Brewing Science

Troubleshooting & Quality Analysis

Why Evaluate Beer

- Quality control and Consistency
- To be able to describe beer
- To score and/or judge a competition
- To define styles
- To detect problems and improve your own or someone else's beer

Flavor Profile

- Appearance (Visual examination)
- Aroma/Bouquet (Olfactory examination)
- Taste (In the mouth examination)
- Overall impression (General quality)

Use all six senses

- Sight
- Hearing
- Smell
- Taste
- Touch and feel
- “Pleasure”

Sight

- Head space in the bottle
- Surface deposit inside the bottle neck
- Gushing
- Haze
- ‘Legs’
- Foam stability/Head retention
- Clarity

Hearing

- Level of carbonation
- Specific tones for specific levels of CO_2

Smell - (Aroma/Bouquet)

- Volatiles/Aromatics
  - Diacetyls
  - Phenolic character
  - Esters
- Aroma from malt, grain, and fermentation
- Bouquet directly attributable to hops
- Odor - (Sulfur based compounds/oxidation)

Taste

How beer affects the sensation of taste

- Bitterness - Hops, Tannins, Malt, Minerals
- Sweetness- Malt, Hops, Esters, Diacetyl
- Sourness- Carbonation, Contamination
- Saltiness - Minerals

Touch and Feel

- Texture - creamy, over/under carbonated
- Body - full bodied or thin...
- Astringency - Dry, puckery feeling (Not really a flavor)
- Others - Oily, menthol-like, burning, etc

Pleasure

- Overall impression
- Close your eyes- Is it memorable?
- Would you want another one?

Maximizing Flavor Perception

- Begin with lighter styles and progress to darker, more full bodied beer
- Don't smoke or be in a smoky room
- Do not eat salty or greasy food while tasting
- Do not wear lipstick or Chapstick
- Eat french bread or saltless crackers to cleanse palate
- Use clean glassware

Evaluating Beer

- Appearance
  - Examine bottle for sediment
  - Pour the beer
  - Quickly sniff the beer
  - Examine the beer in the glass
- Odor
  - Aroma (non-hop odors from raw materials)
  - Bouquet (odor from fermented elements)
  - Hop nose (hop aroma of beer)

Evaluating Beer - cont'd

- Taste in the mouth
  - Take a good sip
  - Swirl and slosh around your whole mouth
  - "Swizzle" (suck in air through beer in your mouth)
  - Small sip to check 4 tastes
  - Check Astringency
  - Check after-taste or tail
- General Quality
  - Memorableness or "come hither appeal"

The ‘taste’ of beer

- Hop quality
- Hop intensity
- Sweet/dry balance
- Beer character
- Aftertaste or tail
- Body and Palatefullness
- Flavor balance

Summary

- Becoming a knowledgeable beer drinker takes practice
- Taste, smell, feel, and look at your product during every step
- Evaluate the beer as it ages
  - What sulfur characters come and go?
  - Which phenolic characters get worse with age?
  - How does bitterness and diacetyl rise and fall?

Troubleshooting

Introduction

- Many problems with our brews can be attributed to poor ingredients, poor brewing techniques, or poor sanitation. Fortunately, many of these issues can be identified and resolved.

Fault Examples

- Off flavors: fruity, harsh, sweet, or bitter
- Haze: level of particles in suspension
- Lack of body – level of non-fermentable sugars and polyphenols
- Poor head retention or formation

Gram Negative/ Gram Positive Bacteria Contamination

- **Gram Negative**
  - Acetic Acid Bacteria
  - Pectinatus cervisiiphilus
  - Enterobacteriaceae
  - Zymomonas
  - Pectinatus frisingensis
  - Selenomonas Lacticifex
  - Zymophilus raffinosivorans
  - Zymophilus paucivorans
  - Megaspaera
- **Gram Positive**
  - Lactobacillus
  - Lactic Acid bacteria
  - Pediococcus
  - Leuconostoc
  - Homofermentative cocci
  - Kocuria, Micrococcus and Staphylococcus
  - Endospore-forming bacteria

Alcoholic

- By alcoholic, we mean the aroma, flavor, and warming effect of ethanol and higher alcohols. It can be described as hot.
- High levels of fusel alcohols can lead to an alcoholic characteristic in beer. Fusel alcohols have a more complex molecular structure than ethyl alcohol.
- Typically, fusel alcohols:
  - provide an initial sweetness followed by a harsh after taste.
  - are formed by the metabolism of amino acids, so over modification during malting or mashing can lead to higher fusel alcohol levels.
  - increase with fermentation temperature, level of amino acids, and wort gravity.
- Wild yeast can produce very high levels of fusel alcohols, so use proper sanitation techniques during brewing.

Astringency

- By astringent we mean a mouth puckering sensation
- Common causes of astringency in beer include:
  - Extraction of tannins from grain due to over crushing or over sparging.
  - If the pH of the sparge water exceeds 6 or if the sparge water temperature exceeds 168 °F, then tannins may leak into your wort causing astringency.
  - Acetic acid bacteria, like acetobacter, can cause sour or vinegary flavors and aromas. Use good sanitation to avoid bacterial contamination.

Beer Haze

Chill Haze

- Haze occurs when the beer is chilled but disappears as the beer warms.
- Chill haze is from high molecular weight proteins and polyphenols forming weak bonds. The bonds are broken as the temperature of the beer increases.
- To avoid use properly malted grains and use a protein rest.
- Also, fining agents can be used to control chill haze. Polyvinylpolypyrrolidone (PVPP) removes polyphenols and silica gels and Irish moss remove proteins.

Beer Haze

Starch Haze

- A permanent haze in beer from large molecular weight carbohydrates, including β-glucans.
- Caused by poor mashing and sparging.
- To avoid starch haze in beer:
  - Allow proper starch conversion during mashing
  - Reduce sparge temperature
  - Use quality malts that do not have high amount of β-glucans .

Beer Haze

Biological Haze

- Bacteria and wild yeast can cause haze in your beer.
- To avoid biological haze:
  - always use proper sanitation during brewing
  - Pitch proper amount of healthy yeast cells
  - Use well flocculating yeast strain.

Beer Haze

Oxidation Haze

- Over time oxidized compounds in beer can cause protein and polyphenol haze.
- This haze will eventually occur in all beers
- To control oxidation haze, avoid introducing oxygen into wort and beer, except to aerate yeast at pitching.

Body

- Body means fullness of flavor and mouthfeel. Examples range from watery for Lite American Lager to thick and chewy for a Strong Scotch Ale.
- The body of a beer is determined by the amount of dextrins and medium level proteins.

Body

- Light beer body is caused by:
  - Lack of dextrins from low starch conversion temperatures during mashing.
  - Excessive use of adjuncts.
  - Using high attenuating yeast strains.
  - Lack of medium level proteins from long protein rest.
  - Adding large amounts of fermentable sugars
  - Using too many fining agents.

Dimethyl-Sulfide (DMS)

- DMS may create an aroma and flavor of cooked vegetables like corn, celery, or cabbage. Low levels are common in Pils malt.
- The precursor to DMS is S-methyl methionine (SMM) which is formed during malting. SMM levels are controlled by the maltster.
- The brewer can also control SMM by performing a vigorous open rolling boil for at least one hour. The strong open boil will evaporate the SMM.

Dimethyl-Sulfide (DMS)

- After boiling, cool the wort as quick as possible because cooling the wort too slowly can lead to higher levels of DMS.
- A vigorous fermentation can reduce DMS levels because CO_2 bubbles can carry away DMS.
- Wild yeast can also produce high levels of DMS, so make sure you use proper sanitation to avoid these unwanted bacteria.

Head Retention

- For good heat retention, beer needs an adequate supply of polypeptides, with molecular weight between 500 to 12,000. Under modified malts require a protein rest to reduce the higher molecular weight proteins to lower molecular weight proteins.
- Another requirement for good head retention is proper carbonation levels.
- Fatty acids from wort trub and unclean glassware can reduce head retention by decreasing the surface tension of the beer foam.