




# Maturity and Quality Standards

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# QUALITY

- **Quality** is defined as “...degree of excellence, relative nature, attribute, trait, or faculty” (Oxford Dictionary)
- **Grade standards** for perishable products provide objective criteria for marketing fruits & vegetables
  - They provide a common language for the marketing chain, allowing accurate reporting of prices and supplies and assisting in the settlement of claims



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## I. Components of Quality

- Quality attributes of perishable commodities:
  - Appearance
  - Kinesthetic (feel)
  - Flavor (taste and aroma)
  - Nutritional
  - Safety



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## I. Components of Quality

- **Appearance** quality
  - Size: dimensions, weight, volume
  - Shape: diameter, length, compactness, uniformity
  - Color: hue, intensity, uniformity
  - Gloss: wax of cuticle, “bloom”
  - Defects: external, internal



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## I. Components of Quality

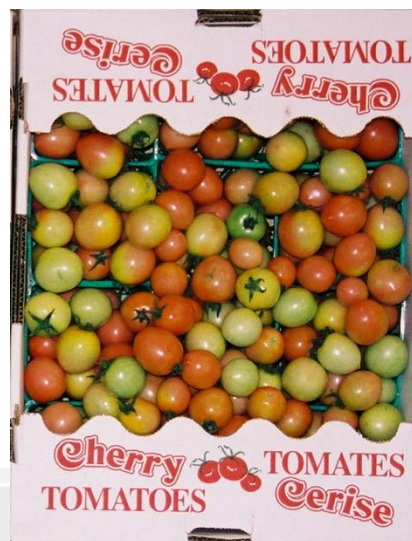
- **Defects:** May have little or nothing to do with eating quality
- In a competitive marketplace, however, premium prices are reserved for produce that is free from blemishes



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## I. Components of Quality

- **Defects: External**
  - **Morphological**
    - Sprouting
    - Rooting
    - Elongation
    - Curvature
    - Seed germination in fruits
    - Doubles, split pits
    - Floret opening



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## I. Components of Quality

- Defects: External

- **Physical**

- Shriveling and wilting
    - Internal drying
    - Mechanical damage:
      - punctures, cuts and deep scratches, splits and crushing, skin abrasions, scuffing, deformation (compression), bruising
    - Growth cracks: radial, concentric



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## I. Components of Quality

- Defects: External

- **Physiological**

- Temperature-related disorders: freezing, chilling, sunburn, sunscald
    - Puffiness
    - Nutrition-related disorders, blossom-end rot, bitter pit, cork spot, tipburn, internal breakdown, water core, black heart



- **Pathological**

- Decay caused by fungi and bacteria
    - Virus and mycoplasma-related disorders, blemishes, irregular ripening, and other disorders



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## I. Components of Quality

- Defects: External

- Other defects

- Insect damage
    - Hail damage
    - Bird damage
    - Chemical injury



- Scars, scabs and other blemishes (russetting, staining, *etc.*)



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## I. Components of Quality

- Kinesthetic quality (feel)

- External smoothness or roughness

- Internal texture

- Firmness, fibrousness, toughness, succulence/juiciness, grittiness, woodiness, mealiness, *etc.*
    - Instruments: “pressure” testers & penetrometers, deformation testers, Instron machine



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## I. Components of Quality

- **Flavor quality** (taste and aroma)
  - Sweetness, sourness, saltiness, bitterness, astringency
  - Aroma (volatiles); also off flavors and aromas



Thomas Wright, IFAS  
Comm. Serv.

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## I. Components of Quality

- **Nutritional quality**
  - Includes concentrations of nutrients as well as their availability
- **Safety quality**
  - Absence of human pathogens (*i.e.*, food poisoning microbes), toxins, allergens, and chemical or physical contaminants



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## Perspectives on Quality & Value

- **From the standpoint of:**
  - **Grower:** yield, intended market, packout
  - **Packer/shipper:** uniformity, lack of defects, shelf life
  - **Retailer:** uniformity, proper maturity, shelf life
  - **Consumer:** appearance, flavor, social responsibility
    - Consumer segments: regional, ethnic, age
  - **Government:** public safety, market transparency



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## II. Maturation and Maturity Indices

- Maturity is the number one determinant of the potential quality of fruits and vegetables
  - Optimal maturity generally coincides with optimal eating quality of **nonclimacteric** crops (quality does not improve postharvest).
  - There are exceptions, *e.g.*, cured sweetpotatoes.



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## II. Maturation and Maturity Indices

- The relationship between maturity and quality is more complicated for **climacteric** fruits
  - Eating quality at maturity may be far from optimal
  - Quality mature fruit should be acceptable after postharvest ripening, but...
  - Best quality corresponds to ripening on the plant (*i.e.*, tree-ripe or vine-ripe)



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## Maturity Indices

- The need is due to the sometime conflicting priorities of growers, merchants, and regulatory authorities to know whether or not a commodity is mature
  - Maturity and quality standards
  - Consumer interests
  - Planning harvest operations



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## Maturity Indices

- The search for objective maturity indices...
  1. **Simple:** (can be performed in the field with inexpensive equipment)
  2. **Objective:** (measured, not subjective)
  3. **Relates to quality:** regardless of grower, district or year
  4. **Predictive:** a progressive change with maturation



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## Maturity Indices

- **Fruits:** Quality vs. storage life
  - Tree-ripe = higher eating quality
  - Mature-green = longer storage life
- **Vegetables:** Size vs. quality
  - Yield increases with greater maturity, but...
  - Texture and flavor quality decline



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## Maturity Indices for Selected Fruits and Vegetables

<u>Index</u>	<u>Examples</u>
Elapsed days from full bloom to harvest	Apples, pears
Mean heat units during development	Peas, apples, corn
Development of abscission layer	Cantaloupe, many tree fruits
Surface morphology and structure	Cuticle formation on grapes and tomatoes netting of cantaloupes; gloss of some fruit (wax development)
Size	All fruits and vegetables
Specific gravity	Cherries, watermelons, potatoes
Shape	Angularity of banana fingers and full cheeks of mangos; compactness of broccoli and cauliflower

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## Maturity Indices for Selected Fruits and Vegetables

<u>Index</u>	<u>Examples</u>
<b>Solidity</b>	Lettuce, cabbage, Brussels sprouts
<b>Textural properties</b>	
Firmness	Apples, pears, stone fruits
Tenderness/toughness	Peas, asparagus
<b>Color</b>	
External	All fruits and vegetables
Internal	Tomatoes, mangoes, stone fruits
<b>Compositional factors</b>	
Starch content	Apples, pears
Sugar content	Apples, pears, stone fruits, grapes
Acid content and sugar:acid ratio	Pomegranates, citrus, papaya, melons, kiwifruit
Juice content	Citrus fruits
Oil content	Avocados
Astringency (tannin content)	Persimmons, dates

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### III. Grade Standards and Inspection

- There are >150 federal grade standards covering 85 crops in the U.S.
- <http://www.ams.usda.gov/standards/>
- Federally licensed inspectors work in fields as crops are harvested, in packinghouses, and at terminal markets
  - Shipping point and destination provisions sometimes differ



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### Why Grade Standards?

- Grade standards provide a common “language” for buying and selling.
- Grading is based on standards, and standards are based on measurable attributes that describe the value and quality of the product
  - *e.g.*, regular shape, netting on cantaloupes, freedom from defects, damage and decay, etc.



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## Why Grade Standards?

- Grade standards ensure that contract specifications have been met:
  - The buyer receives the product in the condition and quality described by the terms of the contract



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## Quality and Grade Standards

- Quality and grade standards can hardly be separated from:
  - Phytosanitary (quarantine) requirements
  - Food safety (sanitary hygiene) requirements

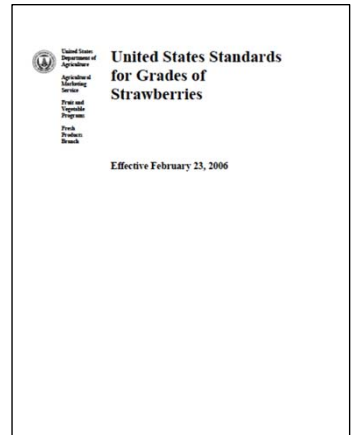


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[https://www.ams.usda.gov/sites/default/files/media/Strawberry\\_Standard%5B1%5D.pdf](https://www.ams.usda.gov/sites/default/files/media/Strawberry_Standard%5B1%5D.pdf)



## Grade Standards



- **Voluntary**
  - Federal grade standards have been developed by the industries involved
  - Buyers and sellers may use them or not
- **Required**
  - Marketing orders can require grade standards (the standards then apply to all sales, including imports)
  - State regulations (California has minimum, required standards for sales outside state)



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## Marketing Orders

- **Marketing Orders:** producers organize to work at solving marketing problems.
  - Marketing Orders are legal instruments that have the force of law in the U.S.
  - Marketing Order rules apply to both domestic and imported products sold in the U.S.
    - May require certain quality/grade standards
    - May require standard packages or containers
    - Authorize collection of fees for advertising, research, and market development



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## Inspections

- **Requested by shipper** (for protection)
  - Inspections may be required by a Marketing Order
- **Requested by receiver** (to settle a dispute)
  - If the grade is not the grade agreed upon, the receiver is not bound to buy
- **Inspectors** have guides, visual aides, and standard sampling procedures to use to ensure uniformity of inspections
- **Standard schedule of fees**



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## Quality Factors Found in Some Grade Standards

Commodity	Quality factors
Avocados (Florida)	Maturity; shape; texture; skin and flesh color; and freedom from decay, anthracnose, freezing injury, bruises, russeting, scars, sunburn, mechanical damage and other defects
Broccoli	Color; maturity; stalk diameter and length; compactness; base cut; and freedom from defects and decay
Watermelons	Maturity and ripeness (optional internal quality criteria - %SSC >10% = VG, >8% = G); shape; uniformity of size (weight); and freedom from anthracnose, decay, sunscald, whiteheart, <i>etc.</i>



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## Strawberry Grade Standards

- **Grades:** U.S. No. 1, U.S. Combination, and U.S. No. 2
- **Application of Tolerances:** what (and how much of it) is allowed within each grade
- **Definitions:** Overripe, Undeveloped, Damage, Serious damage, Diameter



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## U.S. No. 1 Strawberry Grade

- Firm, not overripe or undeveloped, free from mold or decay, free from damage, at least  $\frac{3}{4}$  red, and not less than  $\frac{3}{4}$ -inch diameter
- Not more than 10% total defects (5% serious; 5% undersized; 2% decay)
- No individual basket with more than 20% total defects (10% serious; 4% decay; but one defective and one off-size fruit allowed)



- Provided, the average for the entire lot is within the tolerances



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# Classification of Some Grapefruit Defects

§51.784 Classification of defects.

Table I

Factor	Injury	Damage	Serious Damage	Very Serious Damage
Ammoniation		Not occurring as light speck type.	Scars are cracked or dark and aggregating more than a circle 1 inch (25.4 mm) in diameter.	Aggregating more than 25 percent of the surface.
Bruises	Segment walls are collapsed, or rag is ruptured and juice sacs are ruptured.	Segment walls are collapsed, or rag is ruptured and juice sacs are ruptured.	Segment walls are collapsed, or rag is ruptured and juice sacs are ruptured.	Fruit is split open, peel is badly water-soaked, or rag is ruptured and juice sacs are ruptured causing a mushy condition affecting all segments more than 3/4 inch (19.1 mm) at bruised area or the equivalent of this amount, by volume, when affecting more than one area on the fruit.
Buckskin		Aggregating more than a circle 1-1/4 inches (31.8 mm) in diameter.	Aggregating more than 25 percent of the surface.	Aggregating more than 50 percent of the surface.
Caked melanose		Aggregating more than a circle 3/4 inch (19.1 mm) in diameter.	Aggregating more than a circle 1 inch (25.4 mm) in diameter.	Aggregating more than 25 percent of the surface.
Dryness or mushy condition		Affecting all segments more than 1/4 inch (6.4 mm) at stem end, or the equivalent of this amount, by volume, when occurring in other portions of the fruit.	Affecting all segments more than 1/2 inch (12.7 mm) at stem end, or the equivalent of this amount, by volume, when occurring in other portions of the fruit.	Affecting all segments more than 3/4 inch (19.1 mm) at stem end, or the equivalent of this amount, by volume, when occurring in other portions of the fruit.

[https://www.ams.usda.gov/sites/default/files/media/Grapefruit\\_%28FL%29\\_Standard%5B1%5D.pdf](https://www.ams.usda.gov/sites/default/files/media/Grapefruit_%28FL%29_Standard%5B1%5D.pdf)

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## Worldwide Grade Standards

- **European Union:**
  - Directorate-General for Agriculture and Rural Development ([http://ec.europa.eu/dgs/agriculture/index\\_en.htm](http://ec.europa.eu/dgs/agriculture/index_en.htm)) Fruit and Vegetable Common Market Organisation (CMO)
  - DG for Health and Food Safety ([https://ec.europa.eu/info/departments/health-and-food-safety\\_en](https://ec.europa.eu/info/departments/health-and-food-safety_en)) is responsible for food safety and nutrition labeling
  - The main requirements of E.U. marketing standards relate to:
    - **Quality classification**
    - **Information labelling:** identification, origin, safety, nutrition, etc.

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## Worldwide Grade Standards

- **Codex Alimentarius Commission (Codex)**  
<http://www.codexalimentarius.org/>
  - An FAO Commission – more than 160 member countries
  - **Purpose:** develop international food standards, related codes of practice, and guidelines to protect consumer health and ensure fair practices in the food trade
  - More than 200 standards

