Post-Harvest Losses of Fruits , Vegetables and Preservation"

Dear Students, in to-day's lecture, we will discuss about "P**ost-harvest losses of fruits ,vegetables and preservation"**

Introduction:

There is a renewed interest in vegetables, in light of the recent findings on their health promoting properties. Vegetables are highly perishable agricultural commodities due to high moisture content and higher metabolic activities. Botanically, a fruit is the ripened ovary or fruit is an ovary that has ripened after fertilization.

An important cause for vegetable spoilage is microorganisms. The source of microbes includes fecal maters, transport rot, *Earwina*, *Pseudomonas*, water and soil pathogens, yeast and moulds present on vegetable surface. There are reports stating that physical contamination, insect, and dust processing conditions, where in storage temperature acts like a booster. Gram negative bacterial flora causes major spoilage of vegetables. The post-harvest handling procedures such as hygienic and safety conditions during transportation, quality of microbes on foods with special reference to vegetables.

The post-harvest losses recorded during previous decades are alarming. Spoilage of fruits & vegetables mainly occur due to microbial attack, auto-oxidation and insect pest attack. As a result, about 25 to 30 per cent of the production is lost after harvest due to improper handling, storage and microbial contamination. As processing technology is a young science in India, existing knowledge about the way in which minimally processing along with edible coatings like carnauba wax and nisin can improve the shelf life of vegetables during storage at room temperature as well as at low temperature. These spoilage organisms thrive and multiply faster at ambient temperatures and high humidity. Many of these spoilage organisms multiply even at lower temperatures during refrigeration. Refrigeration of vegetables for long period results in spoilage due to the growth of Psychotropic bacteria; they are capable of surviving and multiplying in refrigeration temperature.

This episode deals with fallowing :

1. Production and processing in India
2. Postharvest Losses in the Asia Pacific Region
3. Common Causes and Types of post harvest losses

4. Microbial and physical loss.
5. Preservation and prevent spoilage

Table-1: Fruits and vegetable production in India

Year	India produced, Export and processing of Fruits and vegetables	
2011	Production of fruits	72.28 million tons
2011	production vegetables	133.54 million tons.
2012-13	Production fruits	81.285 million metric tons
	Production vegetables	162.19 million metric tons
	Exported fruits and vegetables worth	Rs. 8760.96 crores
	In India we process only	1.5% to 2%.

Common Causes of Post Harvest Losses: Can be divided in to two major groups ie

1. Physiological disorders 2. Postharvest factors

1. **Physiological Disorders** • Causes: Pre- and post-harvest factors

• Pre harvest: ammonization, Zebra skin, fruit-splitting, sun burn, wind scar and freezing.

2. **Postharvest factors:** – Temperature, humidity, gaseous composition, mechanical stress.

Aging disorders: Puffiness, pitting, chilling injury, granulation and freezing injury.

Table-2: Estimated Levels of Post harvest Losses in the Asia Pacific Region

No	Country	% losses
1	India	40
2	Indonesia	20-50
3	Iran	35
4	Korea	20-50
5	Philipines	27-42
6	Sri-Lanka	16-41
7	Thailand	17-35
8	Vietnam	20-25

R.S. Rolle, Agr.Industries Officer, FAO, 2004.









Microbial Losses due to Diseases :

CONTAMINATION OF VEGETABLES AND PATHOGENIC BACTERIA:

Many types of post-harvest disorders and infectious diseases affect fresh fruits and vegetables. Using polluted muddy water or stream water for irrigation can also contaminate produce in the field. Soil and decaying plant material in the field can contain post-harvest pathogens in great abundance. Vegetables are exposed to various types of contaminants. They

generally contain heterogeneous microflora, total microbial population depends on the field organisms and other bacteria encountered. Hence galaxies of pathogens that form surface microflora of vegetables are, *Salmonella*, *Aeromonas hydrophila*, *Listeria monocytogenes.* Association of vegetables with the outbreaks of human Listeriosis is often reported. *L. monocytogenes* have been isolated from cabbage, cucumber, radish, tomatoes, salad vegetables, beans sprout et

Postharvest Losses:

1. Disease:-Fungi and bacteria
2. Injuries:-Mechanical force, heat or freezing or chilling and due to chemicals
3. Non Disease disorder

Over packing or under packing of field or marketing containers careless handling, such as dropping or throwing or walking on produce and packed containers during the process of grading, transport or marketing.

Postharvest losses may occur at different levels during the marketing chain

1. Losses at harvest: → injuries, pressure damage
2. Losses at the packinghouse: → chemicals, brushes and wax damage
3. Losses during storage: → chilling injuries, decay, peel disorders
4. Losses during transport: → bruising, deformation, decay
5. Losses at retail: → decay, softening, wilting
6. Losses at the consumers: → decay, softening, wilting

Table-3:**Composition of fruits and Vegetables**

		Fruits	Vegetables
1	water	85%	88%
2	CHO	13%- less water and more CHO than vegetables	8.6 %, Includes readily available mono- and disaccharides like glucose and maltose, as well as more complex oligosaccharides, which are available to fewer types of microorganisms
3	protein	0.9%- bit low	1.9%
4	fat	0.5%	-0.3 %
5	minerals		0.84 %
6	pH	low pH (1.8-5.6)	6.0- most vegetable is around; within the growth range of many bacteria
7	others	trace amounts of vitamins, nucleotides,etc.	also contain fat and water soluble vitamins and nucleic acids (<1%).

Like vegetables, fruits are nutrient rich substrates but the pH of fruits does not favor bacterial growth. As a result, yeasts and molds are more important than bacteria in the spoilage of fruits.

Vegetables are a good substrate for yeasts, molds or bacteria.

Microflora of vegetables is primarily composed of:

1. G+ bacteria like lactic acid bacteria (e.g. *leuconostocs, lactobacilli, streptococci.*

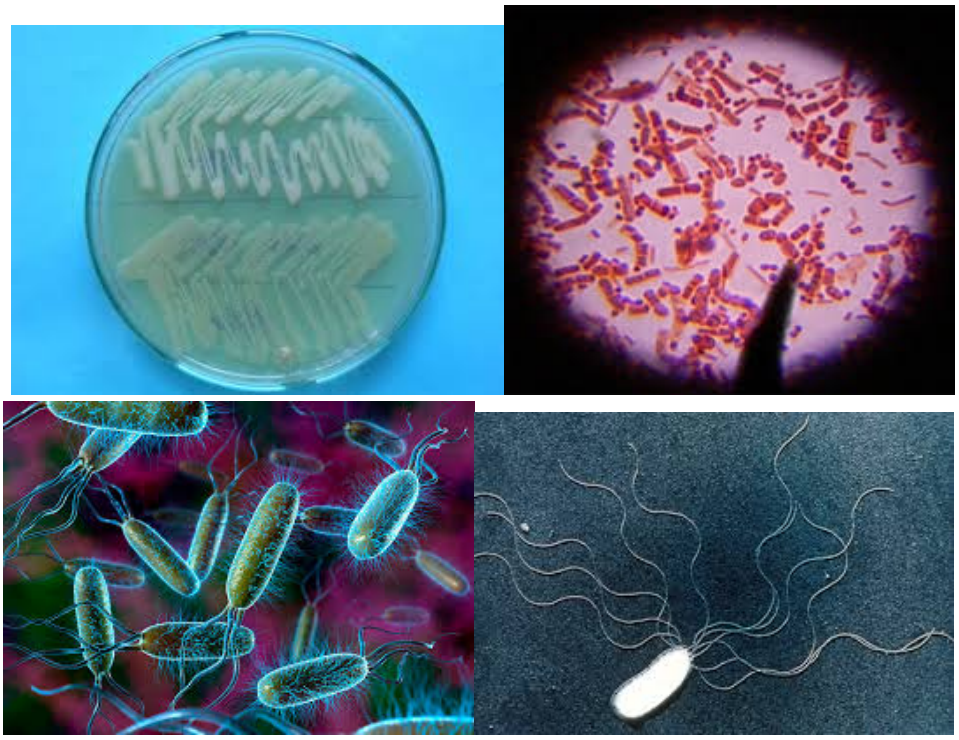
   Coryneforms and staphylococci)the latter coming from the hands of employees during processing.

2. *Staphylococci* are usually unable to proliferate but cross-contamination can introduce them into other foods where growth conditions are more favorable.
3. *Penicillium expansum and Botrytis cinerea* are well-known postharvest pathogens. They produce blue and gray rots, respectively.

Soft rot

a. One of the most common types of bacterial spoilage.

b. caused by *Erwinia carotovora* and sometimes by *Pseudomonas* spp., which grow at 4^{o}C



Because bacteria grow more rapidly, they usually out-compete fungi for readily available substrates in vegetables. As a result, bacteria are of greater consequence in the spoilage of vegetables with intrinsic properties that support bacterial growth (favorable pH).

Mold spoilage

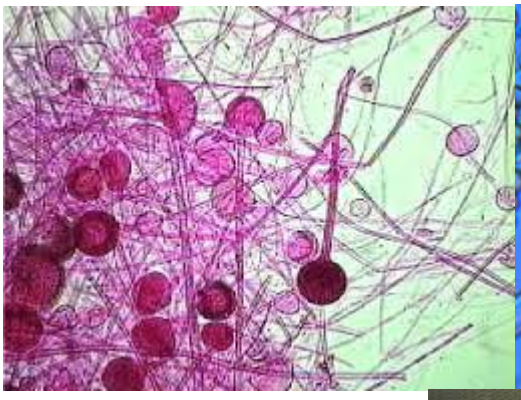
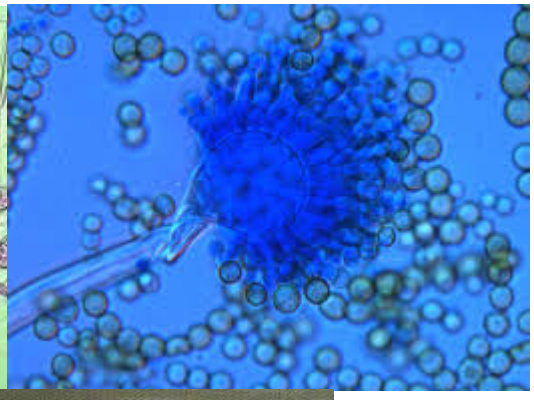
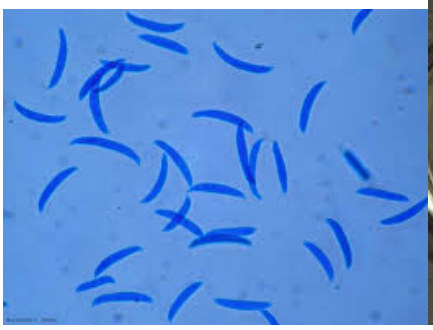
a. In vegetables where bacterial growth is not favored (e.g. low pH), molds are the principal spoilage agents.

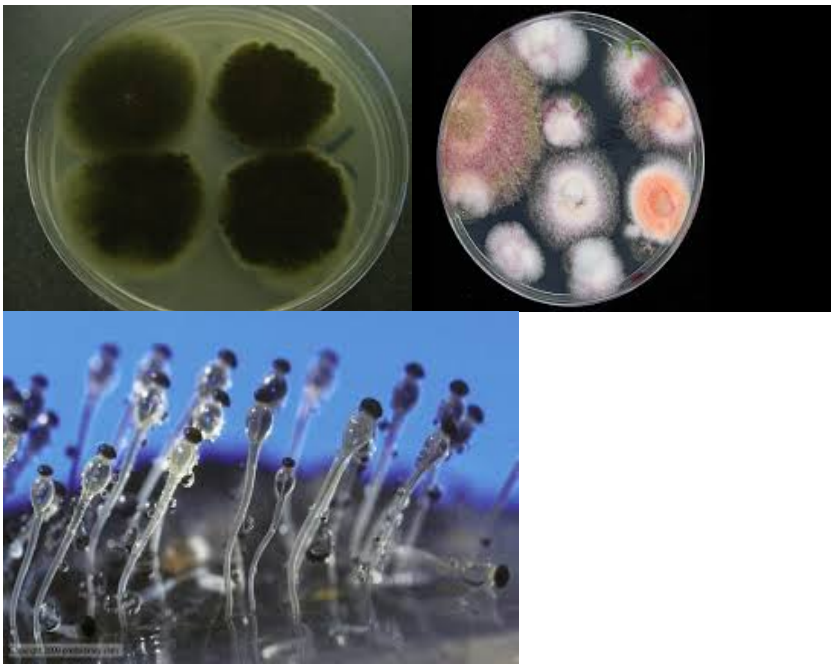
b. Most molds must invade plant tissue through a surface wound such as a bruise or crack.

c. Spores are frequently deposited at these sites by insects like *Drosophila melanogaster*, the common fruit fly.

d. Other molds like *Botrytis cinerea*, which causes grey mold rot on a variety of vegetables, are able to penetrate fruit or vegetable skin on their own.



Sources of Contamination

1. Surface contamination – Soil, water, air, human pathogens from manure (night soil)
2. Harvesting - hand picking vs. machines ,high damage if crop is ripe,harvest before ripe

   Geotrichium candidum – mold on harvest
3. Packaging: containers reused
4. Processing plant
5. Markets – handling, cross-contamination

Fruits spoilage by fallowing organism:

a. Several genera of yeasts can be found on fruit.

b. Because these organisms grow faster than molds, yeast often initiates fruit spoilage.

c. then molds spoilage by degrading complex polysaccharides in cell walls

Specific Spoilage Organisms:

1. Blue rot – *Penicillium,* fruits

2. Downy mildews – *Phytophora*, large masses of mycellium (grapes)
3. Black rot – *Aspergillus,* onions
4. Sour rot – *Geotrichum candidum,*citrus fruits

1.Bacterial soft rot, caused by *Erwinia carotovora* is a plant pathogen belonging to the Family *Enterobacteriaceae. Pseudomonas spp, Clostridium* and *Bacillus* spp, have also been associated with these rots. It results water-soaked appearance, a soft, mushy consistency, and often a bad odor.

2. Gray mold rot: caused by species of Botrytis, eg: *B.cinerea,* which is favored by high humidity and warm temperature.

3. Rhizopus soft rot: caused by species Rhizopus, eg *R.stolonifer*. A rot results that often is soften and mushy. The cottony growth of the mold with small, black dots of sporangia often covers masses of the foods.

4. Alternaria rot, caused by *Alternaria spp* and other species. Areas become greenish-brown early in the growth of the mold and later turn to brown or black spots.

6. Blue mold rot: caused by species of *Penicilfium digitatum* and other species. The bluish-green color that gives the rot its name results from the masses of spores of the mold.

7. Downy mildew, caused by species of *Phytophthora, Bremia*, and other genera. The molds grow in white, woolly masses.

8. Watery soft rot caused chiefly by *Sclerotinia sclerotiorum,* is found mostly in vegetables.

9. Stem-end rots, caused by species of molds of several genera, e.g., *Diplodia, Alternaria, Phomopsis, Fusarium,* and others, involve the stem ends of fruits.

10. Black mold rot, caused by *Aspergillus niger*. The rot gets its name from the dark-brown to black masses of spores of the mold, termed "smut".

11. Black rot, often caused by species of *Alternaria* spp.

12. Pink mold rot, caused by pink-spored *Trichothecium roseum*.

13. Fusarium rots, a variety of types of rots caused by species of *Fusarium.*

14. Green mold rot, caused usually by species of *Cladosporium* but sometimes by other green-spored molds, e.g., *Trichoderma.*

15. Brown rot caused chiefly by Sclerotinia (*Monilinia fructicola*) species.

16. Sliminess or souring, caused by saprophytic bacteria in wet, heating vegetables.

Fungal spoilage of vegetables often results in water-soaked, mushy areas, while fungal rots of fleshy fruits such as apples and peaches frequently show brown or cream-colored areas in which mold mycelia are growing in the tissue below the skin and aerial hyphae and spores may appear later. Some types of fungal spoilage appear as "dry rots," where the infected area is dry and hard and often discolored. Rots of juicy fruits may result in leakage.

The composition of the fruit or vegetable influences likely type of spoilage. Thus, bacterial soft rot is widespread for the most part among the vegetables, which are not very acidic. Because most fruits and vegetables are somewhat acid, are fairly dry at surface. Thus the character of the spoilage will depend the product attacked and the attacking organism.

Fungal Spoilage during storage






SubsistencePatternFoodGarden.blogspot.com

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Botrytis cinerea

Physical causes for vegetable losses:

Vegetables after picking and before processing are “alive”. Physical and chemical changes takes place after harvest and continue during storage periods. Major physiological changes ensuing post harvest period are:

1. **Loss of moisture:** Loss of moisture leads to rapid shriveling and loss of crispness. Plant tissue become eventually inedible, it leads to loss of soluble carbohydrate and reduction in weight. Moisture loss from surface initiates immediately after harvest and continue during storage or transportation period.
2. **Loss of stored energy**: Vegetables are living tissues, respiration that occurs during post harvest period require energy. The stored carbohydrates are degraded for the purpose of energy supply.
3. **Loss of food constituents**: Moisture loss during storage is the major factor responsible for nutrient loss. The most labile nutrients that are lost are vitamins.
4. **Fiber development**: In vegetables such as beans, knolkhole and carrot, pectin degradation takes place as a result of moisture loss. The tissues become hard and fiber development takes place.
5. **Root and shoot development**: Certain vegetables like beans, potatoes and root vegetable develop such parts during storage.
6. **Loss of nutritional important pigments**: Chlorophyll, Carotenoids, Lycopene’s and Xanthophylls are degraded during storage. The extents of loss are proportional to period of storage atmosphere.
7. **Overall Quality**: Owing to the losses described above, the stored vegetables have poor overall quality.

Chemical and enzyme spoilage occurs especially when vegetables and fruit are damaged by falling or breaking. Such damage can release enzymes that trigger chemical reactions. Tomatoes become soft, for example apples and other types of fruit turn brown. The fruit can also become rancid. As soon as the peel of fruit is damaged by falling, crushing, cutting, peeling or cooking, the chance of spoilage increases considerably.

Preservation and preventation:. Enzymes can be deactivated by heating the fruit or vegetables. The same effect can be achieved by making the fruit or vegetables sour or by drying them. The peel of a fruit or vegetable provides natural protection against micro-organisms. To retain the desired quality of a product longer than if it were simply stored after harvesting, it must be preserved. To preserve food it must first be treated, with the goal of stopping physiological aging and enzyme changes and preventing the growth of micro-organisms.

Respiration is a continuing process in a plant and cannot be stopped without damage to the growing plant or harvested produce. It uses stored starch or sugar and stops when reserves of these are exhausted, leading to ageing. Fresh produce continues to lose water after harvest; water loss causes shrinkage and loss of weight. These perishable commodities need very careful handling at every stage.

It is important to minimize mechanical damage by rough handling and bruising during the different steps of pack house operations. Marketing of fruits and vegetables is the major bottleneck, 30 to 40 % will get perished because of poor marketing infrastructure.

Recommended practices for preservation of fruits and vegetables

1. Wash your hands thoroughly with hot water and soap before beginning to prepare food.
2. Make sure that kitchen utensils and appliances are well cleaned and disinfected.
3. Always store food in a clean place.
4. Use herbs and spices as little as possible, because they are an important source of contamination.
5. Use clean and pure salt only if the salt is not pure; heat it on a dry, metal sheet above the fire.
6. Allow only clean drinking water to come in contact with fruits and vegetables.

Conclusion:

All over India people are suffering from nutritional losses and acceptability determination as well due to the drastic methods of processing and preservation. India is the second largest country to produce horticulture food according to Food and Agriculture Organization (FAO) statistics. Many factors contribute to postharvest losses in fresh fruits and vegetables. Post harvest losses can be defined as losses of horticultural commodities in quality and quantity after harvesting till consumption. Fruits and Vegetables are living parts of plant and contain 65 to 95 percent water. The source of microbes includes fecal maters, during transport insect, dust and processing conditions, where in storage temperature acts like a booster. Gram negative bacterial flora causes major spoilage vegetables. They thrive and multiply faster at ambient temperatures and high humidity.

Several essential nutrition are required for human health. Fruits and vegetables are the rich source of vitamins, minerals, antioxidants and fibres. The deficiency of vitamins may lead to many diseases such as scurvy, beriberi, night blindness, etc.

Food spoilage can also caused by the action of enzymes which is chemical in nature presents in the food. They speed up chemical changes that result in loss of flavour, colour and texture. As enzymes are mainly composed of protein, they are sensitive to heat but less active in low temperature. Enzymes again cause browning in certain foods the moment they are exposed to air. When you cut or bruise food such as apple or yam, the exposed surface will discolour and turn brownish due to the activity of enzymes. Some enzymes remain inactive once activated, such

enzymes speed up the process of decay by breaking down the tissues and spoil the food in various ways such as oxidation, browning and ripening.

Oxidation: When oxidation occurs ie when food comes in contact with oxygen, the enzyme cause the destruction of certain nutrients e g.Vitamin.C, thiamine and carotene.

Effective elimination of postharvest losses has been required good knowledge and ideas exchange among farmers, scientists .Maintenance of the physical appearance, flavour, market value is a must for consumers. Several preservation methods like cold storage, modified atmosphere packaging and edible coating has been used for keeping the fruits and vegetables for longer period.

Eating a diet rich in fruits and vegetables as part of an overall healthy diet may reduce risk for stroke, cardiovascular disease, type 2 diabetes and may protect against certain cancers. The potassium in fruits and vegetables may play a key role in reducing the risk of developing kidney stones and may help to decrease bone loss. Eating fruits and vegetables that are low in calories and high in fiber may also help individuals reduce their overall calorie intake to assist with weight loss and support the maintenance of a healthy weight. Fruits such as mango, grapes, banana, litchi, sapota, pomegranate and vegetables like onion, potato, and green vegetables have good export market potential. Growers will not have proper infrastructure facilities for handling or storage of produce in growing areas. Minimization of postharvest losses from harvest to consumer table depends upon the several factrus,ie biological, environmental aspects and use of appropriate postharvest technology. It will reduce losses due to spoilage; add value to the fresh fruits and vegetables.