Sensory Evaluation of Foods

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Human Senses

• Many accepted definitions
  - Senses are the physiological methods of perception

• Aristotle - There are five senses in humans:
  - Sight
  - Hearing
  - Touch
  - Smell
  - Taste

http://en.wikipedia.org/wiki/Senses
Human Senses

- From neurological Sciences - Humans have at least six additional senses (at least 11 senses all together):
  - Nociception - pain
  - Equilibraception - balance
  - Proprioception and kinesthesia - joint motion and acceleration
  - Sense of time
  - Thermoception - temperature differences
  - Magnetoception - direction (weak in many individuals)

- From all the senses above the only one that may influence sensory evaluation of a food item is thermoception

http://en.wikipedia.org/wiki/Senses
Human Senses

• Commonly recognized categorization for human senses is:
  - Chemoreception (taste and smell)
  - Photoreception (sight)
  - Mechanoreception (touch)
  - Thermoception (thermoception)

• All human senses fit into one of the categories listed above

http://en.wikipedia.org/wiki/Senses
Human Senses

- **Sight or vision:**
  - Ability of the brain and eye to detect electromagnetic waves within the visible range (light) and interpret the image

- **Touch, mechanoreception or somatic sensation:**
  - Sense of pressure perception, generally in the skin

- **Hearing or audition:**
  - Sense of sound perception
  - Sound is vibrations propagating through a medium (e.g. air)
  - Detection of these vibrations is a mechanical sense similar to ‘touch’ but much more specialized

http://en.wikipedia.org/wiki/Senses
Human Senses

• **Taste or gustation:**
  - This is a "chemical" sense
  - There are four main types of tastes that receptors (buds) in the tongue can distinguish:
    • Sweet
    • Salt
    • Sour
    • Bitter

http://en.wikipedia.org/wiki/Senses
Human Senses

• **Taste or gustation:**
  - In 1908 a fifth receptor, for a sensation called *umami* (*SAVORINESS*), was first theorized. In 200 its existence was confirmed.
    - The umami receptor detects the amino acid glutamate, a flavor commonly found in meat and in artificial flavorings such as monosodium glutamate (*MSG*).
  - Most of what we perceive (or describe as taste) is actually smell
    - E.g. “This ice-cream tastes like strawberry and banana”; it actually smells like banana and possibly tastes sweet and sour

http://en.wikipedia.org/wiki/Senses
Sense of Taste - Our Tongue

- The majority of taste buds on the tongue sit on raised protrusions of the tongue surface called papillae. Four types of papillae present in the human tongue:
  - **Fungiform papillae** - Slightly mushroom-shaped if looked at in longitudinal section. These are present mostly at the apex (tip) of the tongue, as well as at the sides.
  - **Filiform papillae** - Thin, long papillae "V"-shaped cones that don't contain taste buds but are the most numerous. These papillae are mechanical and not involved in gustation.
  - **Foliate papillae** - Ridges and grooves towards the posterior part of the tongue found on lateral margins.
  - **Circumvallate papillae** - Only about 3-14 of these papillae on most people. Present at the back of the oral part of the tongue. Arranged in a circular-shaped.
Contrary to popular understanding that different tastes map to different areas of the tongue, taste qualities are found in all areas of the tongue although some regions are more sensitive than others.

View of a portion of the mucous membrane of the tongue. Two fungiform papillae are shown. On some of the filiform papillae the epithelial prolongations stand erect, in one they are spread out, and in three they are folded in.

http://en.wikipedia.org/wiki/Taste
**Human Senses**

- **Smell or olfaction**
  - This is a “chemical" sense
  - Unlike taste, there are hundreds of olfactory receptors in our olfactory epithelium (where the receptor are located)
  - Odor molecules have a variety of features and can combine with many or few receptors
  - It is known that there isn’t one receptor for specific kinds of smells, our sense of smell works with ‘patter recognition’

http://en.wikipedia.org/wiki/Senses
Human Senses

- **Smell or olfaction**
  - This combination of signals from different receptors makes up what we perceive as smell of substances or mixtures of substances (volatiles)
  - Volatiles are molecules of low boiling point at atmospheric pressure (1 atm or 760 mm Hg)

- **Note:** Taste is not the same as flavor!

- **Flavor includes the smell of a food as well as its taste**
  - In the strawberry-banana ice-cream example the correct description would be ‘This cream has a strawberry-banana flavor’

http://en.wikipedia.org/wiki/Senses
Sense of Smell - Our Nose

http://www.senseofsmell.org/feature/smell101/lesson1/01.php
About the Trigeminal Nerve

• Sensation of cooling (e.g. menthol, mint) or hot (e.g.
cinnamon or clove) in back of our throats is not part
of ‘taste’ but a response to stimulus in the trigeminal
nerve
  - Trigeminal nerve = fifth cranial nerve
    • Responsible for sensation in the face
    • The fifth nerve is primarily a *sensory* nerve, but it also has certain
      *motor* functions (biting, chewing, and swallowing)
    • There are two basic types of sensation: touch/position and
      pain/temperature
About the Trigeminal Nerve

http://www.clinicalexams.co.uk/images/trigeminal_nerve_5.jpg
What is Sensory Analysis?

- Identification of food product(s) properties
- Scientific measurement of food product(s) properties
- Analysis and interpretation of the identified and measured food product properties
  - As there are perceived through the five senses:
    - Sight (e.g. color of a food product)
    - Smell (e.g. presence of rancidity in a product)
    - Taste (e.g. intensity of sweetness)
    - Touch (e.g. firmness of a muscle food)
    - Hearing (e.g. crunchiness of a potato chip)
What Questions Sensory Analysis Answer?

- Questions that deals with quality of food products under **three** main categories:
  - **Discrimination**
    - These questions have the objective of determining if differences exist between two or more products
    - Type of questions that may be asked in discrimination sensory tests:
      - Is product A identical to product B?
      - Find the two similar products among the three samples provides
      - Find the odd sample among the three samples provided
What Questions Sensory Analysis Answer?

- Questions that deals with quality of food products under **three** main categories:
  - **Description**
    - These questions have the objective of describing characteristics of a product and/or measuring any differences that are found between products
      - What does this product taste like?
      - What are the three most important texture attributes you perceive in this product?
      - For which sensory attributes are the differences between product A and B most marked?
What Questions Sensory Analysis Answer?

• Questions that deals with quality of food products under three main categories:
  - Preference or Hedonics
    • These questions have the objective of describing liking or acceptability of a product
      - Do you like this product? How much do you like this product on a scale of 1 to 10, where 1 = dislike extremely, and 10 = like extremely?
      - Is this product acceptable?
      - What do you like most about this product?
      - Is product A better then product B?
      - Which of the three products A, B and C do you prefer?
Why Use Sensory Analysis to Evaluate Food Products?

• To evaluate quality (quality control) or improve quality
  - E.g. Maintain a product with same sensorial characteristics so consumers of that product continue to buy it
  - E.g. Release production batch for sale because the products inspected meet the standards set by the manufacturer
  - E.g. Reject production batch because the products inspected are below the acceptable level of quality set by the manufacturer

• To provide input for decision making (product development)
  - E.g. Launching a new fruit snack, or a new flavor fish stick
Why Use Sensory Analysis to Evaluate Food Products?

- **To determine the market value of a product**
  - E.g. Determine value of perishable products such as fish. If fish is very fresh and was handled with great care, then it is likely to be sold for a higher price than frozen fish that has kept in frozen storage for 6 months.

- **To determine shelf-life of a product**
  - E.g. How long can a cracker remain in the grocery shelves before it becomes stale?

- **Ingredient substitution in product formulation**
  - E.g. Cost reduction of a product formulation by substitution of ingredient A for ingredient B. Does it change the product? Can the consumer perceive it? How does it change the product?
Why Use Sensory Analysis to Evaluate Food Products?

• To compare a product (s) with the competitor‘s product (s)
  - E.g. How close in taste is beverage A produced by company A as it compares to beverage B produced by company B?

• To determine storage conditions
  - Should the product be stored refrigerated, frozen or at room temperature?
  - Will the product become rancid very quickly if it sits at room temperature? (butter; cheese...)
  - Will the product change texture, appearance or taste if it is stored frozen? (eggs; milk...)
Sensory Evaluation Pitfalls

- Determining the wrong objective for conducting sensory analysis
- Choosing the wrong set of participants in the sensory test(s)
- Asking the wrong questions to the participants
- Having biased judgments of the products tested
- Lacking scientific control (scientific rigor)
- Conducting the sensory test in the wrong (inadequate) environment
Sensory Panel Rooms
Sensory Panel Room

- Round table - mostly for product development (e.g. launching new product; change in product formulation) and internal sensory assessment (e.g. consumer complain)

- Booths are widely used to provide an environment that prevents panelists from being distracted and interacting with other panelists - unbiased evaluation
  - Booths can be computerized so panelists enter the answers to the sensory assessment questions electronically
  - Booths may have features that change environmental conditions such as different colors of light to mask product color
**Sensory Panel Room**

- Noise level should be kept low
- Room should be free of foreign odors
- Testing area should be well lit and ventilated
- Testing area should be easy to clean and disinfect (sanitation)
- Temperature and relative humidity should be constant and controllable
- The room where food products are prepared for sensory testing is generally separated from the testing area
Sensory Panel Room

- Large room normally are used for testing products using consumers - Untrained panelists
- Panelists (participants) can be trained to evaluate specific products (odor, taste, texture, and or visual evaluation)
- At time before training panelists are screened for sensitivity in order to remove from the group of panelists people that may not have the ability to perform the sensory evaluation (e.g. people with specific type of anosmia - inability to smell certain odors)
Sensory Analysis Questionnaires

- It needs to address the main question being tested
- Questionnaires are variable and need to be design in a simple, practical way to yield clear and concise answers
- When designing a sensory questionnaire (also called a sensory ballot), one needs to take into consideration the audience (panelists)
  - E.g. children vs. adults, trained panelists vs. untrained panelists, etc...
Triangle Sensory Test on Cookies
Please take a drink of water before tasting cookie samples. Eat cookie samples from left to right, and please take a sip of water between samples. **Place an “X” under the cookie which is different than the others.**

767  312  189

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Comments:

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TRIANGLE SENSORY PANEL FOR COOKED STURGEON SAMPLES

Date: / / 

Name: 

Panelist Number: 

Instructions:
1. You have presented with 3 Gulf of Mexico Sturgeon samples. Please taste the samples in the order presented from left to right. Two of the samples are identical and one is different: select the odd sample of the three (guess if you can’t tell a difference) by circling the number.

2. Indicate, with a check mark, the degree of difference between the duplicate samples and the odd sample.

   Slight
   Moderate
   Much
   Extreme

3. Acceptability:

   Odd sample more acceptable
   Duplicates more acceptable

4. Comments:
Sensory Analysis Questionnaires

Evaluation of Appearance of Gulf Sturgeon Raw Fillets

Name: ____________________________  Date: / /  
Panelist #: _____

Instructions:

1. You have been presented with three trays of sturgeon fillets. Pretend that you are at the grocery store and evaluate the samples for overall appearance. Inspect the trays in the order presented below and indicate, with a check mark, how much you like or dislike each group of fillets.

<table>
<thead>
<tr>
<th>Tray #</th>
<th>like extremely</th>
<th>like very much</th>
<th>like moderately</th>
<th>like slightly</th>
<th>neither like nor dislike</th>
<th>dislike slightly</th>
<th>moderately dislike</th>
<th>very much dislike</th>
<th>dislike extremely</th>
</tr>
</thead>
</table>

3. Would you purchase any of the samples on a given tray?

_____ YES
_____ NO

4. If the answer of the question above is YES, please write the tray(s) number below?

5. Comments:

Thank you! ☺

Sensory Evaluation of Smoked Gulf of Mexico Sturgeon Samples

Name: ____________________________  Date: / / 99

Instructions:

1) Please take a bite of cracker and a sip of water to rinse your mouth before tasting the samples.
2) Taste all three samples from left to right.
3) Place a vertical line on the location on the line scale, that best indicates your comparison of each sample according to the given attribute (see example below).
4) Feel free to add any comments at the bottom of this sheet.

Thank you! ☺

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Example on how to use an unstructured interval scale:
Comparison of the degree of lightness between any given samples coded X, Y and Z.

![Line Scale]

Very Light  Y  Z  X  Very Dark

IMPORTANT: If you have any questions regarding the use of the given scale, PLEASE ask for assistance BEFORE starting the evaluation.

Scales of Attributes for Smoked Sturgeon Samples

<table>
<thead>
<tr>
<th>Dislike Extremely</th>
<th>Like Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Dry</td>
<td>Very Moist</td>
</tr>
<tr>
<td>Not Salty</td>
<td>Very Salty</td>
</tr>
<tr>
<td>Very Fatty</td>
<td>Not Fatty</td>
</tr>
<tr>
<td>Weak Smoked Flavor</td>
<td>Strong Smoked Flavor</td>
</tr>
</tbody>
</table>

General Comments:
Types of Sensory Tests

- **DISCRIMINATION TESTS**
- **Paired Comparison Tests** - Testing for differences between two samples
  - Simple test: request panelist to taste two samples and respond if the samples are identical or different
  - More complex tests can involve differences in specific attributes such as sweetness, bitterness, type of odor.
- **Duo-Trio** - Panelists evaluate three samples, and one is marked as reference. Panelist is asked to pick the sample that is closer in taste, odor, etc. To the reference sample.
- **Triangle Test** - Panelists evaluate three samples, two are identical and one if different. Panelist is requested to pick the sample that is different.
Types of Sensory Tests

- **DESCRIPTIVE SENSORY ANALYSIS**
  - Useful when a detailed specification of the sensory attributes of a product is desirable
  - Also, it can be useful for comparisons between products when descriptions of differences are needed
  - Normally uses trained panelists
  - Some of descriptive sensory analysis methods:
    - Flavor Profile®; Quantitative Descriptive Analysis (QDA) ®; Texture Profile ®; Sensory Spectrum ®; Generic Descriptive Analysis; Free-choice Profiling, etc...
Types of Scales

• Many types of scales available...
• Numerical scale
  - E.g. Intensity: (weak) 1 2 3 4 5 6 7 8 9 (strong)
• Verbal categorical scales
  - E.g. Oxidized flavor: not noticeable; trace; faint; mild; moderate, strong, very strong
• Ranking or ordering scales
  - E.g. Preference between products A, B, C: 1 most preferred, 2 intermediate preference; 3 least preferred
• Magnitude of differences (interval scale, see sturgeon example slide 8)
• Hedonic scaling for children (‘smiley face model’)

Quality Index Method and Fish freshness

- QIM was designed to standardize the method to evaluate fish freshness for different fish species
- It is a method that takes in consideration the sensory attributes that different fish species have
- Uses well defined experimental conditions
- Uses trained panelists
- It is based on the calculation of a “Quality Index” that is determined from the scores given for a product for each attribute evaluated. E.g. appearance of the gills, firmness of the fish muscle, dullness of the eyes, fillet color, etc...