Basics of Postharvest Handling for Fresh Produce

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Outline

- What postharvest means and why it is important
- Characteristic of fresh produce
- Causes of postharvest loss/ways to reduce losses
- Tips you could follow during the different stages
  - Harvest
  - Packaging
  - Storage
  - Transportation

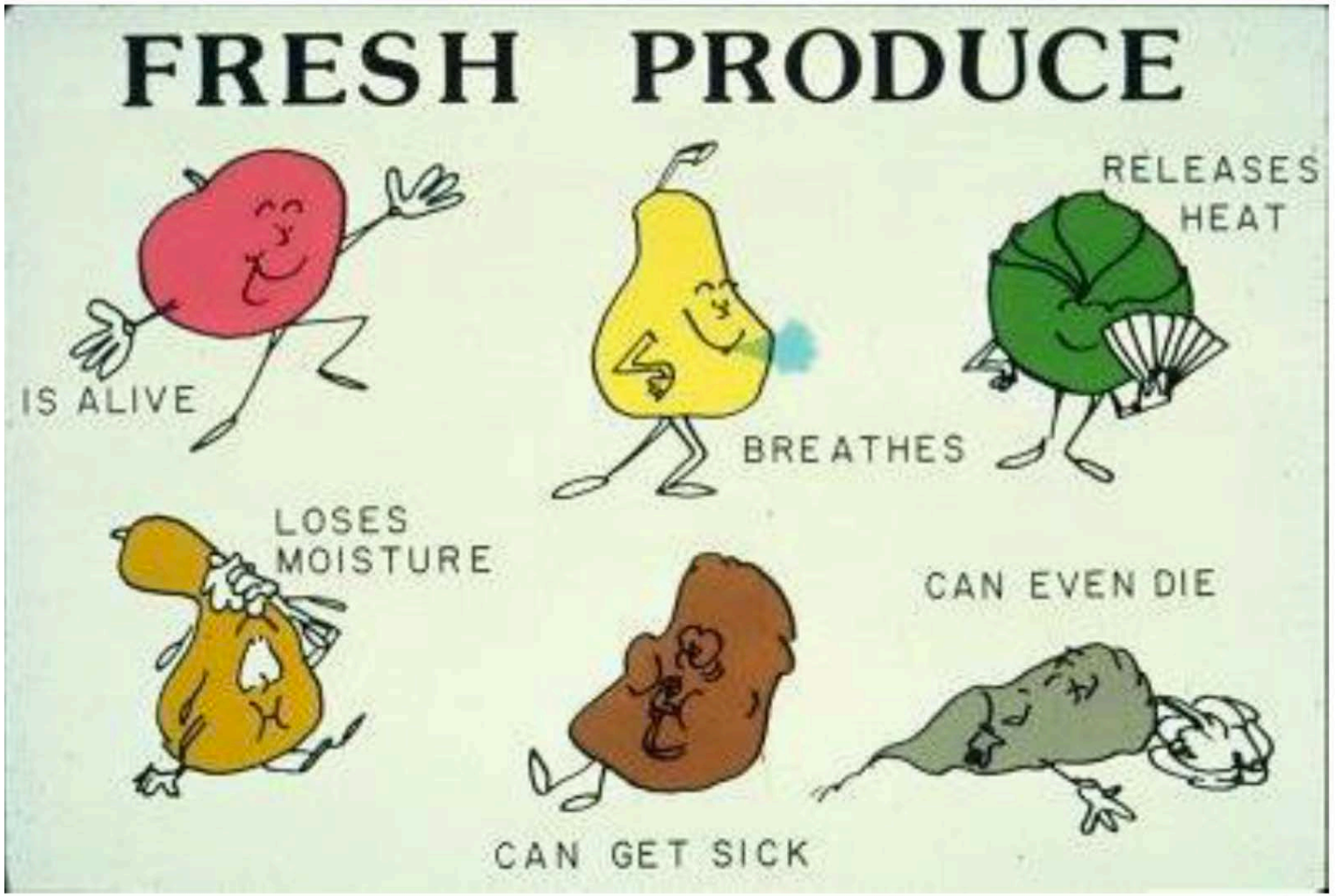
What postharvest means?

- A pragmatic (practical) science
- Primarily deals with perishable commodities
- By definition:
  Postharvest = After Harvest

What postharvest means?

- Also concerned with:
  - Pre-harvest factors because they strongly influence postharvest quality (**quality is set during growth)**
  - Harvest of the crop (e.g., when & how to harvest; maturity standards)
- **Ultimately, maximum product quality is determined at harvest**

Are the fruits and vegetables alive after harvest?



Characteristics of Perishable Commodities

- Living tissues
- High in water content
- Subject to pathological breakdown
- Very diverse in:
  - Morphological structure
  - Composition
  - General physiology

Name the part!

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Answer:

- **Onions** are modified leaves
- **Lettuce** are really leaves too!
- **Broccoli** is a stalk and immature flower
- **Peach** is a fruit
- **Peas** are seeds

What factors influence postharvest loss?

Internal factors

- Metabolic rate (respiration)
- Compositional changes
- Morphological changes
- Physiological disorders
- General senescence

Environmental factors

- Changes in temperature
- Physical damage
- Pathogens
- Humidity
- Rodents
- Contamination

Fresh Commodities Are Still ALIVE!

- They carry out respiration:

Sugar + O_2 ⇨ CO_2 + Water + Energy + Heat

(ATP)

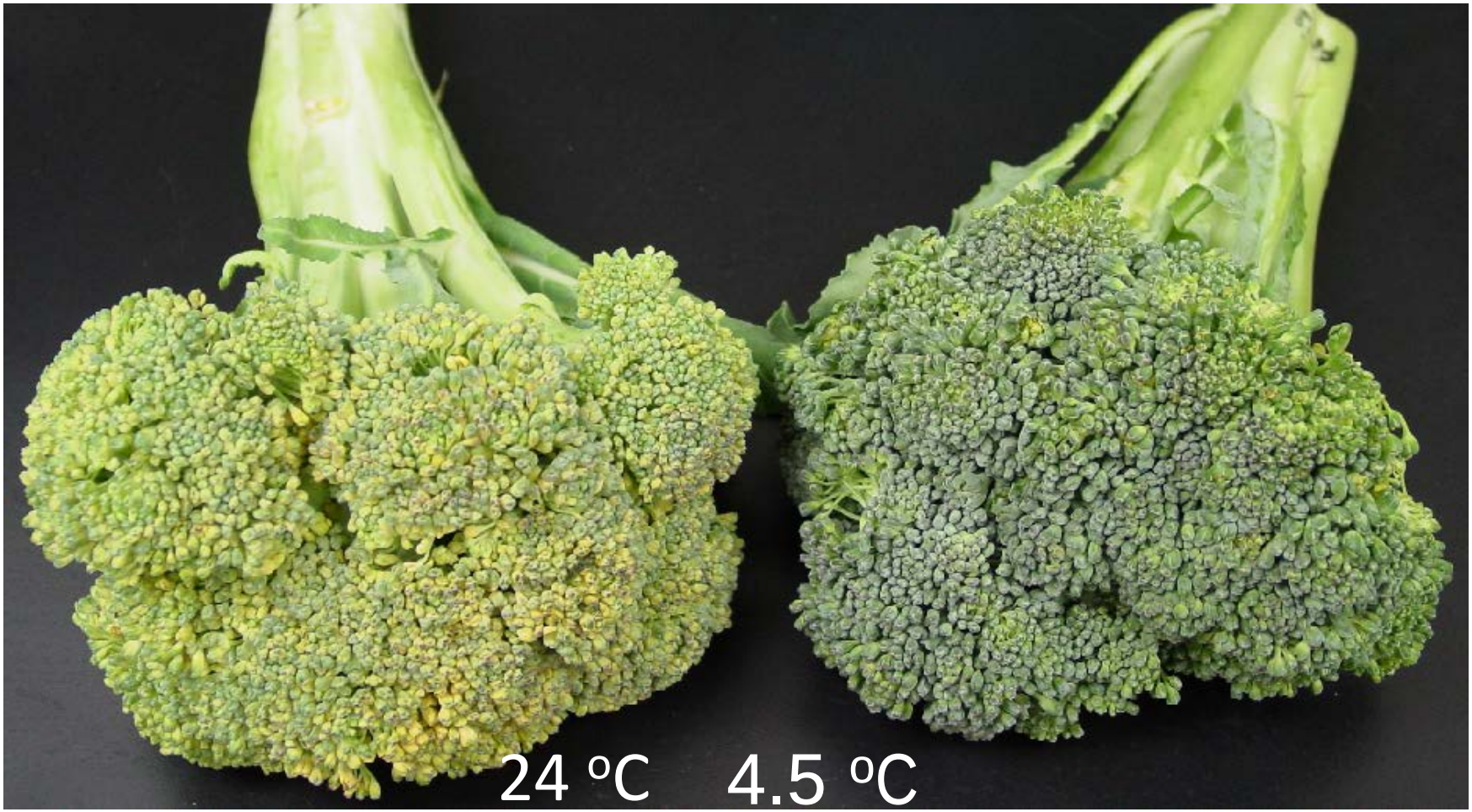
HARVESTED PRODUCE ARE LIVING SYSTEMS THAT "AGE"

GOAL: slow down the aging process!

Temperature

- Temperature is the most important factor influencing the postharvest life of a given commodity
  - Dictates the speed of chemical reactions (including respiration)

- Typically, for every 18 ^{o}F (10 ^{o}C) increase, respiration increases between 2 and 4 fold



Effect of temperature on the quality of broccoli after just 48 h of storage at either room temperature (24 °C) or in the refrigerator (4.5 °C)

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Cooling down the produce

- Air cooling
  - Room
  - Forced-air
- Hydrocooling
- Ice Cooling
  - Top icing
  - Liquid ice
- Vacuum Cooling

Maintaining the Cold Chain for Perishables

Harvest

- Protect the product from the sun
- Transport quickly to the packinghouse

Cooling

- Minimize delays before cooling
- Cool the product thoroughly as soon as possible

Temporary Storage

- Store the product at optimum temperature
- Practice first in first out rotation
- Ship to market as soon as possible

Transport to Market

- Use refrigerated loading area
- Cool truck before loading
- Load pallets towards the center of the truck
- Put insulating plastic strips inside door of reefer if truck makes multiple stops
- Avoid delays during transport
- Monitor product temperature during transport

Handling at destination

- Use a refrigerated unloading area
- Measure product temperature
- Move product quickly to the proper storage area
- Transport to retail markets or foodservice operations in refrigerated trucks
- Display at proper temperature range

Handling at home or foodservice outlet

- Store product at proper temperature
- Use the product as soon as possible

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Water Loss

- Besides resulting in direct loss of salable weight, it is also an important source of quality loss
  - Appearance quality - wilting, shriveling, accelerated development of injury symptoms
  - Textural quality – loss of crispness, juiciness, etc.
  - Nutritional quality – e.g., vitamins A & C

% Water loss that results in unmarketable product

- Asparagus 8%
- Cabbage 7%
- Celery 5%
- Lettuce 3%
- Spinach 3%

Wilting

How we prevent water loss

- Control relative humidity
- Lower temperature
- Reduce air movement
- Protective packaging

Reducing Water Loss

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Atmospheric Composition Modified or Controlled Atmospheres

- Modified Atmospheres (MA)
  - Altering the normal gas composition surrounding a commodity (e.g., lowering O_2 and/or raising CO_2 concentrations)
  - The commodity is placed in a gas impermeable container (flushed or not = "active" or "passive" MA) and the crop's respiration consumes (lowers) O_2 and gives off (increases) CO_2
- Controlled Atmospheres (CA)
  - Same as MA, except gas concentrations are actively regulated using special equipment

The Commodity & Its Environment

- Oxygen
- Carbon Dioxide
- Humidity
- Ethylene
- Heat

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Morphological Changes (Form & Structure)

- Because horticultural commodities are living (and sometimes still growing) they often continue development in ways that sometimes detract in quality
- Changes include:
  - Sprouting (onions, tubers, root crops)
  - Rooting (onions, root crops)
  - Elongation & Curvature (asparagus, gladiolus)
  - Seed Germination (tomato, pepper, grapefruit)

Sprouting

Geotropic Curvature of Asparagus

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Physiological Disorders

Blossom end rot of tomato.

- Temperature
  - Heat, freezing, or chilling injury
- Altered atmospheric gas concentrations
  - Low O_2 or elevated CO_2
  - Ethylene
- Nutrition
  - e.g., calcium deficiency or

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Photos courtesy of Steve Sargent

45 degrees:
snap beans, eggplant, cucumbers, melons, peppers

50 degrees:
pumpkins, hard squashes

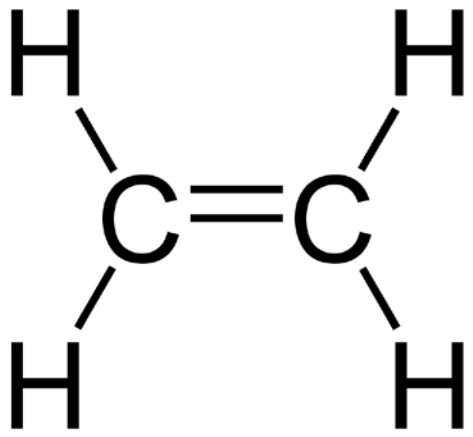
Chilling Injury of Tomatoes

45-50 degrees: ripe tomatoes

55 degrees: mature green tomatoes

Ethylene production

- Regulates growth and development
- Rate different for each commodity
- Slow by **lowering temperature**
- Can be good
- Can damage



Ethylene sensitive

- Leafy Greens
- Flowers
- Herbs
- Root Vegetables
- Watermelon

Russet spotting  (ethylene)

Physical Damage

- Causes the greatest amount of loss to fresh horticultural products
- Affects (among other things):
  - Water loss
  - Respiration, ethylene production, ripening, and other metabolic processes
  - Pathogen growth and ability to invade tissue
  - Tissue discoloration

Pepper Physical Injuries

Photos courtesy of
Steve Sargent

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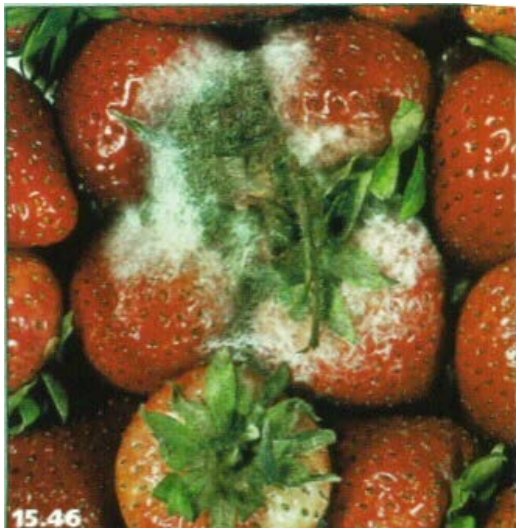
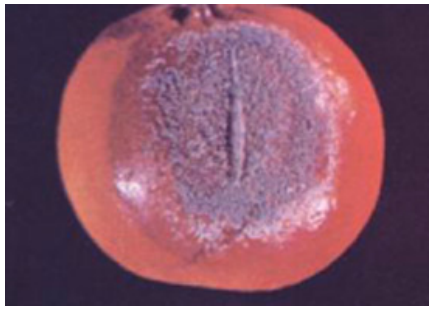
Melon Internal Bruising

Photos courtesy of Steve Sargent

Pathology (decay)



- Fungi, bacteria and viruses
- Preharvest (latent) and postharvest infections
- Most postharvest infections are a result of breaks in the epidermis of the commodity



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Harvest

- Pick early in AM
- Shade
- Keep moist
- Air circulation
- Mature
- Gentle & sanitary picking
- Discard damaged product
- Pick clean some crops

Field packing & packinghouse operation

- Remove soil
- Trim
- Pack

Field packing & packinghouse operation

Transportation to/from the field

- Don’t overfill containers
- Grade roads
  - Identify and select the proper maturity
  - Remove unmarketable produce as soon as possible
- Shade vehicle

The Pack ‘N Cool mobile refrigerated unit, developed by Dr. Parkins Veazie at N.C State University

Storage and Transportation

- Pre-cool produce
- Pre-cool vehicle
- Record produce temperature
- Leave space for air to flow over the top of the produce
- Avoid lording boxes tightly against the walls
- Allow at list 4 inches of space between the end of the load and the near doors for return air

Keys To Success In Postharvest Handling Of Fruits and Vegetables

1. Highest Initial Quality/Proper Maturity
2. Careful Handling to Minimize Physical Damage
3. Management of Environmental Conditions:
   - **Temperature**
   - Relative Humidity
   - Atmospheric Composition (O_2, CO_2, C_2H_4)
   - Ventilation
4. Proper Sanitation Procedures

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Thank you all for your attention

QUESTIONS ?

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