Sensory Analysis: Detecting, Preventing, and Resolving Off Flavors in Draught Beer
Introduction:

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<table>
<thead>
<tr>
<th>True to Brand Fat Tire</th>
<th>Stale Fat Tire</th>
<th>True to Brand Sierra Pale Ale</th>
<th>Stale Sierra Pale Ale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diacetyl Fat Tire</td>
<td></td>
<td>Brass Torpedo Extra IPA</td>
<td>Sanitizer Torpedo Extra IPA</td>
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</tbody>
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We use a combination of our senses to determine our overall impression of a beer...

**VISUAL**
How does the beer look?

**AROMA**
How does the beer smell?

**TASTE**
How does the beer taste?

**MOUTHFEEL AND BODY**
How does the beer feel?
VISUAL

We “drink” with our eyes. What can the visual tell us about the beer?

The Four C’s...

• Color:
  • Indicator of the malts used
  • Kilning: how roasted are the malts

• Clarity: Filtration

• Carbonation:
  • Does the beer have a nice head?
  • Does the beer look alive?

• Cleanliness:
  • Is the head collapsing quickly?
  • Bubble Patches
VISUAL: Color

SRM = Standard Reference Method

SRM x 1.97 = EBC
(European Brewery Convention)
VISUAL: Clarity

- **Bright** = clear
- **Sheen** = very small particles you can’t see individually; looks slightly filmy
- **Haze** = small, uniformly dispersed particles you can see individually, but shouldn’t be large or “chunky”
- **Particulate** = large particles, chunky monkeys
AROMA

What does the aroma tell us about the beer?

- Aroma contributes 80% to the overall perceived flavor of the beer.
- Smell is direct: Compounds floating in the air come into contact with our neurons.
- Humans can perceive around 10,000 perceptible aromas.
- We can only identify up to 3 compounds in a mixture.
AROMA

Vs.

• **Aroma** is cognitive, *Brain Power*, not *Nose Power*
  • **Experts** = cognitive
  • **Novices** = emotional
• **Repeated training**s are important!
AROMA

Ortho-nasal vs. Retro-nasal

• Between the upper part of the nasal cavity and the back of the throat there are around 9 million olfactory neurons
• The two systems are separate and processed by the brain differently
• The retro-nasal system perceives less as “aroma” and more as “flavor”
AROMA

Aromas fall into different categories

<table>
<thead>
<tr>
<th>Esters</th>
<th>Sulfurs</th>
<th>Organic Acids</th>
<th>Aldehydes</th>
<th>Phenols</th>
<th>Hop Oils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoamyl A</td>
<td>DMS</td>
<td>isov</td>
<td>acetaldehyde</td>
<td>Phenolic(4VG)</td>
<td>geraniol</td>
</tr>
<tr>
<td>E hex</td>
<td>H2S</td>
<td>butyric</td>
<td>papery</td>
<td>chlorophenol</td>
<td>lianalool</td>
</tr>
<tr>
<td>Ethyl but</td>
<td></td>
<td>caprylic</td>
<td></td>
<td>smokey</td>
<td>grassy</td>
</tr>
</tbody>
</table>

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TASTE

What are we tasting?

• Flavor vs. Taste
• There are only 5 Tastes...
  • Sweet
  • Bitter
  • Sour
  • Salty
  • Umami
TASTE

Papillae

Taste bud

Dissolved food enters taste pore

Chemical change

Signal sent to brain

Different signals = different tastes
TASTE

- **Sweet**: Indicates energy-rich foods
- **Sour**: Indicates unripe and spoiled foods
- **Salty**: Indicates electrolyte balance in our bodies
- **Bitter**: Indicates toxicity
- **Umami**: Indicates Protein-rich and ripe foods
MOUTHFEEL & BODY

What can the feel of the beer tell us about the beer?

- Carbonation (pain)
- Alcohol warming (pain)
- Mouth-coating
- Astringency
- Metallic
- Viscosity
- Body (how filling?)
What can the feel of the beer tell us about the beer?

- The trigeminal nerve is responsible for touch (feel), pain, and temperature.
- The lingual nerve (a branch of the mandibular) carries somatic sensation from the tongue.
Texture perception, viscosity, and mouth-coating from detecting frictional and hydrodynamic forces by neural mechanoreceptors.

Yeah...
BODY

Basically, how thick (how viscous) is the beer?

Three categories:

LIGHT

MEDIUM

FULL
BODY

Carbonation

• Carbonation is pain (nociception)
• Carbonation makes liquids appear to have a lighter body
• Smaller bubbles have a thicker mouthfeel. Nitrogenation makes lighter beers perceived as “heavy” or “filling” – not true.
5 Step Taste Evaluation:
How do we maximize these sensations?

VISUAL – AROMA – FLAVOR – MOUTH-FEEL

1. Hold up to the light and look for color and clarity
2. Swirl and “Drive By” (run under your nose)
3. Two short sniffs
4. One small sip - Just enough to coat your mouth
5. One more sip with Retro-nasal
Oxidation Leads to Stale Beer

• Time & temperature
• 2-3X faster for every 10 degrees
• Complex biochemical reactions
• How much D.O. is in the beer
• What are the temps
• How long is storage
Importance of Cold Storage

![Graph showing the time to develop distinct aged character (days) at different temperatures.]

- Refrigerator
- "Classic" room temperature
- California summer

**Temperature (°C)**
- 0°C (32°F)
- 10°C (50°F)
- 20°C (68°F)
- 30°C (86°F)
- 40°C (104°F)
- 50°C (122°F)
- 60°C (140°F)

**Time to develop distinct aged character (days)**
- 800
- 700
- 600
- 500
- 400
- 300
- 200
- 100
- 0
Stale Flavor Development

Schema of beer aging/flavor changes

- Bitterness
- Ribes aroma: catty - tomato leaves, blackcurrant leaves
- Sweet aroma (Honey-Sherry-like)
- Sweet taste, toffee-like (Bourbon) aroma and flavor
- Cardboard (oxidized) aroma/flavor

Time (months)
Intensity

Adapted from Daigleish ca. 1977
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Oxidation

...is such a broad word that just means “the combination of a substance with oxygen”

There is an entire flavor wheel dedicated to oxidative flavors in beer, but we are only going to focus on the most prevalent ones.
Oxidation: Fat Tire

Oxidation flavors and aromas include:

- The dulling of key flavors
- Rotten vegetables
- Dried fruit (fig, raisin, currants)
- Vinous (wine-like)
- Soy sauce
- Sweaty socks (think stinky cheese)
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Oxidation: Sierra Pale Ale

...is such a broad word that just means “the combination of a substance with oxygen”

- Hop and ester aromas dissipate and disappear
- Cooked cereal manifests
- Sherry-like characteristics develop
Ensuring Freshness-Supplier

• Brewer production planning
• Package stable beer
• Ship beer in good condition
• Ensure reasonable age
• Maximize selling days for distributor
• Communicate quality standards
DATE LOT CODING

It is the position of the Brewers Association that it is in the best interest of Craft Brewers, distributors, importers, and consumers that all Craft Beer be identifiable by some form of a date or lot code ("code"). It is the responsibility of all brewers, big and small, to ensure that their products are clearly coded for traceability.

The code should act as a vehicle to trace a package in the marketplace back to a package date. The assigned lot number should cross reference the specific brewed batch (es) of beer that encompass the specific packaged beer, through internal brewery tracking.

As stated by the Bioterrorism Act, breweries are required to insure traceability of their beer. Brewers must keep internal records of the specific ingredients, including manufacture lot numbers that were used in individual batches.

Lot coding serves three main functions:

1. The most critical function is for the unfortunate case of a quality or safety recall. While all brewers strive to avoid such cases, it is critical for all to be prepared for this occurrence.
2. A valuable quality tool in the distribution chain, allowing wholesalers and retailers to rotate and utilize first-in first out methodology.
3. Allow a degree of transparency for consumers to understand the shelf life of a beer.

The methods of coding vary, and the specific method through which it is accomplished is up to the brewer. A brewer may choose to list the specific packaging date or to use an encrypted code, provided the code is legible. However for the sake of transparency, it is the recommendation of the BA that either the package date or a "best by" date is listed and easily readable by the consumer.

There are several methods for coding. Some examples are:

• Standard or Gregorian Date package date coding
• "Best by" dating
• Julian date coding
• Unique company specific date coding

There is a wide variety of techniques and equipment available to use for coding purposes. They can be as simple as hand written numbers or as sophisticated as automated laser etched coding systems. The specific technique a brewer uses will vary depending on the size of the brewery and available resources.
Ensuring Freshness-Distributor

- Plan inventory with brewer
- Store according to standard
- Rotate according to date
- Manage freshness at retail
- Monitor par levels
- Rotate beer & remove OOC
5 Step Taste Evaluation:
Repeat With Each Sample

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Diacetyl (anaerobic)

Visual, Aroma, Flavor, Body

- **Visual** → Where’s the foam?
- **Aroma** → Buttery, movie popcorn
- **Taste** → Sweet
- **Body** → Slick, coating mouth-feel

![Images of Pediococcus and Lactobacillus]

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Acetic Acid (aerobic)

Visual, Aroma, Flavor, Body

- **Visual** → Pretty much the same
- **Aroma** → Vinegar
- **Flavor** → Vinegar, acidic, sour
- **Body** → Dissipated
Diacetyl

Where does it come from?

• A normal byproduct of fermentation, produced by yeast, that the yeast then uptakes near the end of fermentation
• An abnormal byproduct of *anaerobic* bacterial contamination when hygiene standards are inadequate – starts in-line
• Prevented with proper line cleaning practices
• Required deep clean and part replacement to remove
Diacetyl

Line Cleaning: The Industry Standard Way

Cleaning Agent = non-chlorinated caustic
Concentration = 2-3% solution
Temperature = 90° F
Method = pump recirculation
Contact time = 15 minutes
Frequency = every 2 weeks
Diacetyl

Line Cleaning: The Industry Standard Way

Sonic Cleaners

Devices that purport to electrically or sonically clean draught lines are not a suitable substitute for chemical line cleaning. Although some sonic cleaners may inhibit bacteria and yeast growth, they have little or no cleaning effect on the draught system’s hardware and fittings.
5 Step Taste Evaluation:
Repeat With Each Sample

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Stainless vs. Brass

Smooth  pitted
Stable  corrosive
Inert  reactive

Probe, tailpiece, splicer, shank, faucet
Comparison

Stainless Steel
50-100 ppb Copper
Expressive hoppy
Carbonated
Malt/hop taste
Clean finish, hop bitter

Brass
700-900 ppb Copper
Muted/restrained
Slightly flat
Harsh/astringent
Metallic coating
tongue
5 Step Taste Evaluation: Repeat With Each Sample

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Sanitizer

- Clean, Rinse, Sanitize...Air-dry
- Trichlororomelomine
- Methods of air-drying
- Chilled but never frozen
- Aroma transfer
Storing

- Glasses need time to dry
- Glasses need time to cool down
- Space needs to be free of odors, smoke, dust
- Maximize air circulation
- No smooth surfaces
QUESTIONS?