08-25.0%
Chlli	4-35,0%
Radish	3-5%
Carrot	5-9%

(d) Causes of post-harvest losses

Horticultural crops not only provide nutritional and healthy foods to human beings, but also generate a considerable cash income for growers. However, horticultural crops typically have high moisture content, tender texture and high perishability. If not handled properly, a high-value nutritious product can deteriorate and rot in a matter of days or hours. The causes of post-harvest losses can be divided into different categories:

1. Metabolic

All fresh horticultural crops are live organs. The natural process of respiration involves the breakdown of food reserves and the aging of these organs.

2. Mechanical

Owing to their tender texture and high moisture content, fresh fruits and vegetables are very susceptible to mechanical injury. Poor handling, unsuitable containers, improper packaging and transportation can easily cause bruising, cutting, breaking, impact wounding and other forms of injury.

3. Developmental

These include sprouting, rooting, seed germination, which lead to deterioration in quality and nutritional value.

4. Parasitic diseases

High post-harvest losses are caused by the invasion of fungi, bacteria, insects and other organisms. Micro-organisms attack fresh produce easily and spread quickly, because the produce does not have much of a natural defense mechanism and has plenty of nutrients and moisture to support microbial growth.

5. Physiological deterioration

Fruits and vegetable cells are still alive after harvest and continue their physiological activity. Physiological disorders may occur due to mineral deficiency, low or high temperature injury or undesirable atmospheric conditions, such as high humidity, physiological deterioration can also occur spontaneously by enzymatic action leading to over-ripeness and senescence, a simple aging phenomenon.

6. Lack of market demand

Poor planning pr inaccurate production and market information may lead to over production of certain fruits or vegetables which can’t be sold in time. This situation occurs most frequently in areas where transportation and storage facilities are inadequate. Produce may lie

rotting in production areas, if farmers are unable to transport it to people who need it in distant locations.

7. Consumption

These losses can be due to inadequate preservation methods at home, methods of cooking and preparation such as peeling, consumption styles etc.

8. Others

— Lack of clear concept of packing house operations.

— Lack of awareness among the growers, contractors and even the policy makers.

— Lack of infrastructure.

— Late realization of its importance,

— Inadequate technical support.

— Wide gap in technologies available and in vogue.

— Inadequate post-harvest quality control.

— Unorganized marketing.

— Absence of pre-cooling and cold storage.

— Inadequate market facilities, market intelligence and market information service (MIS)

— Poor storage facilities.

(e) Impact of post-harvest losses

Post harvest losses of horticultural crops affect both the nutritious status of the population and economy of the country.

Nutrition

Fruits and vegetables are rich source of vitamins and minerals essential for human nutrition. These are wasted in transit from harvest to consumer represent a loss in the quantity of a valuable food. This is important not only in quantitative terms, but also from the point of view of quality nutrition.

Economy

Careless harvesting and rough handling of perishable bruise and scar the skin, thus reducing quality and market price. Such damaged produce also fails to attract the international buyers, and bring the exporting country less profit and bad name. This ultimately results in huge economic losses to the country.

For improving the situation, it is essential to create awareness among growers, farm workers, manager's traders and exporters about the extent of losses being incurred and their economic consequences. These groups of people involved in the fruit industry also need to learn the basic principles of fruit handling and storage. In addition, the government needs to

provide basic infra-structure like storage, handling, grading, packing, transport and marketing facilities and technical expertise. This could be carried out by the public and private sectors.

(f)Technologies for minimizing the losses

Fruits and vegetables are perishable in nature. Scientific harvesting and handling are the practical way to reduce the losses due to physical damage, spoilages, due to insect damages and microbial growth. Various protocols are standardized and available for adoption to get the best result, which will give economic benefits. Similarly, proper storage conditions, with suitable temperature and humidity are needed to lengthen the storage life and maintain quality once the crop has been cooled to the optimum storage tempera Lure. Greater emphasis need to be given on the training of farmers, creation of infrastructure for cold chain with common facilities for sorting, grading, packing and post harvest treatments in all major markets. Some technologies for extension of shelf life of fruits and vegetables are:

1. Waxing

It is used as protective coating for fruits and vegetables and help in reduction in loss in moisture and rate of respiration and ultimately results in prolonged storage life.

2. Evaporative cool storage

It is the best short-term storage of fruits and vegetables at farm level. It helps the farmers to get better returns for their produce. In this structure, horticultural crops reduce shriveling and extend their storage life.

3. Pre-packaging

This technology controls the rate of transpiration and respiration and hence keeps the commodity in fresh condition both at ambient and low temperature. It can able to bring revolutionary progress in our trade practice and also benefit the consumer and the producer because of its low cost and ready availability.

4. Cold storage

These structures are extensively used to store fruits and vegetables for a long period and employ the principle of maintaining a low temperature, which reduces the rate of respiration and thus delays ripening.

5. Modified atmosphere packaging (MAP)

These packaging modify the atmosphere composition inside the package by respiration. This technology is successful to extend the shelf life of (Cavendish banana, carrots capsicum, green chilli and tomatoes by 15, 14, 13, 8 and 15 clays as against 5, 7, 8, 4 and 7 days in control respectively, under ambient conditions. Storage of Papaya can be extended 4 weeks when stored at 10 -12 °C under modified atmosphere (MA) conditions by wrapping them in low

density polyethylene (LDPE) bag. Using this technique, the fruit can be transported to different markets in refrigerated sea containers with Temperature Sea at 10-12 °C. Fruits ripen within 3-4 days after arrival when placed at ambient temperature. While using optimum low temperature, storage life of Cavendish banana, capsicum, green chili and tomato can be extended to 42,21,28 and 30 days in comparison to 21, 10,21 and 15 days respectively.

6. Controlled Atmosphere (CA) storage

It is based, on the principle of maintaining an artificial atmosphere in storage room, which has higher concentration of CO2 and lower concentration of 02 than normal atmosphere. This reduces the rate of respiration and thus delays aging. This method of storage is very effective when combined with low temperature storage.

7. Cold chain

Following cold chain handling system for fresh horticultural crops from (arm to consumer. It helps in reducing wastages and retention of quality of commodities.

8. Irradiation

It is the newer technologies that can be gainfully employed during storage to reduce post-harvest losses and extend storage life of fruits and vegetable. When fruits and vegetables expose to ionizing radiation (such as gamma-rays) at optimum dosage delays ripening minimizes insect infestation, retards microbial spoilages, control sprouting, and rotting of onion, garlic and potato during storage. It is also used as a disinfection treatment and controls fruit fly on citrus, mango seed weevil and papaya fruit fly.

9. Edible coatings

These are continuous matrices prepared from edible materials such as proteins, polysaccharides and lipids. They can be used as film wraps and when consumed with the food, become an ingredient of the food. They not only minimize the post harvest losses but also need for energy intensive operations and controlled atmosphere storage. They can control migration of gases, moisture, oil, fat, and solutes, as well as retain volatile flavouring compounds. An edible coating improves structural integrity and mechanical handling and carry product so that they help to maintain quality and inhibit microbial growth causing deterioration of the product.

10. Others

— Facilities/ services like grading, washing, cleaning, scientific harvesting and the like, in respect of perishables at the farm level.

— Cold storage facilities should be extended to tropical fruits and vegetables.

Handling protocols should be established for crops other than mango, citrus, grapes and capsicurn to improve the shelf life and export.

— The issue relating to increasing the shelf life of horticultural products needs to he addressed.

— Appropriate packaging material for export of fresh fruits, vegetables and for modified atmosphere packaging should be developed.

— Value addition needs to be viewed in a wider perspective than mere processing to ensure better return to the producer/ farmer, besides providing better quality product to the consumer.

— Development of natural food columns, fiber, single cell protein and food grade enzymes from processing wastes will be useful.

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