What is Flavor?

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Perception of Quality

• Our sensory systems are responsible for generating an internal representation of the outside world, including its chemical (taste and olfaction) and physical (mechanical, sound, vision and temperature) features.
• When evaluating the quality of the foods we eat, we use the complete array of our sensory system (chemical and physical senses) and integrate this information to formulate a judgment.
• From an evolution standpoint, chemical senses are the most primal of the senses.

Sensory Attributes of Foods

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

Flavor

Quality Class of compound Examples

<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></td>
<td>Some proteins</td>
<td>Monellin, thaumatin</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, Terpenoids, some proteins</td>
<td>Naringin, escorbuticins, limonoids</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>
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A rapid method for measuring sugar content in a liquid

- A refractometer measures the refraction of light as it passes through a drop of liquid.
- The refractive index is directly proportional to the concentration of diluted solutes in the liquid.
- The "Brix" scale is based solely on a dilution series of sucrose in water.
- The correct term for fruit juice is:

\[
\text{TSS or SSC} = \text{sugars, organic acids, soluble pectins, anthocyanins, phenolic compounds...}
\]

Rapid methods for measuring acidity

- pH
- Titratable acidity

Sensory Attributes of Foods

“The Tongue Map”

Taste Receptor Cells on tongue

Taste Receptor Mechanisms

- **Sweet**
- **Bitter**
- **Umami**

- **Ligand receptors**: taste molecules (sweet, bitter, or umami) bind to receptors. This activates a cascade of responses inside Taste Receptor Cells, and sends information to the brain.

- **Salty**
- **Sour**

- **Ion channels**: ions (Na⁺ or H⁺) directly enter cells through channels in the membrane. This activates a cascade of responses inside Taste Receptor Cells, and relays information to the brain.
People have different levels of taste sensitivities...

### Sensory Attributes of Foods

#### Chemical irritation
- Common chemical sense
- Stimulated by chemical irritants
  - Ex: capsaicin, piperin, allicin, glucosinolates, etc...

Innate dislikes (protection)

### Sensory Attributes of Foods

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

We have learned likes and dislikes for it.

#### What is a volatile compound?
- A "volatile" is a small lipophilic molecule which has a high tendency to evaporate.
- Volatiles are naturally produced by plants (from almost all plant organs) and animals. They can also be made artificially (by chemical reactions designed for their production).

#### What does a volatile compound smell like?
- Each single volatile compound has a distinct smell.

- **β-ionone**
  - Floral, woody, sweet, fruity, berry, green

- **Dimethyl disulfide**
  - Sulfurous, vegetable, cabbage, onion

- **Myrcene**
  - Peppery, spicy, plastic
Olfactory Sensory Neurons (OSNs) in Nasal Cavity

- We have millions of odor receptors in the nose.
- In humans, odor receptors (ORs) are coded by a gene family which comprises about 1,000 genes (~350 functional genes). This gene family represents about 1% of all our genes, making it the largest gene family in the human genome.

Can we predict what a volatile will smell like?...

- The olfactory character of a volatile compound depends on:
  - the spatial arrangement (shape) of the molecule
  - the chemical (electronic and hydrophobic) properties of the molecule
  - the chirality of the molecule
  - the chemical interactions (hydrogen-bonding, electrostatic and dipole-dipole) that a volatile can have with other volatiles

Complexity of fruit aromas

- A natural aroma, smell or odor is typically made up of tens or sometimes hundreds of different volatile compounds, each of them present at different concentrations.
- Each volatile compound is characterized by a specific odor threshold (minimum concentration of a substance at which a majority of test subjects can detect and identify its characteristic odor).
- A mixture of volatile compounds is not perceived as "the sum of its parts": volatiles interact to create a unique, distinct aroma.

Sensory Attributes and Fruit Composition

- All fruit components (sugars, acids, volatiles, etc...) combine to generate a unique sensory experience for the consumer.
- Physical methods can give accurate measurements of fruit composition but it is difficult to relate these measurements to fruit quality without information about sensory perception.
Fruit Biology

- Fruit quality is closely linked to fruit composition
- Fruit composition is strongly affected by internal (genetic) and external (environment, handling...) factors
- If we define and understand the effect of these factors, we can control fruit flavor quality throughout production and postharvest handling

In climacteric fruits, the plant hormone ethylene serves as a signal for the fruit to begin ripening.

Ethylene controls softening. It also controls aroma development.

Questions?