

Strategies Used for Reducing Postharvest Losses in Fruits & Vegetables

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Abstract - The strategies for reducing waste and loss will necessarily be different because the underlying causes are different, but curbing waste and loss in both developed and developing countries will nevertheless be critical to reducing hunger in developing countries and meeting future demand. Consumers demand fresh produce of good physical quality (appearance) which is safe. Fruit and vegetables that are fresh and have good flavor bring repeat sales and may bring higher prices. Strategies for reducing postharvest losses in developing countries include: (1) Application of current knowledge to improve the handling systems (2) Overcoming the socioeconomic constraints, such as inadequacies of infrastructure, poor marketing systems, and weak R&D capacity; and (3) Encouraging consolidation and vertical integration among producers and marketers of horticultural crops.

I. Introduction

Fresh horticultural crops are diverse morphological structure (roots, stems, leaves, and so on), composition, and general physiological. Thus, commodity requirements and recommendations for maximum postharvest of fruit and vegetable vary among the commodities. All fresh horticultural crops are high in water content and are subject to desiccation and mechanical and phylogenetic injury. They are also susceptible to attack by bacteria and fungi, with pathological breakdown. Biological (internal and external) causes of deterioration include respiration, ethylene production and action, rates of compositional changes, mechanical physiological injuries, water stress, sprouting and rooting, physiological disorders, and pathological breakdown. The rate of biological deterioration depends on several environmental (external) factors, including temperature, humidity, air, frost and

atmospheric gases composite, and sanitation procedures. Fresh fruits and vegetables play a very significant role in human nutrition, especially as sources of vitamins, minerals, and energy. Other constituents that may lower risk of cancer and other diseases include phytonutrients. Postharvest losses in nutritional quality, particularly Vitamin C content, can be substantial and are enhanced by physical damage, extended storage duration, high temperatures, low humidity, and chilling injury of chilling-sensitive (Kader, 2011)

You have spent months working in the fields, and now have a beautiful fruits and vegetables. You want to ensure that your customers will also enjoy this healthy harvest. How can you best maintain the quality and safety of your produce as it travels from the field to the table? High-quality, disease-free produce with a good shelf life is a result of sound production practices, proper handling during harvest, and appropriate postharvest packaging

handling and storage (Janet Bachmann and Richard Earles, 2000)

(1) Losses and Quality

Losses in fresh horticultural produce are directly related to quality degradation. Quality loss is the result of improper handling and transportation in marketable of produce. A number of transaction sites referred to as terminals of agribusiness (TA) and sub terminals of agribusiness (STA) have been established at several sites in an effort to reduce losses and improve the quality of fresh fruits and vegetables. These agribusiness terminal stations are intended to serve as sites for information exchange as well as a transaction points for buyers and sellers. Moreover, these stations are also used for sorting, grading, packaging and marketing of produce.

Two TAs are currently operational in Indonesia, and a further 6 are currently under construction. Approximately 62 STAs are also operational. A majority of STAs are inadequately equipped with cold storage, Temperature washing, packaging and shipping facilities. Packing houses have been constructed by a number of private sector entities in order to facilitate collection, sorting, and grading of fruits. Salak fruit produced in Magelang Regency,

Postharvest handling and packing requires knowledge of postharvest technology, proper facilities, and trained human resources. Poor postharvest handling in Indonesia is the result of limited facilities and low-grade human resources. Postharvest facilities for horticultural produce pale in comparison of those developed for other food crops.

(2) Food Safety

Consumers demand fresh produce of good physical quality (appearance) which is safe. Efforts are currently being made to implement

Good Agricultural Practices on the farm in order to assure the safety of fresh produce in Indonesia. An Integrated Pest Management Program has also been implemented in order to minimize pesticide residues in horticultural produce. This program has been less than satisfactory owing to the poor discipline of farmers involved with the program.

II. POSTHARVEST HANDLING

Fruit and vegetables that are fresh and have good flavor bring repeat sales and may bring higher prices. How produce is handled directly affects freshness and, with some produce, how well peak flavor is retained.

For most produce, maintaining cool temperatures (to slow deterioration) and high humidity (to prevent moisture loss) are the most effective means of preserving quality. However, there are several things producers, handlers, and retailers can do to assure that fruit and vegetables going to the market or into storage are of high quality.

A. Harvesting and handling:

1. Provide gentle harvesting and handling to avoid cuts, abrasions, and bruising damage that allow decay-causing micro organisms to enter the tissue.
2. Harvest produce at the peak of quality. This assures greatest value at the time the commodity begins a sales period or storage period for later sale. Because most produce begin to deteriorate at the time of harvest, the highest-quality produce will have the greatest shelf life.
3. If possible, harvest during the cool part of the day. Because temperature controls the rate at which produce deteriorates, harvesting

when the produce is coolest (usually just after sunrise) will extend their quality.

4. If storage facilities are not available, harvest only as much produce at one time as you can pack or sell before the quality deteriorates. This also allows displays at roadside markets to be replenished with freshly harvested produce throughout the day, which ensures highest quality available to customers
5. Make successive plantings and use several varieties of varying maturity to spread the harvest season. This ensures that freshly picked material will be available over an extended period.
6. Shade is cheap and important. Use trees or a shade cover on field wagons, trucks, and market areas. Hold produce in a shaded area while awaiting packing. Perform sorting and packing operations in a shaded location. Vegetables exposed to the sun will absorb solar energy and become warmer than those in the shade. This is especially true of dark-collared vegetables, such as zucchini squash, eggplants, peppers, watermelons, green beans, and tomatoes, which are often harvested during the middle of summer when solar energy is at a maximum.
7. At farm markets, display only good-quality vegetables for sale. Those of poor quality will never improve and will detract from sales of good-quality produce. Frequent sorting to remove poor quality material will present the best display possible to customers. Sales displays should be out of direct sun.
8. Remind customers to keep produce cool and prevent moisture loss during transportation and storage at home.
9. For commodities that loose quality rapidly and those to be shipped to market, special

postharvest washing, handling, and cooling are

required to maintain quality. Take care to avoid bruising in transportation to the packing shed, during unloading, washing and grading.

III. PRE-HARVEST FACTORS ON POSTHARVEST QUALITY

The postharvest quality of fruits and vegetables are largely determined by preharvest factors

such as production location, soil type, irrigation, rootstock, shading and nutrition. **Monselise and Goren (1987)** divided the pre-harvest factors into primary and secondary. The primary factors include climate, nutrition and plant growth regulators, and secondary factors include soil quality and management, rootstock, irrigation, training and pruning and crop load manipulation. The influences of important pre-harvest factors on postharvest quality of fruits and vegetables are described below.

1. Temperature

Atmospheric temperature has been found to influence fruit shape, size, colour and other quality parameters. Temperature variation during the early stage of fruit development caused variation in shape of orange fruit (Monselise and Goren 1987), Temperature cause undesirable thick peel and puffiness in citrus (Pantastico 1975). Pineapple fruits grown in winter months or in cool growing areas had reduced eating qualities due to lower Sugar/acid ratio (Hofman and Smith 1998).

2. Radiation

Radiation interception by fruit has marked effects on the quality attributes of fruits and vegetable. It has been found difficult to determine whether the effect of radiation is through light or heat (Jackson 1980). Any

factor that reduces radiation interception results in reduced soluble solids, higher acidity and abnormal skin colour development. Low light intensity can reduce the firmness of fruits at harvest and during storage (Combrink *et al.* 1995). Low light intensity increases postharvest disease incidence because of reduced physical and physiological integrity of the fruit and vegetable; reduces fruit size and vegetable size decreases ripening characteristics. Shade increases diseases in Kiwi fruit and vegetable. Chilling injury during storage was reported in grapefruit because of high radiation interception by the fruit and vegetable, which may be attributed to the increase in weight loss due to changes in wax and cuticular structures (McDonald *et al.* 1993). They also reported that reduced exposure to sun decreased chilling injury of grapefruit.

3. Relative humidity

Relative humidity plays an important role in determining fruit and vegetable quality. Higher relative Humidity around the fruit and vegetable reduces water and movement into the fruit. In contrast, higher relative humidity around the plant increases Ca accumulation into the fruit by reducing leaf evapotranspiration (Hofman 1998). Similar results have been observed in tomato fruit, where higher relative humidity around the plant increases fruit Ca, and decreases shelf life due to Ca toxicity (Adams and Holder 1992; De Kreij *et al.* 1992). High relative humidity around the plant has also been reported to be associated with increased maturity bronzing in banana fruit (Campbell and Williams 1976).

4. Nutrition

Several nutrient elements, especially N, Ca, Mg and K have been found to influence the quality attributes of fruits and vegetable. The application of Ca and high fruit and vegetable Ca concentration resulted in increased firmness; reduced disease incidence, chilling injury, physiological disorders and ripening; and improved storability (Hofman 1998). According to Simmons *et al.* (1995), the application of gypsum (Ca containing fertilizer) did not show any significant effect on shelf life and other quality attributes of mango fruits. Whitney *et al.* (1991) reported that the spraying of Mg decreased fruit Ca and increased bitter pits in apples. Potash has been found to improve fruit qualities. In bananas, high K increased total soluble solids and vitamin C and reduced acidity (Mustaffa 1988). In pineapple, the influence of K is detrimental. Vis (1989) reported that high K application increased acidity in pineapples. Application of excessive N element is very detrimental in terms of postharvest quality attributes.

5. Irrigation

Irrigation has immense influence on fruits and vegetables quality. Generally, the excessive availability of water can result in larger fruit, reduced firmness and flavor and more disorders. Ebel *et al.* (1993) reported that excessive irrigation decreased fruit firmness through increased fruit size. Water stress also affects fruit qualities. Sirkul and Turner (1995) showed that low irrigation reduced fruit growth rate and green life of bananas. In case of mango, lowering irrigation during rapid fruit expansion stage reduced storage duration and fruit Ca concentration (Simmons *et al.* 1995).

6. Plant growth regulators (PGR)

The application of plant growth regulators in the fruit and vegetable development stage has important effects on the quality parameters of fruits. Different types of growth regulators are applied to the plants to improve the fruit qualities, which include gibberellins, cytokine and auxins (Hofman1998). Pradhan *et al.* (1988) observed that the application of gibberellins during fruit development increased fruit weight. Another growth regulator, Cuter was found to increase the size and other quality attributes of avocado fruit and vegetable. Cytokine and auxin have been reported to increase shelf life and reduced fruit splitting in persimmon and citrus, respectively (Almela *et al.* 1994; Itai *et al.* 1995).

In Bangladesh, PGRs are used in horticultural crops to increase the size of the edible portion of fruits and vegetables and to obtain early bearing. In the case of mango, maximum growers of Chapai Nowabgonj and Rajshahi apply PGRs from the stage of flowering to entire harvesting season. The PGRs, namely Biogeem, Ferti and Yield are used in the production of mango in Chapai Nowabgonj and Rajshahi districts (Plate 2.1). In case of banana, majority of growers of Ghatail and Shakhipur Upazillas under Tangail district apply plant growth regulators to banana crops from the stage of flowering to the entire harvesting season at a rate of 5-15 ml/10-16 liter of water. Among different plant growth regulators, Okozim, Plano fix, Argon and Voxal Super are commonly used by the banana growers. Similar findings were also reported by Bhuiyan *et al.* (2009), who mentioned that 40.7 and 30.7% of the banana growers were found to be the low to medium users of PGRs in banana cultivation, especially for quick maturity and high yield.

IV. GRADING

Grading of fruits and vegetables after harvesting is an essential step in post-harvest management. Grading of fruits and vegetables on the basis of physical characteristics like weight, size, colour, shape, specific gravity quality, and freedom from diseases depending upon agro climatic conditions. The known methods of grading of fruits and vegetables are manual grading, size grading. Grading of fruits and vegetables in the fresh form for quality is essential, as the people are becoming quality conscious day by day. Further, upon arrival of fruits and vegetables at the processing centres, they should be graded strictly for quality. The immature properly mature and over mature fruits and vegetable should be sorted out for the best attributes.

V. PACKAGING

Packaging is an integral element in the marketing of fresh fruits and vegetables produce. It provides an essential link between the producer and the consumer. Owing to its favorable properties, wood and plastic has remained the main packaging material for fruits and vegetables. Timber conservation is, however, critical in order to maintain an ecological balance, and there is an urgency to identify substitutes for the use of timber in an effort to protect forest resources in many developing countries. Packaging has been identified as one of the most important areas where substitutions of wood and plastic is not only possible but also obviously desirable. Considerable work has been done by different agencies in introducing alternative types of packaging. CFB boxes can also be fabricated from Kraft paper produced from bamboo, long grasses and many other types of agricultural residues like black gram, paddy, cotton stalk, jute stick, wheat straw bar seem and recycled paper and cardboard. Packaging produced

from timber is often used as a source of firewood, owing to the severe shortage of wooden India.

Wire-reinforced wood veneer baskets and hampers of different sizes were once used for a wide variety of fruit and vegetable from strawberries to sweet potatoes. They are durable and may be nested for efficient transport when empty.

1. Wooden Crates and Lugs.

Wooden crates, once extensively used for apples, stone fruit, and vegetable have been almost totally replaced by other types of containers. The relative expense of the container, a greater concern for tare weight, and advances in material handling and packing have reduced their use to a few specialty items, such as expensive tropical fruit.

2. Pallet Bins.

Substantial wooden pallet bins of milled lumber or plywood are primarily used to move produce from the field or orchard to the packing house. Depending on the application, capacities may range from 12 to more than 50 bushels. Although the height may vary, the length and width is generally the same as a standard pallet (48 inches by 40 inches).

3. Wood Pallets.

Literally form the base on which most fresh fruits and vegetable produce is delivered to the consumer. Pallets were first used during World War II as an efficient way to move goods. The produce industry uses approximately 190 of the 700 million pallets produced per year in the U.S.A. About 40 percent of these are single-use pallets.

4. Plastic Bags.

Plastic bags are the predominant material for fruits and vegetables consumer packaging. Besides the very low material costs, automated

bagging machines further reduce packing costs.. Plastic films are available in a wide range of thicknesses and grades and may be engineered to control the environmental gases inside the bag. The film material "breathes" at a rate necessary to maintain the correct mix of oxygen, carbon dioxide, and water vapor cooled temperature inside the bag. Since each produce item has its own unique requirement for environmental gases, modified atmosphere packaging material must be specially engineered for each item

5. Rigid Plastic Packages.

Packages with a top and bottom that are heat formed from one or two pieces of plastic are known as clamshells. Clamshells are gaining in popularity because they are inexpensive, versatile, provide excellent protection to the produce, and present a very pleasing consumer package. Clamshells are most often used with consumer packs of high fruit and vegetable value produce items like small fruit, vegetable, mushrooms, and etc polystyrene containers have been test marketed as a substitute for wooden crates.

6. Bulk Bins

Bulk bins, originally used in harvesting, are now used for shipping and storage of some produce. Bin sizes vary, but there is a move to a standard 40 -48-inch size with a palletized bottom for easy packaging and handling. Placement and type of bin vents varies. Most bulk bins are wood and stackable. Corrugated fiberboard bins that are attached to wooden pallets are mostly used for watermelons and other vine crops. Bulk bins are replacing loose bulk loading and handling for commodities such as potatoes, onions, . Bins reduce the amount of handling labor needed, and may reduce bruising of **Karen L. B. Gast**

7. Storage

Production of horticultural produce is limited by certain climate conditions and through proper storage of fruits and vegetables the availability of the produce is extended. In this way, the reasonable prices are ensured to the fruit and vegetable growers and the dumping of fruits and vegetable in the market is avoided.

VI. METHODS OF STORAGE

(1) Air cooled storage: Fruits are placed in racks in the insulation building .fruit should not be heaped but spread at racks

(2) Air cooled storage refrigerated with ice: Few storage are filled with ice and salt and equipped with fans for quick cooling of the fruit

during warmer periods

(3) Refrigerator Storage Refrigerated: Fruits and vegetables should be kept in plastic bags in the produce drawers of the refrigerator. You can either purchase plastic bags or make small holes with a sharp object in imperforated bags. Separate fruits from vegetables (use one drawer for each group) to minimize the detrimental effects of ethylene produced by the fruits on the vegetables.

VI. TRANSPORTS OF FRUITS AND VEGETABLES

Resources utilized for carry in markets of fruit and vegetable

1. For distant markets-

- (a) By Aeroplanes
- (b) By Water resources
- (c) By Trains
- (d) By Refrigerating cars

2. For medium distance markets-

- (a) By Trains
- (b) By motor trucks

3. For local market-

- (a) By pack animal – as horse and cannel
- (b) By banhegi
- (c) By Bicycle or Rickshaw
- (d) Bullock carts
- (e) By tongs
- (f) By head load

VII. MARKETING OF FRUITS AND VEGETABLE

After post harvest of fruit and vegetable carry in market .than good rates meet in markets

Type of marketing of fruit and vegetable

1. Selling to consumers-

- (a) House to house
- (b) Road side markets
- (c) Small markets
- (d) Weekly markets

2. To retailer's-

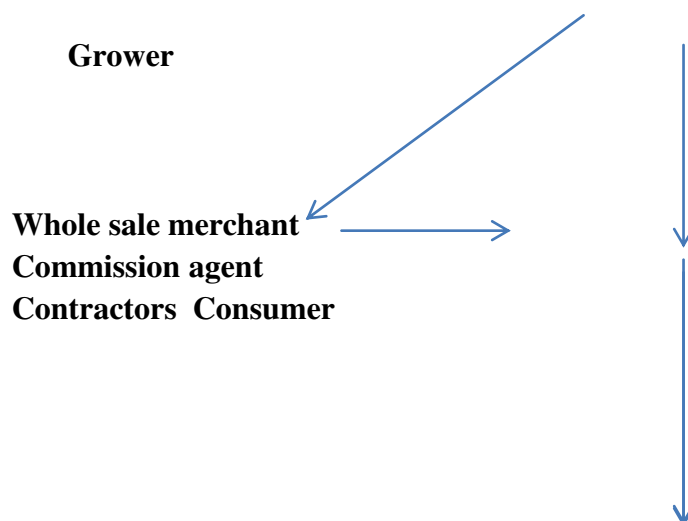
- (a) Mundies
- (b) Selling at farm
- (c) Auction markets

3. To wholesale merchants-

4. To contractors-

5. To co-operative societies-

Present status marketing-



VIII. CONCLUSION

Significant progress has been made in the development of Strategies used for Reducing Postharvest Losses in Fruits &Vegetables in India. With the availability and use of improved technologies, postharvest losses in fruits and vegetable losses can be minimized and betterquality produce can be making available to consumers. Postharvest technologies must be further refined in terms of increasing their effectiveness and reducing their cost. The government and the private sector must implement changes to ensure that all activities of the postharvest handling chain are improved.

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