Fresh Produce Quality Parameters

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Quality

- The degree of excellence or superiority
- Any of the features that make something what it is

Quality may be Defined Differently

- Producers
  - Good appearance and few defects, high yield, disease resistance, ease of harvest
- Receivers and Marketers
  - Appearance quality is most important, also firmness and long storage life
- Consumers
  - Good appearance, firm, good flavor and nutritional value, safety

Quality Factors for Fresh Horticultural Crops

- Appearance – visual
- Texture – feel
- Flavor – taste and smell
- Aroma
- Nutritional value

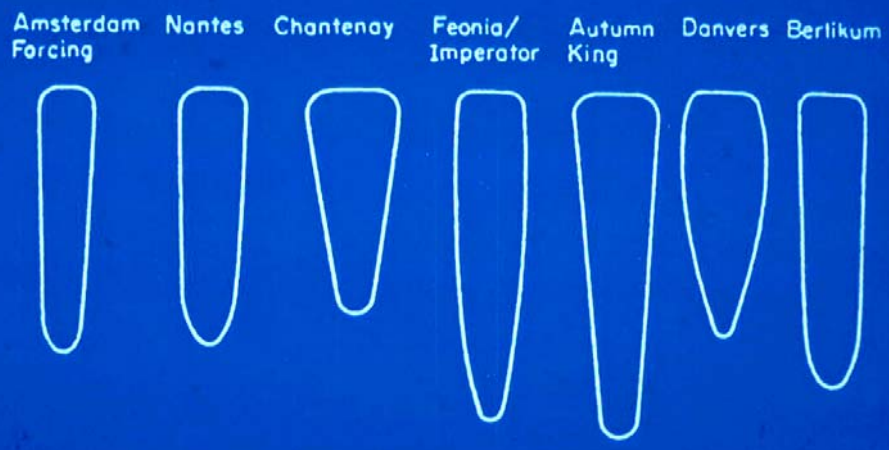
Appearance – Visual

- Size
- Shape and Form
  - Ratio of diameter to depth
  - Smoothness
  - Compactness
- Gloss
  - wax

If picked at the same maturity, is there a relationship between cantaloupe size and flavor?

Is there a relationship between shape and other quality attributes?

Shape of Various Cultivars of Carrot

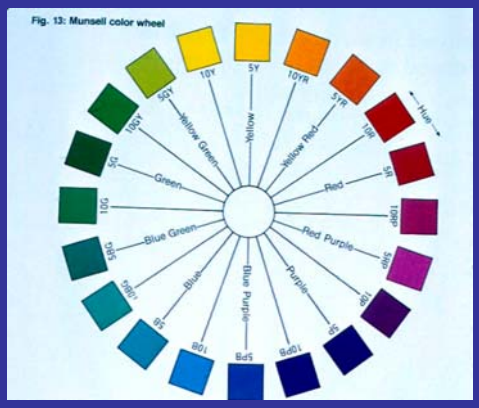


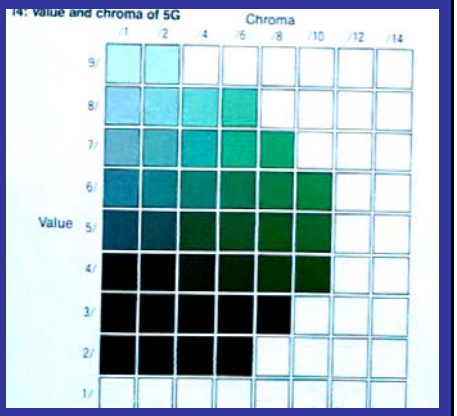
Color Measurement

- Visual assessment
- Matching of colors
  - Color charts or models
- Optical instrumentation
  - Light reflected or transmitted by commodity
- Chemical analysis for pigment content

COLOR

Hue: red, purple, blue, green, yellow
Chroma: intensity of color
Value (L): Light to dark





Minolta Colorimeter for measuring color hue, chroma, and value

Appearance - Visual

- Defects – external or internal
  - – Morphological
    - Sprouting, rooting, floret opening
  - – Physical & mechanical
    - Shriveling, bruising
  - – Physiological
    - Blossom end rot of tomato, bitter pit of apple
  - – Pathological
    - Fungi, bacteria, viruses
  - – Entomological
    - Insects caused damage

Examples of Defects that Do Not Influence Postharvest Life Potential of Fresh Produce

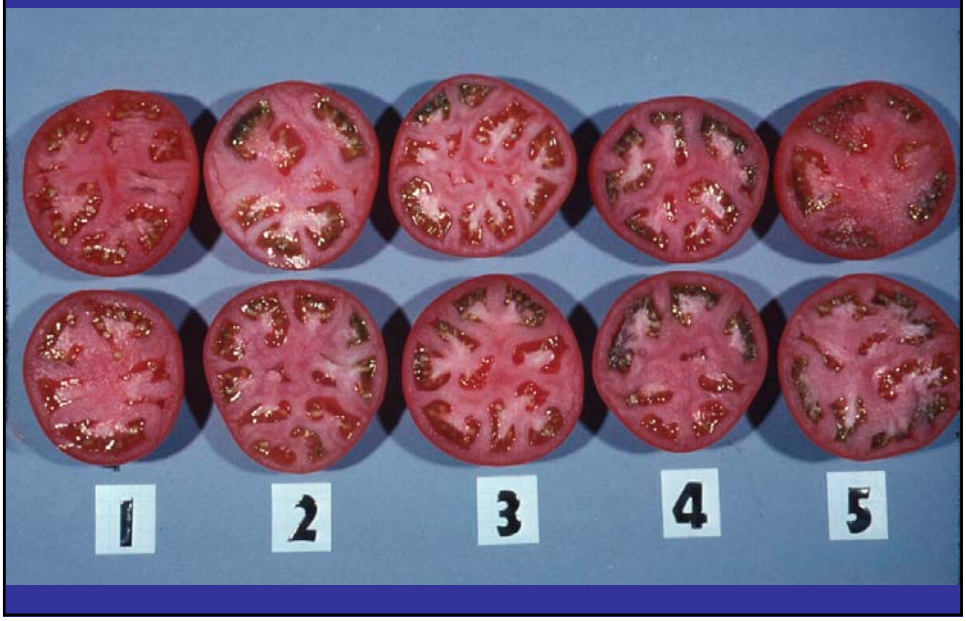
- Healed frost damage
- Healed scars and scabs
- Well healed insect stings
- Irregular shape
- Suboptimal color uniformity and intensity

Healed scars on nectarine

Examples of Defects that Reduce Postharvest Life Potential of Fresh Produce

- Softening
- Sunburn & sunscald
- Bruising
- Cracks
- Sprouting
- Chilling injury
- Insect injury
- Scald
- Decay
- Cuts, abrasions & skin breaks

Rating scale for tomato bruising



Serious defects of potatoes

Scoring System for Visual Quality

SCORE	DESCRIPTION
9	EXCELLENT: Field fresh, no defects
7	GOOD: Defects minor
5	FAIR: Defects moderate, limit of salability
3	POOR: Defects serious, limit of usability
1	VERY POOR: Non-usable under usual conditions

Texture - Feel

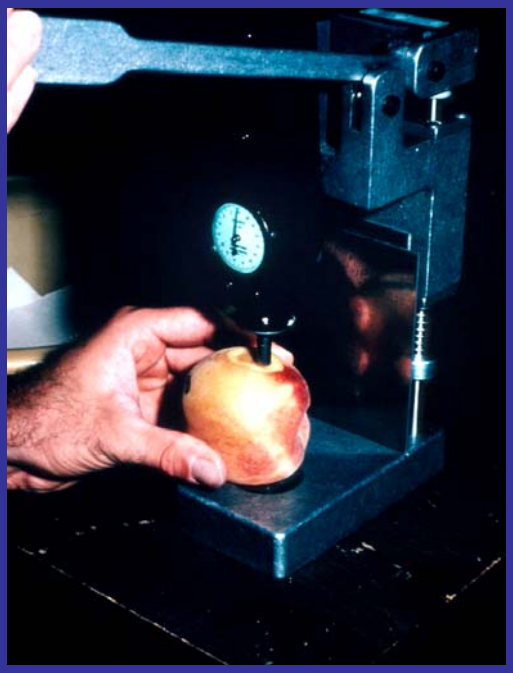
- Firmness
  - Hardness, softness
- Crispness
- Succulence, juiciness
- Mealiness, grittiness
- Toughness, fibrousness

Texture Measurement

- Firmness or softness
  - Puncture (various sized tips)
    - Magness-Taylor pressure tester; Effegi penetrometer
    - May be mounted in a stand or automated
  - Compression or Deformation
    - FirmTech, Instron
  - Acoustic measurement (non-destructive)

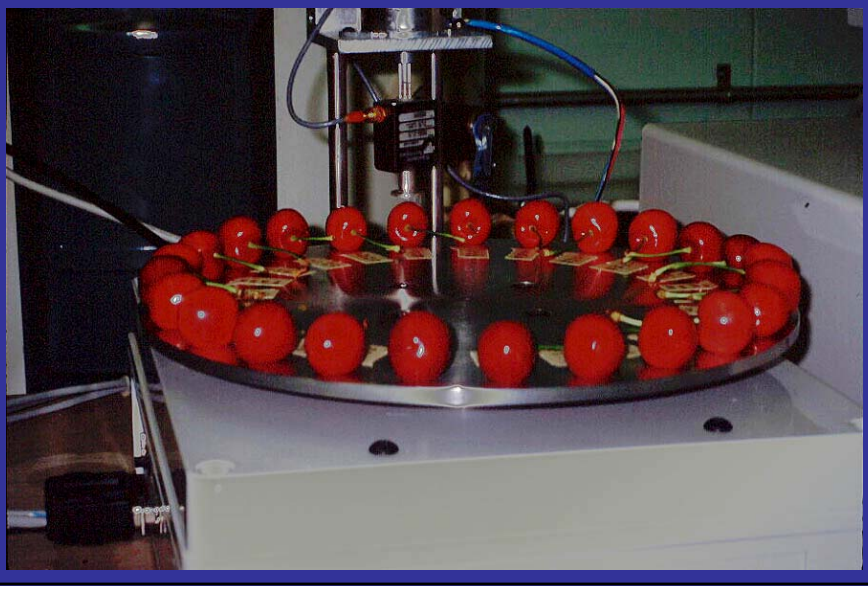
Texture Measurement

- Fibrousness or toughness
  - Shear force
  - Resistance to cutting (Fibrometer)
  - Chemical analysis of fiber or lignin content
- Succulence and juiciness
  - Water content or extractable juice
- Sensory textural quality
  - Grittiness, crispness, mealiness, chewiness, oiliness



Drill Stand Mounted Penetrometer

FirmTech1 Firmness Tester



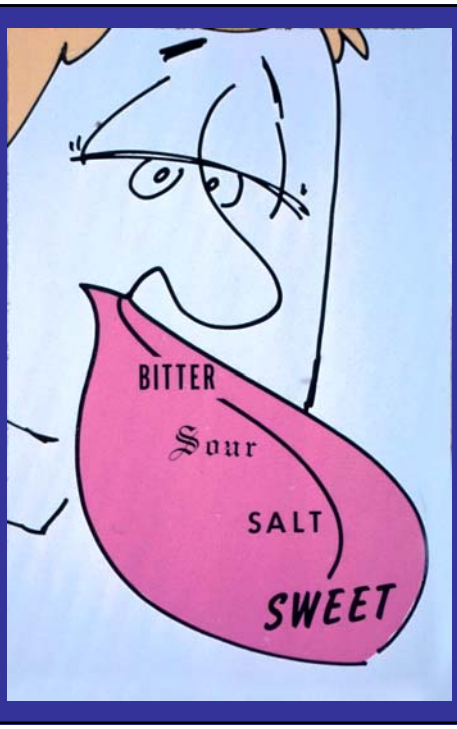
Sensory Characteristics of Textural Quality

- *Firmness*
- *Hardness*
- *Softness*
- *Juiciness, succulence*
- *Turgidity, flaccidity*
- *Chewiness*
- *Crispness*
- *Fiberousness, toughness*
- *Mealiness, grittiness*
- *Oiliness*

Flavor – Taste and Smell

- *Sweetness*
- *Sourness – acidity*
- *Astringency*
- *Bitterness*
- *Aroma – volatile compounds*
- *Off-flavors*
- *Off-odors*

Taste



Composition vs Flavor

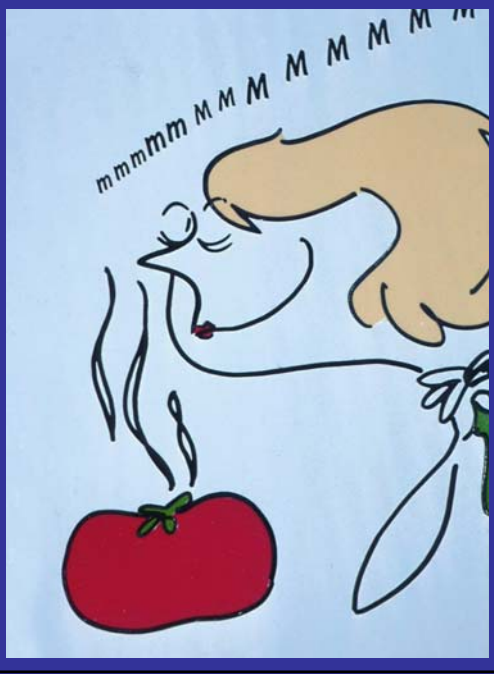
Flavor attribute	Constituents
Sweetness	Sugars
Sourness	Acids
Astringency	Tannins
Bitterness	Isocoumarins
Aroma	Odor-active volatiles
Off-flavors	Acetaldehyde, ethanol, ethyl acetate
Off-odors	Sulfurous compounds

Measurement of Total Soluble Solids by Refractometer

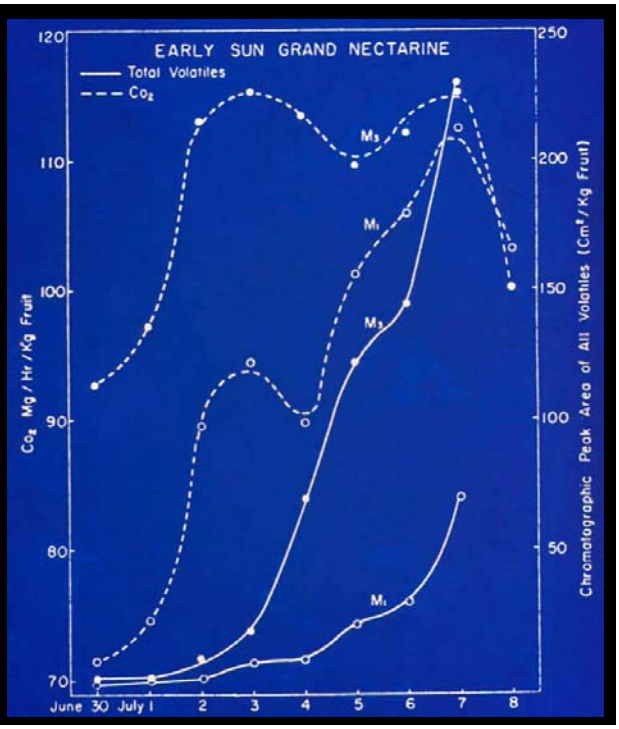
Flavor vs Sugar/Acid Ratio

Acids	Sugars	
	Low	High
Low	Insipid, tasteless	Sweet
High	Sour, tart	Best flavor combination

Aroma

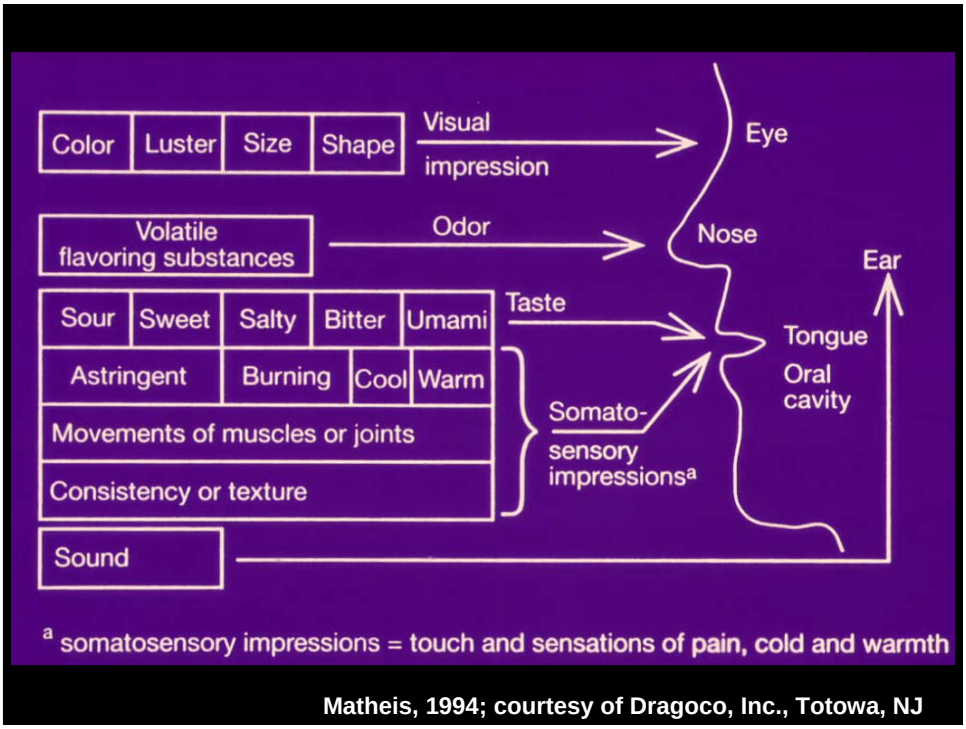


Nectarines picked partially-ripe (M3) produce more total aroma volatiles than those picked mature-green (M1)



Sensory Evaluation of Product Quality

Consumer Taste Test



Matheis, 1994; courtesy of Dragoco, Inc., Totowa, NJ

Nutritive Value

- Carbohydrates
  - Including dietary fiber
- Proteins
- Lipids
- Vitamins
- Minerals
- Phytonutrients
  - antioxidants

Potential Health Benefits of Fruits and Vegetables

Constituents	Impacted Human Diseases
• Antioxidants – Vitamins A, C & E – Flavonoids	• Cancer, cataracts, heart disease, stroke
• Fiber	• Diabetes, heart disease
• Folate	• Birth defects, cancer, heart disease
• Potassium	• Hypertension, stroke

Quality of Fresh-Cut Fruits and Vegetables

Components of Quality

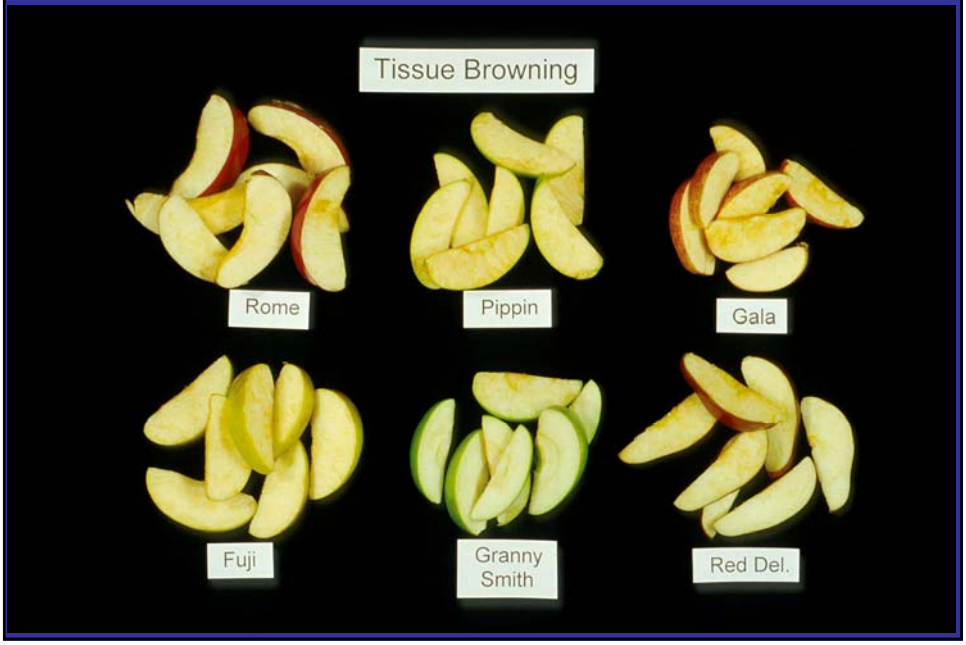
- *Visual appearance: freshness, color, absence of defects and decay*
- *Texture: tissue integrity, turgidity, crispness, firmness, toughness*
- *Flavor: taste, smell (aroma, odor)*
- *Nutritive value: vitamins A & C, minerals, dietary fiber*

Quality of Fresh-Cut Fruits and Vegetables

Factors Influencing Composition and Quality of Intact Commodities

- ***Genetic factors:***
  Intercultivar differences in composition, browning potential, and postharvest-life
- ***Preharvest factors:***
  Climate conditions (temperature, light, rainfall, pollutants)
  Cultural practices (fertilization, irrigation, crop load, pest management
- ***Harvesting stage and method:***
  Optimum maturity stage in relation to quality and postharvest-life, degree of mechanical injuries

Intercultivar Differences in Browning Potential



Quality of Fresh-Cut Fruits and Vegetables

Maintaining Quality Between Harvest and Preparation By:

- *Care in handling (minimizing mechanical injuries)*
- *Rapid cooling to optimum temperature*
- *Maintenance of optimum temperature and relative humidity*
- *Exclusion of ethylene from ethylene-sensitive commodities*
- *Ripening of fruits picked mature-green or partially-ripe*

Quality of Fresh-Cut Fruits and Vegetables

Influence of Preparation Procedures

1. *Cleaning with chlorinated (100-150ppm) water to remove contaminants and reduce microbial load*
2. *Cutting increases rates of respiration, ethylene production, browning, water loss, and overall deterioration*
   - *Sharp blades → less injury*
   - *Greater wounding → faster deterioration*
3. *Washing the cut product removes tissue exudate, which can favor microbial growth*

Quality of Fresh-Cut Fruits and Vegetables

Influence of Preparation Procedures (cont'd)

4. *Uniformity (presence of off-size pieces and/or inedible tissues*
5. *Packaging to reduce water loss and tissue browning*
   Improper packaging ⟶ restricted gas diffusion ⟶ fermentative metabolism ⟶ off-odors
6. *Sanitation procedures to minimize microbial contamination*

Quality of Fresh-Cut Fruits and Vegetables

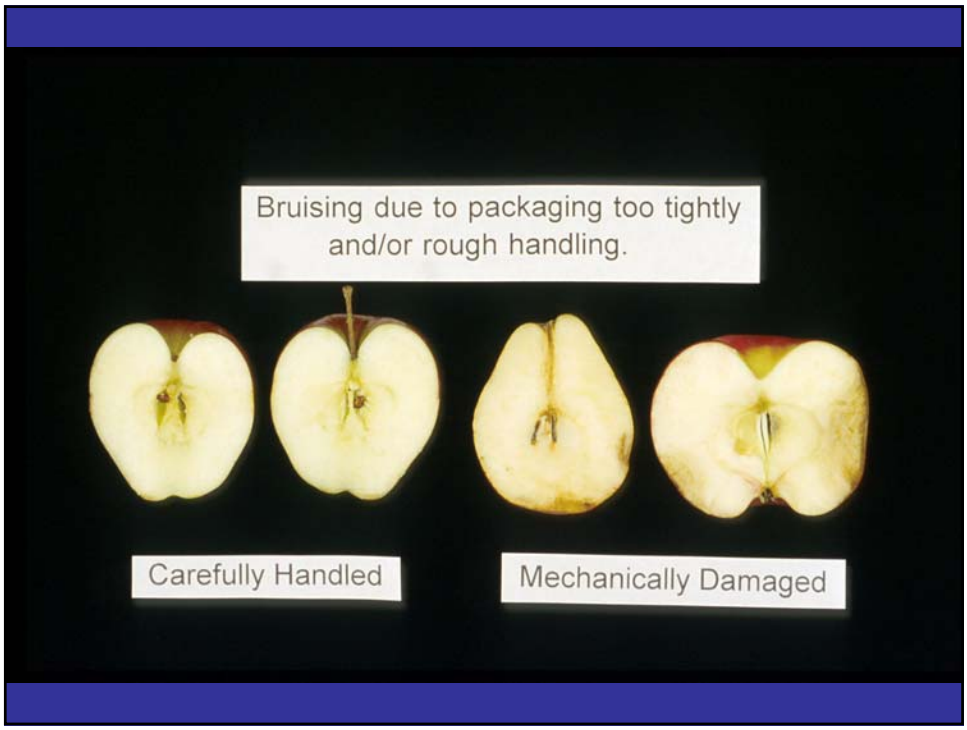
Post-preparation Factors

- *Cooling to optimum temperature (0°C = 32°F for most products).*
- *Maintaining optimum temperature and relative humidity (95-98%) during post-preparation handling all the way to the retail display cabinet.*
- *Expedited handling and marketing. Dating is highly desirable (prepartion date, sell by date, or best if used by date).*

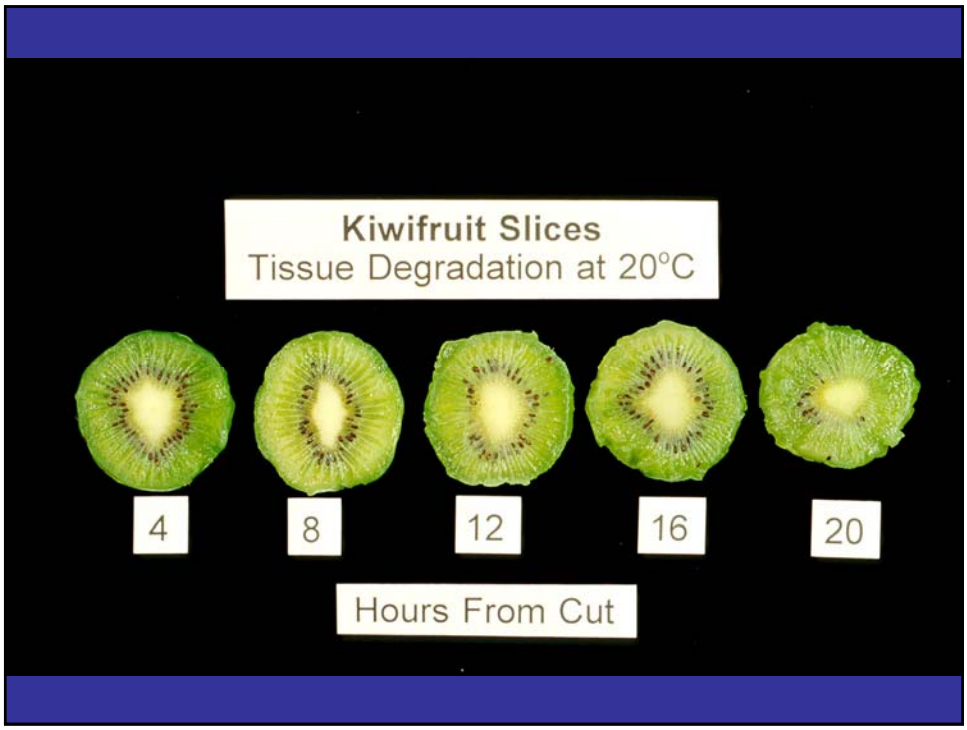
Quality of Fresh-Cut Fruits and Vegetables

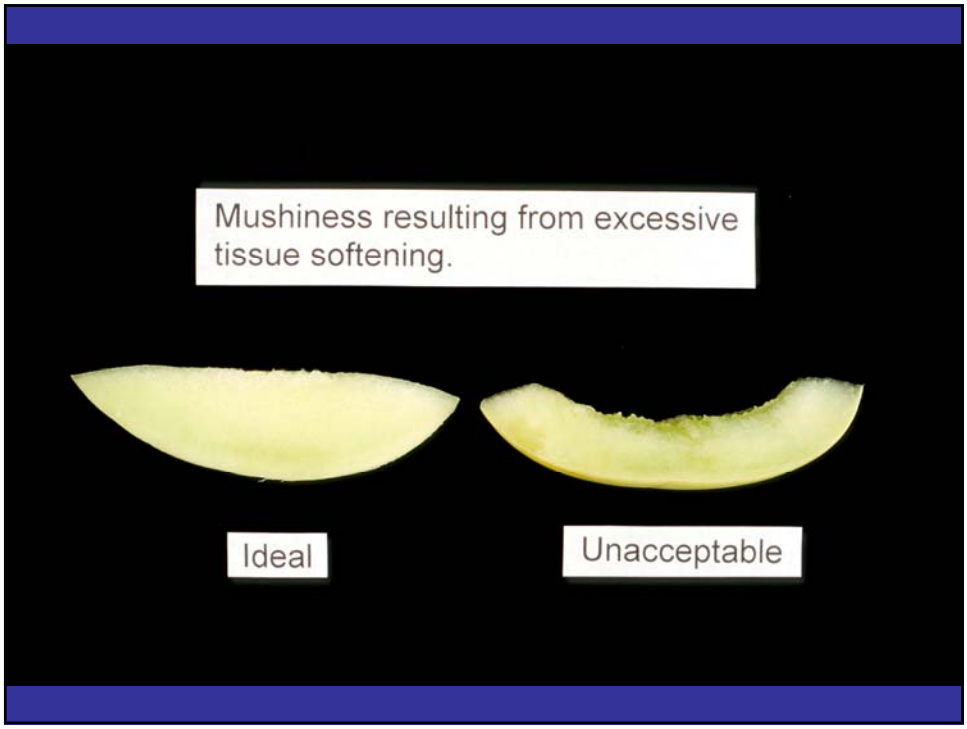
Signs of Deterioration

1. *Bruised or broken pieces due to rough handling*
2. *Wilting, wrinkling, shriveling, flabbiness, flaccidity, and other symptoms of water loss*
3. *Mushiness (excessive tissue softening)*
4. *Discoloration (yellow, red, tan, brown, or black) due to senescence, enzymatic browning, and/or physiological disorders*

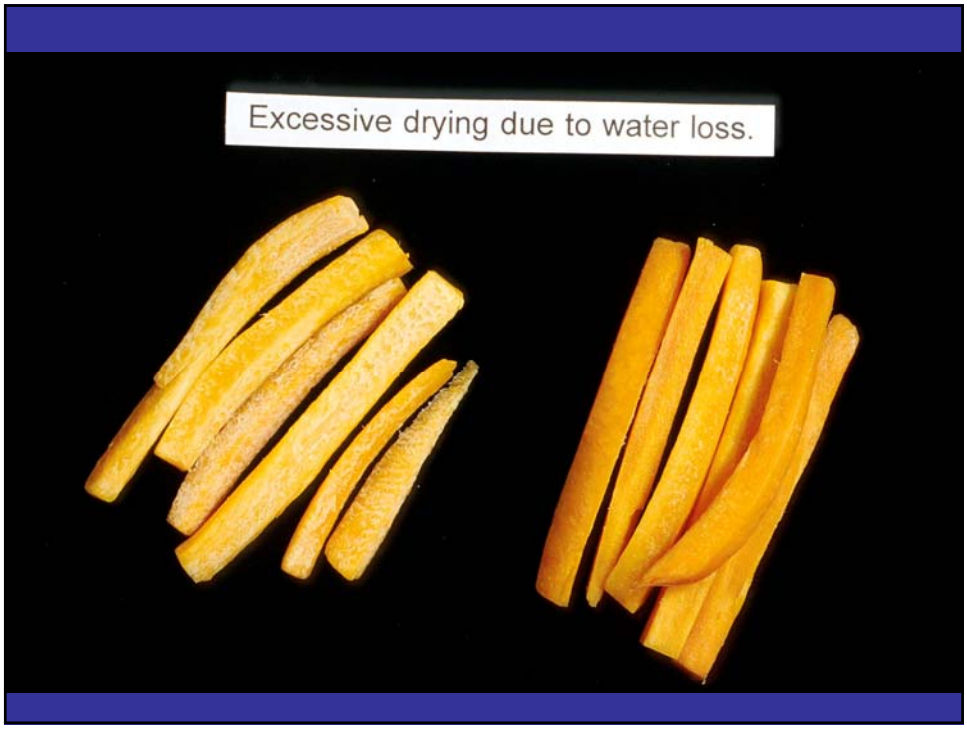



Bruising due to packaging too tightly and/or rough handling.
Carefully Handled
Mechanically Damaged


Kiwifruit Slices
Tissue Degradation at 20°C
4
8
12
16
20
Hours From Cut


Mushiness resulting from excessive tissue softening.
Ideal
Unacceptable


Flacidity due to water loss.



Quality of Fresh-Cut Fruits and Vegetables

Signs of Deterioration (cont'd)

5. *Presence of free liquid within package*
6. *Undesirable odors*
   - *a. fermented aroma due to ethanol, acetaldehyde, and/or ethyl acetate accumulation*
   - *b. Foul odor due to bacteria*
   - *c. Musty and moldy smell due to fungi*
7. *Bloated bags due to excess carbon dioxide from fermenting product*

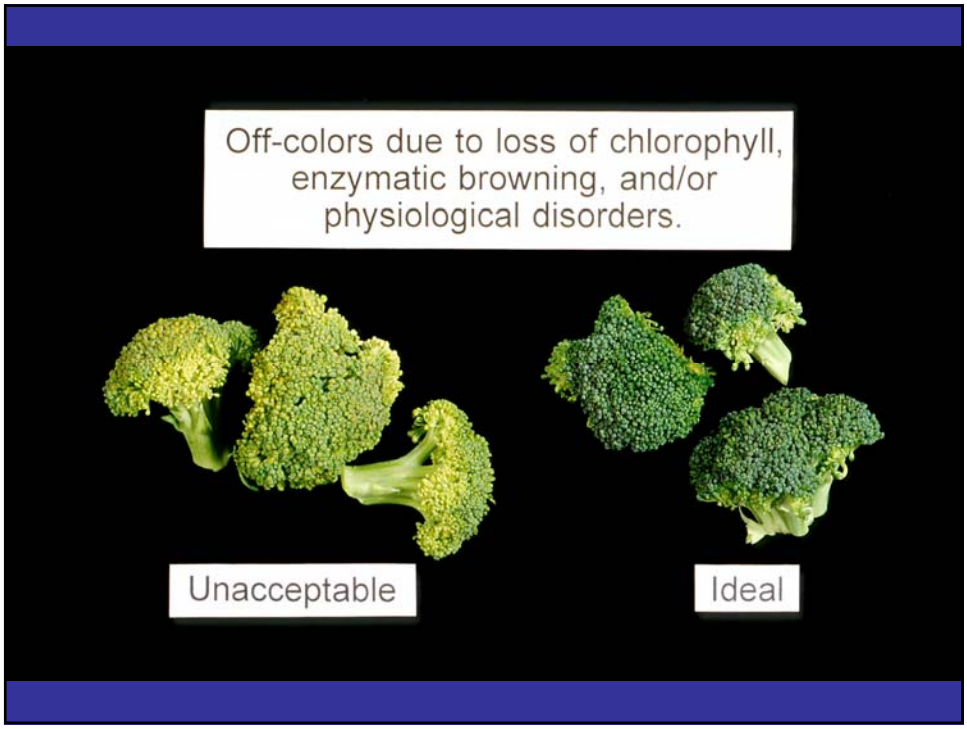

Presence of free liquid within packages due to decay.
Unacceptable
Ideal


ReadyPac
EUROPEAN
Ready Pac
NO PRESERVATIVES
ALL AMERICAN SALAD
Ideal
Unacceptable

Bloated bags due to excess gas in sealed bags resulting from fermenting or decaying product

Ideal ***Unacceptable***

Undesirable Odors

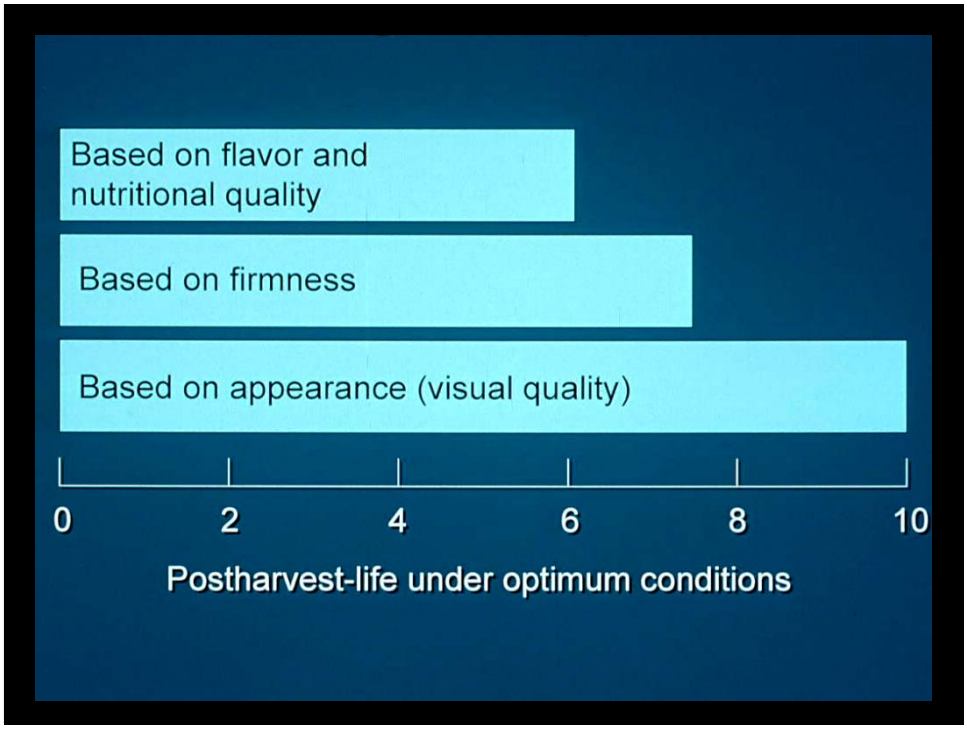

Off-colors due to loss of chlorophyll, enzymatic browning, and/or physiological disorders.
Unacceptable
Ideal


Mushiness resulting from excessive tissue softening.
Ideal
Unacceptable

Quality of Fresh-Cut Fruits and Vegetables

Depends Upon

- *Quality of the intact commodity at harvest*
- *Maintaining quality until preparation*
- *Ripeness stage of fruits consumed ripe*
- *Method of preparation*
- *Subsequent handling procedures*
- *Time between harvest and consumption*



Quality of Fresh-Cut Fruits and Vegetables

Standardization and Inspection

- ***There are no U.S. grade standards for fresh-cut products***
- ***The following booklet provides guidelines and definitions for inspection:***

USDA. 1994. Fresh-cut produce: shipping point and market inspection instructions. Fresh products branch, Fruit & Vegetable Division, Agricultural Marketing Service, U.S. Department of Agriculture, Washington, D.C.