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.

Fruit Quality

- It is a concept encompassing:
  - Sensory properties (appearance, texture, taste and aroma),
  - *nutritive value*,
  - mechanical properties,
  - safety and defects.

"Altogether, these attributes give the fruit a degree of excellence and an economic value” (Abbott, 1999).

Fruit Quality: A Moving Target

- Everyone in the fruit production and marketing chain from the grower to the consumer looks for fruit with no or few defects.
Sensory Attributes of Foods

- Appearance
- Taste
- Odor/smell/aroma
- Irritation
- Texture/mouthfeel

Flavor

Taste is the sensation perceived in the mouth, more specifically on the tongue.

- Sweet
- Salty
- Bitter
- Sour (acid)
- Umami (protein – savory)

Appearance

- First attributes perceived
- Shape, size
- Color (uniformity, intensity)
  - Strongly-set expectations
  - Emotional connotations
- Gloss (wax)

Sensory Attributes of Foods

Taste Perception and Produce Composition

<table>
<thead>
<tr>
<th>Quality</th>
<th>Class of compound</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet</td>
<td>Sugars</td>
<td>Sacrose, fructose, glucose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some proteins Thaumatin, monellin</td>
</tr>
<tr>
<td>Sour</td>
<td>Acids</td>
<td>Citric acid, tartaric acid, malic acid</td>
</tr>
<tr>
<td>Bitter</td>
<td>Alkaloids, phenylpropanoids, terpenoids</td>
<td>Isocoumarins, quinine, nicotine, limonin</td>
</tr>
<tr>
<td>Umami</td>
<td>Amino acids</td>
<td>Glutamate, aspartate</td>
</tr>
<tr>
<td>Salty</td>
<td>Ions</td>
<td>Sodium, calcium</td>
</tr>
</tbody>
</table>
Sensory Attributes of Foods

**Aroma** – perceived in nose
- Volatile compounds released from various items (food, flowers...)

---

**The Aroma of a Strawberry**

Over 200 volatile compounds!!

Guinard, 2005
Potential Health Benefits of Fruits and Vegetables

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Impacted human disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antioxidants (Vitamins A, C &amp; E, carotenoids, flavonoids)</td>
<td>Cancer, cataracts, heart disease, stroke</td>
</tr>
<tr>
<td>Fiber</td>
<td>Diabetes, heart disease</td>
</tr>
<tr>
<td>Folate</td>
<td>Birth defects, cancer, heart disease</td>
</tr>
<tr>
<td>Potassium</td>
<td>Hypertension, stroke</td>
</tr>
</tbody>
</table>

**Total Oxygen Radical Absorbance Capacity (ORAC)**

US Department of Agriculture. 2007.
Fatty acids composition of nuts influences their storage potential

Stability Comparison of Various Nuts

Hazelnuts | Cashews | Almonds | Pecans | Peanuts | Walnuts

<table>
<thead>
<tr>
<th></th>
<th>100</th>
<th>100</th>
<th>100</th>
<th>100</th>
<th>100</th>
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</thead>
<tbody>
<tr>
<td>Hazelnuts</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
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<tr>
<td>Cashews</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
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</tr>
<tr>
<td>Almonds</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
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<td>Stable</td>
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<tr>
<td>Pecans</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
</tr>
<tr>
<td>Peanuts</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
</tr>
<tr>
<td>Walnuts</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
</tr>
</tbody>
</table>

CONSUMER PERCEPTIONS

% of Consumers Using More Walnuts Because They Are Healthy/Good For You/Nutritious


HEALTH RESEARCH - TODAY

89 Published Papers to Date

Recently Published
- UCLA (Robbins) – Male Reproductive Health
- Harvard (Hu) – Alpha-Linolenic Acid
- Penn State (Van Den Heuvel) – Breast Cancer
- Tufts University (Carey) – Cognitive Function

In Progress (27)
- Cardiovascular
- Cancer
- Cognitive Function
- Diabetes
- Male Reproductive Health
- Weight Management

8 in 10 PR impressions health-related

California Walnut Board/Commission 2013 State of the Industry

Nuts are marketed in shell or shelled as whole kernel or prepared in a variety of value-added products in various packages that influence their postharvest-life
How to Assure Consumer Quality

- Minimum Maturity (6.5% SSC)
- Maximum Maturity (≤14 pounds)
- Consumer Quality (≥12.5% RSSC)
- Fruit Handler Quality (≥ 15.1% DW)

Mitchell, G. Crisosto & Crisosto

Impact Bruising

Gatti, R. 1983

Storage Potential

Ethylene free

Kiwifruit Internal Breakdown after 3 Months of Cold Storage

Sacramento Valley, 1998
San Joaquin Valley, 1998
San Joaquin Valley, 1999
Sacramento Valley, 2000
San Joaquin Valley, 2000
Consumer Acceptance (‘in-store’) 15.1-16.1 % DW

**Consumer Acceptance (‘in-store’)**

14-16% SSC

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Acceptance (%)</th>
<th>SSC(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>37.1a</td>
<td>13.5</td>
</tr>
<tr>
<td>1998</td>
<td>31.9a</td>
<td>12.4</td>
</tr>
<tr>
<td>1999</td>
<td>29.8a</td>
<td>12.8</td>
</tr>
<tr>
<td>50% Bright Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>74.7a</td>
<td>18.4</td>
</tr>
<tr>
<td>1998</td>
<td>52.8b</td>
<td>14.1</td>
</tr>
<tr>
<td>1999</td>
<td>77.6a</td>
<td>15.5</td>
</tr>
<tr>
<td>Bright Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>83.8a</td>
<td>19.3</td>
</tr>
<tr>
<td>1998</td>
<td>81.0a</td>
<td>16.5</td>
</tr>
<tr>
<td>1999</td>
<td>80.7a</td>
<td>17.5</td>
</tr>
<tr>
<td>Dark Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>89.9a</td>
<td>21.1</td>
</tr>
<tr>
<td>1998</td>
<td>88.7a</td>
<td>18.3</td>
</tr>
<tr>
<td>1999</td>
<td>94.5a</td>
<td>21.6</td>
</tr>
</tbody>
</table>

Relationship between SSC and consumer acceptance of ‘Brooks’ cherries measured during three consecutive ‘in-store’ consumer tests.

*Values within each column and source of variability followed by different letters are significantly different according to LSD0.05. No letters within a column indicates no significant differences between treatments.


<table>
<thead>
<tr>
<th>Sources of Variability</th>
<th>Fruit Weight (g)</th>
<th>SSC (%)</th>
<th>TA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin Color (SC)</td>
<td>** ** **</td>
<td>** ** **</td>
<td>** ** **</td>
</tr>
<tr>
<td>Full light red</td>
<td>7.4d</td>
<td>15.3d</td>
<td>0.81c</td>
</tr>
<tr>
<td>50% Bright red</td>
<td>8.8a</td>
<td>16.8c</td>
<td>0.68b</td>
</tr>
<tr>
<td>Full bright red</td>
<td>8.2b</td>
<td>18.6b</td>
<td>0.69a</td>
</tr>
<tr>
<td>Full dark red</td>
<td>8.4a</td>
<td>20.4a</td>
<td>0.77c</td>
</tr>
<tr>
<td>Orchard (Or)</td>
<td>** ** **</td>
<td>** ** **</td>
<td>** ** **</td>
</tr>
<tr>
<td>No. 1</td>
<td>7.5a</td>
<td>17.6b</td>
<td>0.85b</td>
</tr>
<tr>
<td>No. 2</td>
<td>8.1c</td>
<td>17.6d</td>
<td>0.77c</td>
</tr>
<tr>
<td>No. 3</td>
<td>8.9a</td>
<td>17.9a</td>
<td>0.69c</td>
</tr>
<tr>
<td>No. 4</td>
<td>7.8e</td>
<td>16.5d</td>
<td>0.66c</td>
</tr>
<tr>
<td>No. 5</td>
<td>7.4d</td>
<td>17.2c</td>
<td>0.79c</td>
</tr>
<tr>
<td>Year (Y)</td>
<td>** ** **</td>
<td>** ** **</td>
<td>** ** **</td>
</tr>
<tr>
<td>1995</td>
<td>8.9a</td>
<td>16.4c</td>
<td>0.95b</td>
</tr>
<tr>
<td>1996</td>
<td>7.5e</td>
<td>18.4d</td>
<td>1.20c</td>
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<tr>
<td>1997</td>
<td>7.8e</td>
<td>17.4b</td>
<td>0.97c</td>
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<tr>
<td>1998</td>
<td>8.2a</td>
<td>18.5e</td>
<td>0.72c</td>
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<tr>
<td>Interactions</td>
<td>** ** **</td>
<td>** ** **</td>
<td>** ** **</td>
</tr>
</tbody>
</table>

Crisosto et al., 2002. Consumer acceptance of Bing and Brooks cherries is mainly dependent on fruit SSC and visual color. Postharvest Biology and Technology 26:159-167.
UNDERSTANDING FRUIT FLAVOR SENSORY TOOLS

Trained Panel

“In Store” Consumer Test

Sensory Panel
- 12 panelists
- 1 week training
- 5 weeks tasting (9 samples/day, 3 days/week)

Training

MORE TYPES OF TREE FRUIT

About 70 varieties released per year.
50% of the releases are sub acid types.
Describing cultivars based on predominant sensory attributes

Segregation of 12 plum and 4 pluot cultivars from different breeding programs according to their sensory characteristics as perceived by a trained panel and determined by PCA

Preparing Samples for Sensory Evaluation Work

Preparing Fruit for Sensory Evaluation

Single Fruit Measurement Technique

**9-POINT HEDONIC SCALE**

Degree of liking of at different levels of ripe soluble solids concentration (RSSC) by American consumers

Variation of "Liking" may be attributed to cultivar characteristics

Crisosto & Crisosto. 2005. Relationship between ripe soluble solids concentration and consumer acceptance of high and low acid melting flesh peach and nectarine cultivars. Postharvest Biology and Technology, 38:79-86
Based on flavor and nutritional quality
Based on firmness
Based on appearance (visual quality)

Postharvest-life under optimum conditions
Fruit Quality Measurements

Cherry Color and Size

Fruit Size

Color

Minolta Colormeter
**CIEL*CH Color Space**

- Lightness
- Saturation

**Measuring Firmness**
- Penetrometer
- Texture Analyzer

**Sugars and Acids**
Where can we get POSTHARVEST INFORMATION?

For information contact: chrisosto@ucdavis.edu
http://postharvest.ucdavis.edu
http://fruitandnuts.ucdavis.edu
Cherry Color Categories

Chemical Composition of Tree Nuts

Comparison among various cooking oils in their fatty acid composition