Sensory Quality Measurements

Evaluating Fruit Flavor Quality

• Appearance
• Taste, Aroma
• Texture/mouthfeel

Instrumental evaluation / Sensory evaluation

Quality aspects for fresh produce

External characteristics
• Color
• Shape
• Blemishes
• Decay
• Affects initial decision to purchase
• Generally longer shelf life

Internal characteristics
• Taste/aroma
• Texture
• Nutrition
• Affects decision for repeat purchase
• Generally shorter shelf life

Appearance

• Shape, size
• Color (uniformity, intensity)
• Gloss (wax)
Fruit Composition and Taste

<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>Sucrose, fructose, glucose</td>
</tr>
<tr>
<td>Sour</td>
<td>Acids</td>
<td>Citric acid, malic acid, tartaric acid</td>
</tr>
<tr>
<td>Bitter</td>
<td>Alkaloids, Phenolics,</td>
<td>Naringin, cucurbitacins, limonoids</td>
</tr>
<tr>
<td></td>
<td>Terpenoids, some proteins</td>
<td></td>
</tr>
<tr>
<td>Salty</td>
<td>Ions</td>
<td>Sodium, calcium</td>
</tr>
<tr>
<td>Umami</td>
<td>Amino acids</td>
<td>Glutamate, aspartate</td>
</tr>
</tbody>
</table>

Sweet Taste – Rapid Methods

**Enzyme-based sugar quantification**

- Fructose
- Glucose
- Sucrose

\[
\text{Glucose-6-P} \rightarrow 6\text{-P-gluconate} \rightarrow \text{NAD}\text{H} \rightarrow \text{NAD}^+ 
\]

- More accurate measurement of sweetness-related solutes

Sour Taste – Rapid Methods

- **pH**
- **Titratable acidity**
- **SSC/Acidity meter from ATAGO (citrus, grape, tomato)**
- **Enzyme-based acid quantification**
Electronic Tongues

Aroma Volatiles

Aroma (or smell or odor) is the sensation perceived when volatile compounds are drawn into the nose.

Ripe fruits generally produce tens to hundreds of volatiles. This mixture of volatiles is what we perceive as “aroma”.

Texture

• Penetrometer

• Texture Analyzer

What is a volatile compound?

• A small molecule which has a high tendency to evaporate.

• Volatiles are naturally produced by plants (from almost all plant organs) and animals.

• Fruit aromas are made up of complex mixtures of volatile compounds (recall strawberry – over 200!).
What does a volatile compound smell like?

• Each single volatile compound has a distinct smell/odor.

- β-ionone: Floral, woody, sweet, fruity, berry, green
- Dimethyl disulfide: Sulfurous, vegetable, cabbage, onion
- Myrcene: Peppery, spicy

Volatile Analysis by GC-MS: the “gold standard”

Electronic Noses

- iSense Colorimetric Sensor Array
- Airsense Portable Electronic Nose

Odor Thresholds

• Our olfactory system has different sensitivity levels for different volatiles.

• Some volatiles, like furaneol, we can detect at extremely low levels; while others, like acetic acid (vinegar!), we can detect only at higher levels.

• Even though acetic acid is much more abundant than furaneol in strawberries, it is furaneol that is most important for determining the characteristic aroma of the strawberry (because of its low odor threshold value).
Sensory Attributes and Fruit Composition

- All fruit components (sugars, acids, volatiles, etc...) combine to generate a unique sensory experience for the consumer.

- Physical methods give accurate measurements of fruit composition but it is difficult to relate these measurements to fruit quality without information about sensory perception.

What is sensory evaluation?

- A SCIENCE that measures, analyzes, and interprets the reactions of the senses of sight, smell, sound, taste and texture to products
- It is a PEOPLE science, i.e. people are essential to obtain information about products


Sensory Evaluation

**Trained panel**

- (objective)
- Can tell differences b/w products
- Can tell why and how much
- Do NOT ask preference
- 10-12 panelists
- Hours of training

**Consumer panel**

- (subjective)
- Can tell differences b/w products
- Cannot tell why
- Can tell preferences between product
- 50-100 panelists
- Logistics

Your Tools: Panelists

- **Consumer panels (no training)** indicate how much a product is liked
- Do not indicate which component of the product is the driver for liking
- **Descriptive analysis (trained panels)** to define descriptors, traits
- Relate consumer with descriptive ➔ Preference mapping
Sensory evaluation is no trivial matter!

Before you start

- Know what question you want to ask and how you are going to get the answer!
- Make sure you make adjustments to commodity needs for experiment
- Recognize that this is a TIME intensive activity
- Work with someone who has training in this area

Variability within the fruit

Variability - within tree

<table>
<thead>
<tr>
<th>Light Class</th>
<th>SSC/TA</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside</td>
<td>12.56</td>
<td>8.54 – 21.00</td>
</tr>
<tr>
<td>Canopy</td>
<td>10.99</td>
<td>4.80 – 16.50</td>
</tr>
<tr>
<td>Inside</td>
<td>10.14</td>
<td>5.71 – 14.17</td>
</tr>
<tr>
<td>Top outside</td>
<td>12.78</td>
<td>9.69 – 18.47</td>
</tr>
<tr>
<td>Top inside</td>
<td>11.50</td>
<td>8.92 – 10.41</td>
</tr>
<tr>
<td>All fruit</td>
<td>11.56</td>
<td>4.80 – 21.00</td>
</tr>
</tbody>
</table>

SSC varies in tree
Less variation in TA
SSC/TA variation due to SSC

- Outside – fruit on outer edge, max. light
- Canopy – fruit embedded in leaf canopy; partially shaded at all times
- Inside – continuous shade
- Top Outside – full light all the time
- Top Inside – top of tree, embedded in foliage; partial light


Does citrus postharvest handling influence eating quality of navel oranges?

M. L. Arpaia and D. Obenland
Does the packing line affect fruit flavor?

Packing House Fruit Sampling Scheme

Field Bin  Washer  Waxter  Packed Box

6.4 a  6.1 a  6.1 a  6.0 b
Average Acceptability (Hedonic Score)

Does time in storage affect fruit flavor?

Fruit stored at 41F for 0, 3, 6 weeks followed by 4 days at 68 F and 3 days at 54 F

<table>
<thead>
<tr>
<th></th>
<th>0 wk</th>
<th>3 wk</th>
<th>6 wk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.4 a</td>
<td>6.2 a</td>
<td>5.7 b</td>
</tr>
</tbody>
</table>

Average Hedonic Score

Mary Lu Arpaia

Differences in aroma active compounds and internal ethanol were detected due to storage and handling

10 compounds changed significantly due to storage duration

5 compounds changed due to handling

Conclusions

• One grower lot out of 3 was distinctly different
• Commercial packline handling had an influence on eating quality
• Eating quality deteriorates with storage
• These differences appear to be primarily related to the final steps of fruit handling since we detected differences due to placement on packline
• The alteration in eating quality is due to changes in volatile characteristics rather than changes in SSC or TA
Concluding remarks

Although there are challenges we are only limited by our imagination on how to apply this tool to our programs

The questions we will ask need to be focused and specific

Understanding that sensory evaluation is another tool to be used in enhancing our knowledge of product quality

Questions?

Many thanks to Mary Lu Arpaia for sharing her slides on sensory evaluation