Sensory Evaluation & Brewing

Tony Aiken/Gary Spedding and the American Brewers Guild

PRINCIPLES OF THE SENSORY EVALUATION OF BEER
Some Principles of the Sensory Evaluation of Beer
The Everyday World of Sensory

Stimulus  Sensation  Perception  Response
Principles of Sensory Evaluation

- Sensory Evaluation defined: the examination of the sensory attributes of a product by assessors. Sensory attributes are commonly referred to as:
  - appearance
  - odor / aroma / fragrance
  - tactile or trigeminal sensations
  - taste
Principles of Sensory Evaluation

Use sensory evaluation as:

- A quality control tool to help define a product’s’ attributes, to monitor and maintain a product’s’ consistency, and to identify any off-tastes that might present themselves over time.
- Tool of evaluation to formulate new products and to compare existing products with those of competitors.
# Principles of Sensory Evaluation

<table>
<thead>
<tr>
<th>Sensory Analyst</th>
<th>Organoleptic Taster</th>
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</thead>
<tbody>
<tr>
<td>- measures with the senses</td>
<td>- comprehends with the senses</td>
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<tr>
<td>- uses exact methods</td>
<td>- uses feeling / emotions to analyze impressions</td>
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<tr>
<td>- evaluates data statistically</td>
<td>- colors evaluations with own preferences</td>
</tr>
<tr>
<td>- receives training</td>
<td>- discusses with others during sessions</td>
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<tr>
<td>- receives periodic retraining</td>
<td>- untrained</td>
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</table>
Principles of Sensory Evaluation
Five Senses

- Smell
- Taste
- Touch
- Sight
- Sound
- Olfaction
- Gustation
- Trigeminal sensation
- Visual sensation
- Auditory sensation
Principles of Sensory Evaluation

- Basic taste: salty, sour, sweet, bitter (Umami*)
- What has fat got to do with it?
- 2000-5000 taste buds located in mouth

  taste molecules (tastants) stimulate receptors which in turn stimulate nerve endings inside the tongue

*Umami = “Delicious taste”
Focus on Flavor

Flavor is a complex mixture of sensory input composed of taste (GUSTATION), smell, (OLFACTION) and the tactile sensation of food as it is being munched > “MOUTHFEEL”

We often use “Taste” to mean “Flavor”

Strictly > taste arises from specialized taste cells in the mouth.
Anatomy of the gustatory system
The Tongue
Anatomy of the tongue showing the three types of taste papillae and the organization of taste receptor cells into a taste bud.

(From Netter, F.H., *The CIBA Collection of Medical Illustrations*, CIBA Pharmaceutical Company, 1983 (with permission).)
The Tongue

- Palatine Tonsil
- Lingual Tonsil
- Foliate Papillae
- Filiform Papillae
- Fungiform Papillae
- Circumvallate Papillae
Taste buds!
Anatomy of the tongue and taste buds
Principles of Sensory Evaluation

Papillae look like bumps on tongue

- fungiform located on front of tongue, look like button mushrooms
- foliates, supposedly leaf-like, show up as a reddish series of folds on each edge near the back of the tongue
- circumvallates are way on the back, practically down the throat, stand like round moated towers across the tongue’s surface in an inverted “V” pattern
Gustatory Nerves
Taste Receptors
Certain proteins on surface of mouth act as receptor sites for specific molecules.

This is done by virtue of particular shape molecule attached.

Protein changes configuration becoming permeable to certain ions.

Gives rise to small electrical charge.

Charge is picked up by nerve fibers.

Nature and overall pattern of currents produced by tongue thought to be info brain uses to determine taste.
Summary – Reception in the Mouth

Chemo- and thermo receptors in the mouth. More than the five basic tastes - other receptors believed to be important for overall taste quality of foods/beverages.
Principles of Sensory: Olfaction
Most of what we perceive as flavor is detected via the olfactory sense.

Humans can discriminate between thousands of odors [10,000 + & down at very low concns!]

From childhood we establish odor memory: can elicit vivid memories - Grandma’s house can elicit reactions - chocolate / onions

Odors commonly classified by object that produce them:

- fruity, grassy, woody, papery
Principles of Sensory Evaluation

- Odor molecules detected by olfactory epithelium located on roof of nasal cavity
- Receptor cells have millions of hair-like cilia which project into mucous layer covering epithelium
- Mucous layer serves to collect and concentrate molecules from air flowing over it
Anatomy of the olfactory system
Anatomy of the olfactory system
Typical nerves paths:

- Most neuronal connections of the sensory system involve the thalamus which relays the sensory experience to the primary center in the cortex.

- For example, mouth feel is an instance of the sense of touch detected by the trigeminal nerve (CN V) and conveyed to thalamus which relays it to cortex.

- Another circuit in the thalamus is involved with the Papez circuit which describes the connections between parts of the brain that link emotions and memory.
Anatomy of the olfactory system

Smell:
- Smell is unique because unlike the other senses its nerve paths don’t go directly to thalamus.
- The olfactory receptor neurons (CN I) convey signals representing the aromas sensed to the olfactory bulb.
- The neurons exiting the olfactory bulb first enter the Papez circuit by targeting the areas involved in memory and emotion on their way to the thalamus, where all the information is interpreted.
- This path seems to give smell a disproportionate affect on memory and emotion formation.
Anatomy of the olfactory system
So how do we smell our beer?
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>ANOSMIA</td>
<td>a complete loss of smell</td>
</tr>
<tr>
<td>HYPOSMIA</td>
<td>partial loss of smell</td>
</tr>
<tr>
<td>HYPEROSMIA</td>
<td>enhanced smell sensitivity</td>
</tr>
<tr>
<td>DYSOSMIA</td>
<td>distortion in odour perception (includes parosmia &amp; phantosmia)</td>
</tr>
<tr>
<td>PAROSMIA</td>
<td>distortion of perception of external stimulus</td>
</tr>
<tr>
<td>PHANTOSMIA</td>
<td>smell perception with no external stimulus</td>
</tr>
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</table>
Synesthesia

- What is synesthesia – how frequent?
  - 1:2000 People

- An issue where an associated sense is coming from another. A number, date person or object will relate to you as a color for example.
Summary Olfaction

1. Odorants bind to receptors.
2. Olfactory receptor cells are activated and send electrical signals.
3. The signals are relayed via converged axons.
4. The signals are transmitted to higher regions of the brain.
Summary Taste/Olfaction
Principles of Sensory Evaluation

Complications can arise

- many terms can be ascribed to a single compound
  thymol = herb-like, green, rubber-like
- multiple terms used to describe the same compound at varying concentrations
  DMS = malty, veggie-like, tomato juice, oysters
- many compounds can be associated with a single term
  lemon = alpha-pinene, citral, linalool, alpha-terpeneol
Principles of Sensory Evaluation

- First principles: GET EVERYONE ON THE SAME PAGE! Train your panelists so that all comprehend flavor notes using the same or very similar descriptors so that you know what each panel member refers to when they describe (an) attribute(s).

- We consider in this seminar thresholds. Panelists must appreciate first of all what they will be looking for (with common terminology) as you determine their (individual) and the group threshold data.
Chemical sense associated with irritation
- pain referred to as Trigeminal Sensations
  - Trigeminal nerve - mediates perceptions of
    - burning, tingling, cooling

Trigeminal stimulants horseradish, ginger, vinegar

Trigeminal nerve splits > several branches > innervates the
tongue, oral mucosa, nasal mucosa, throat, and other areas
of the face.

Reflex responses to trigeminal stimuli serve to reduce
exposure to irritants and include sneezing, increased
salivary flow, sweating.
Pathway of the trigeminal (V) nerve

(Redrawn from Netter, F.H., CIBA Collection of Medical Illustrations, Vols. 1 and 3, Ciba-Geigy Corporation, Summit, NJ, 1973)
Principles of Sensory Evaluation

Flavor
Total oral impression

Taste
Tasting substances via taste buds

Aroma
Total oral impression via olfactory receptors

Tactile Sensations
Physical stimuli

Gustatory Odor
Aroma via retro nasal passage

Odor
Aroma chemicals directly via the nose
Principles of Sensory Evaluation

- Analytical Process
  - The taster
    - Perceives
    - Detects
    - Compares & Remembers
    - Stores
    - Describes
    - Evaluates
The Everyday World of Sensory

Stimulus | Sensation | Perception | Response
Principles of Sensory Evaluation
Myths & Misconceptions - I

“Taste is static”

- Taste is dynamic, not static.
- Environment and personal experiences affect sensitivity.
- Physical as well as mental well being have been linked to sensitivity.
- Senses must be exercised.
Principles of Sensory Evaluation
Myths & Misconceptions - II

“Temperature of sample is not critical”

- For reproducibility, temperature control is essential
- Flavors are enhanced at warmer temperatures
  - cooler temperatures reduce spicy notes
  - warmer temperatures enhance spicy notes
Principles of Sensory Evaluation
Myths & Misconceptions – III

“Once a bad taster, always a bad taster”

- With proper training and practice one can learn and improve sensory acuity
- Even those who are adverse to a product, in many cases, are the most sensitive tasters
- Smokers can be as sensitive as non-smokers
Principles of Sensory Evaluation
Rules of Tasting - I

- Clean, quite room with no competing stimuli
- No eating, drinking, smoking 1 hr. before tasting
- Be prompt
- Gently swirl sample taking short sniffs to record aroma impression first
- Take small sips swirling with tongue throughout mouth
- To avoid oversaturation, allow 15 - 60 seconds for re-adaptation
Panelists should be familiar with the ballot and what is required of them.

Taste samples from left to right.

Arrange samples from lighter to heavier.
  - Consider putting high hopped beers at the end.

Judge similar samples at the same time.

Panelists may be asked to remain in the room until all ballots are turned in for review.
Sensory Test Facilities - I
Sensory Test Facilities - II

- Panel Room
  - Separate clean room
  - Odor free – temp controlled and quiet
  - Individual booths
  - Serve beer “blind” – no visual cues
    - Red light?
  - Computers?
- Separate Entrance/Prep area/Conference room
Sensory Test Facilities - III

- Serving samples
  Correct or randomized order
  Served in ruby-red glasses?
  Served at the right temperature (e.g., 45±2 °F)
  Shape and quality of glass
  Beer clean glasses or plastic
  With full ballot instructions known
  Without overhearing/seeing other panelists?
Additional information can be supplied upon request

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for the
American Brewers Guild
Brewing School - 2014