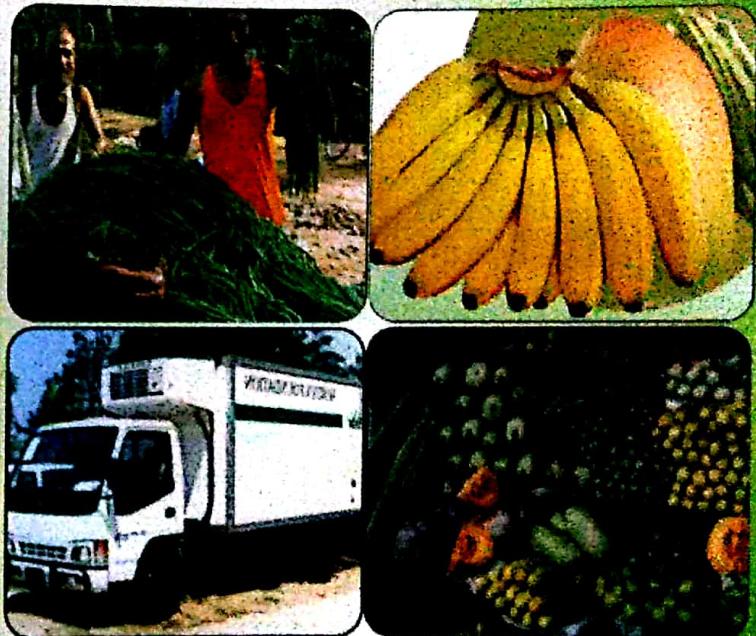


Postharvest Technology for Maintaining Safety and Quality of Fruits and Vegetables

Md.Saleh Ahmed, Ph.D

Post Harvest Handling & Quality Assurance Expert



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PABX: 8128123433, 9141331, 8144906;
Fax. 9125181, 9101065



E-mail: hortex@citechco.net;

hortex@hortex.org, website: www.hortex.org



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1. Introduction

High value crops (HVCs) provide real opportunity for enhancing farm incomes, earning foreign exchange, improving nutrition, and reducing poverty in Bangladesh. The supply chain of HVCs operation generally include those carried out during production, harvesting, before and during packing, transport, storage, distribution and marketing. Quality maintenance in the supply chains hinges on temperature and relative humidity management, as well as protection from mechanical injury. The safety of HVCs must be assured by minimizing the risks of contamination from pre-harvest through post-harvest handling and retail. Most of the HVCs because of their perishability in tropical environment present multiple problems during production, at harvest and after harvest in maintaining desired shelf life, quality and safety of produce. There are many post-harvest technologies that extend the shelf life, reduce the losses, maintain quality and safety of the HVC products.

There is a pressing need to establish efficient firm-cost-energy saving post-harvest technology systems which reduces losses and optimize produce suitability and quality for market requirements.

To be competitive in the markets, small farmers need to market collectively, through their own companies, cooperatives, or contract farming arrangements. These collaborative marketing groups must be of sufficient

size and scale, perhaps including several thousand farmers, to achieve economies of scale in purchasing and logistics and to command significant power in the super-market dominated supply chains. All players in the chains i.e., farmers, packers, processors, distributors, retailers, or wholesalers, must even more effective in safeguarding their products and protecting clients and consumers who are increasingly concerned about the quality and safety of products. They are also demanding that products should be produced and handled in a socially, ethically, and environmentally friendly way throughout the entire supply chain. This situation of HVCs chains in many developing countries including Bangladesh is, however, far from satisfactory.

In this paper, an attempt has been made to review the present situation of safety and quality assurance systems, identify problems that affect the, quality and safety of fresh fruits and vegetables (FFVs), and to suggest post-harvest management practices that are critical to maintain the quality and safety FFVs in Bangladesh.

2. Issues and Concerns of Environment at Farm Level

There exist several quality and safety problems in the supply chains of FFVs. Bruising occurs on farm and throughout the marketing chain. The three main causes are impact, when fruit is dropped, either individually or when packed; compression as a result of pressure from a pile of fruit, excess produce being squeezed into a container or the collapse of containers; and abrasion caused by friction. The effects of bruises are cumulative and a significant loss of quality can result. Lesions occur during harvest and subsequent handlings.

Several studies indicate that contamination of FFVs may take place at all stages during production and processing with possible sources being soil, faeces, water and ice, animals, handling of the products, harvesting and processing equipment, and transport. The stages of the produce supply chain at which quality and safety can be affected are grouped; a). production, b).harvest and post-harvest handling, c).packaging, transport and storage, d). ripening and produce preparation; and e).wholesale and retail marketing.

At the production level, soil can contain excess heavy metals (arsenic, lead and cadmium), while water used for irrigation and for washing harvested produce can be, and frequently is, polluted.

Use of untreated manure can spread pathogens while imbalanced use of chemical fertilizers poses serious threat on soil degradation and water pollution too.

Harvesting practices can have a major impact on both quality and safety, with fruits and vegetables often being harvested immature, too soon after pesticide application, or at the wrong time of the day. There are evidences of indiscriminate and over uses of pesticides that leaves opportunities for their residual effects on human health, ecology and environment. Moreover, farmers are known to apply doses higher than those recommended on the label. There is evidence of using banned pesticides and farmers use them because they are cheaper and sometimes because they are unaware that these are banned chemicals.



Loading vegetables in truck



Sorting of yard long bean

Knowledge of IPM is not widespread and pesticides tend to be applied following a calendar-based rather than a needs-based approach.

Farmers usually place more emphasize on maximizing yield than on minimizing residue level. Most of the farmers are not well aware of the dangers inherent in their production practices and they take their produce as food and feed plant residues to their animals while in rare cases they usually do not eat what they produce utilizing pesticides.

Pesticide spillage is quite common and empty containers/packets are often not properly disposed of and become a source of contamination that harms the environment. However, countering such problems by using pesticides has major implications for food safety as well as environmental protection, particularly when they are not applied in accordance with recommendations or when banned chemicals continue to be used. Risk-averse farmers frequently believe that reducing use of pesticides would significantly reduce their yield. Concern to maximize income often leads farmers to sell produce that has only recently been sprayed; ignoring recommended pre-harvest intervals (PHI) as described in the product label.

Most of the farmers often do not know when to apply pesticide and are unaware of the correct product or dose. Knowledge at farm level of factors contributing to microbial contamination and food adulteration is reportedly negligible.

Managing the production process and the food chain so that the public has access to a safe produce and sustainable environment requires an effective environment management system (EMS), which sets the strategic direction for food control activities in the whole supply chain. The goal of this EMS is to safeguard the quality and safety of the total food supply chain, leading to a reduction in the incidence of food borne illness and quality of life and sustainable environment.



Containers of pesticides



Cleaning and washing of produce

The common food safety and agricultural health management deficiencies in FFVs are as follows:

- Lack of application of GAP (Good Agricultural Practices) , GMP (Good Manufacturing Practices), And HACCP (Hazards Analysis Critical Control Point) principles, and no systems for fresh produce traceability;
- Lack of capacity to undertake pest-risk analyses;
- Weak controls relating to plant pests and diseases;

d) Low capacity to implement quarantine measures and enforce pest-free areas;

e) Limited farmer knowledge of alternative pest-management approaches and appropriate use of pesticides;

f) Weak regulatory systems relating to the import, production, and use of pesticides;

To benefit small and marginal farms there is a need to strengthen Post-harvest management system, encompassing all areas from production to final sale quality standards, processing, storage, transport and warehousing.

3. Post-harvest Management Practices to Maintain the Produce Quality and Safety

Improving quality and safety of FFVs will require recognition that, firstly, farmers and traders need to be motivated to adopt following practices:

- Adopt Good Agricultural Practices (GAPs) in producing FFVs to improve quality and safety;
- Use agro-chemicals judiciously and practice safe use of pesticides, follow IPM technology and use bio-agents for pest control;
- Adopt appropriate post-harvest technology to maintain quality and safety of produce

- Harvest produce at the correct stage of maturity in the cooler hours of the day, preferably early in the morning. This prevents produce getting too hot, reducing water loss and spoilage. However, avoid harvesting in the rain, particularly citrus, peppers and soft fruit, such as mango and papaya, because excessive moisture increases rotting;



Clean cultivation



Vegetables in plastic crates

- Handle the produce carefully in the field and protect from damage, stress and contact with disease.
- Use plastic field crates for handling of produce. These provide good protection to the produce. They should have sufficient holes for ventilation, which cools the produce and allows it to breathe.
- A big advantage of crates is that they can be stacked on top of each other, without damaging the produce, providing that they are not over-filled. Empty crate slot into each other, so they can be stored neatly using little space.

Packaging accessories such as trays, cups, wraps, liners and pads may be used to help immobilize the produce within the packaging container while serving the purpose of facilitating moisture retention, chemical treatment and ethylene absorption. Packing & packaging methods can greatly influence air flow rates around the commodity thereby affecting temperature and relative humidity management of produce while in storage or in transit.

Proper temperature and relative humidity management is to be maintained to protect the deterioration of harvested commodity and maintain deterioration quality of the produce.



Chilli packed in C.F.B cartons



Broccoli packed with ice

Most perishable horticultural commodities have an optimum shelf life at temperatures approximately 0°C. The rate of deteriorations of FFVs however increases two to three folds with every 10°C increase in temperature. Temperature has a significant effect on how her internal and external factors influence the commodity, and dramatically affects spore germination and the growth of pathogens.

- Do not handle fresh produce in sacks because this leads to crushing, bruising and over-heating of produce.

- Field containers should be washed regularly to prevent the build up of dirt which can spread disease to the produce
- Avoid rough handling of produce and do not throw produce into containers
- Do not keep the produce on the ground and keep produce out of the sun, preferably in the shade of a covered shed. Filled field containers can be covered with damp cloths or sacks, to reduce heat build-up and water loss produce into containers



Sorting and grading of produce



Produce in crates with & damp clothes or sacks

- Transport produce from field carefully and grade produce according to market requirements of size, maturity, colour and weight etc.
- Farmers should use best cleaning and sanitizing practices. For products (fruits & vegetables) the cleaning steps vary with how dirty the produce is, and the tenderness and perishable nature of the produce. Root vegetables often require initial rinsing, scrubbing followed by one or two additional rinses to remove

soil residue, while only rinsing can be safely used on leafy green vegetables.

- Fruits and vegetables that grow well above the ground may be brushed or wiped when soil and other residue are minimal. When water is used for cleaning, it should be potable (safe to drink). Clean food contact surfaces by removing soil and residues that involves a three-step process of rinsing away surface debris, washing and scrubbing with soap or detergent, followed by rinsing with clean potable water. (safe to drink).



Packing house value adding operations



Pelleted pineapples for shipment

- Sanitizing will kill most microorganisms or reduce them to a non-harmful level. Chlorine bleaches (sodium hypochlorite concentrations 5.25 to 6.50% in liquid form), 3.0% hydrogen peroxide and chlorine 50-100 ppm may be used for produce contact surfaces. Washing, rinsing, and sanitizing may appear to increase costs, but they enhance product quality and offer benefits by removing soil/particles, micro-organisms/or reducing to a safe level, increasing shelf life and providing good visual appealing to customers.

4. Suggested Measures to Overcome the Problems

- a) Create awareness among the all concerned agencies, policy makers, implementers and users, so as to comply with the quality and safety requirements including orientation and organization of the small scale growers;
- b) Pay more attention to microbial and parasitic contamination issues and ways of such contamination need to be identified and information on the topic made widely available to farmers and traders;
- c) Improve physical infrastructure, especially in the area of pack house, cool chain, testing laboratory services and quality management;
- d) Implement Human Resource Development (HRD) program through providing hands-on training with practical exercises related to quality production, post-harvest management and supply chain management of FFVs;
- e) Strengthen R & D activities and institutional capacity to take care on quality and safety issues in government agencies (BARI, DAE, BADC), NGOs and private sectors etc.;
- f) Disseminate post-harvest technologies that are low cost and applicable to reduce the safety hazards and maintain produce quality through demonstration, organizing training, seminar / workshop etc.;

g) Develop guidelines for appropriate use of pesticides and other chemicals at farm level and publish crop specific leaflets, booklets and other communicating documents;

h) Introduce Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP) & HACCP to ensure food safety and maintaining produce quality;

i) Upgrade laboratory testing facilities for pesticidal residues and provision of subsidy for testing charges to be paid by the farmers;



Packaging of produce for export



Packing house operations for export

j) Develop accreditation system of GAP certification

k) Private sector players should participate actively in national strategies on standards and in the development of national GAP programmes;

l) Ensure proper monitoring of farm practices and proper implementation of pesticide acts.

5. Conclusion

Application of post-harvest technology will not only minimize post-harvest losses of FFVs, but also can increase food availability, decrease the area needed for production, and conserve natural resources. Appropriate post harvest technologies when used effectively can increase the shelf life of the produce, greatly enhance profitability and maintain quality and safety of the products.

Introduction of GAP, GMP and HACCP will ensure safety and maintain good quality of the produce. Effective training and supervision of personnel must be an integral part of quality and safety assurance programs.

Assuring food safety throughout the post harvest handling system is very critical to successful marketing of produce and should be given the highest priority. given the highest priority.