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Home Brewing

Beer Clarity

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Clarity Intro

- When Clarity Matters
- Types of Haze
- Causes of Haze
- Solutions
  - Ingredients
  - Process
  - Finings
  - Filtering

When Clarity Matters

When Clarity Doesn't Matter

Measuring Haze

- Radiometer Haze Meter
  - EBC scale
  - Uses a light beam to measure the amount of matter suspended in a liquid
- "Pseudo Haze"
  - Small particles may reflect light but not affect clarity of beer
- "Turbidity"
  - The particles that are visible

Unfortunately
Measured haze is not always the same as turbidity

Potential Causes

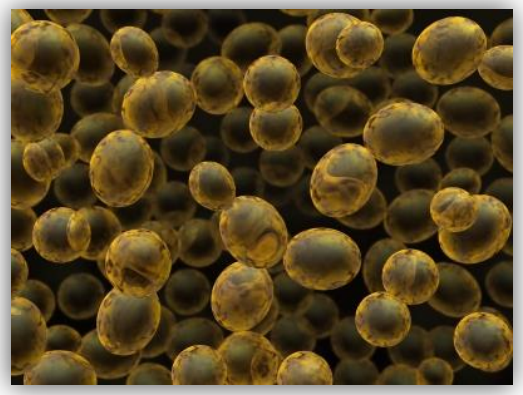
- Proteins and Polyphenols from malt and hops
  - Most frequent cause of clarity issues in beer
- Other Causes
  - Yeast (mainly in immature beers)
  - Calcium deficient worts (Oxalates)
  - Wheat derived adjuncts (Pentosans)
  - Inadequately modified malt (Beta-glucans)
  - Dead bacteria from infection
  - Damaged yeast (Carbs and proteins)
  - Lubricants, excessive finings, foreign material

Types of Haze

- Chill Haze
  - Haze that only shows up when the beer is cold (often near freezing)
- Permanent Haze
  - Haze that is present whether the beer is warm or cold
- Chill Haze often becomes permanent over time
- Haze Generally has no Flavor!

Yeast and Clarity

- Yeast cells a problem early on
  - Yeast is 5-10 micron in size
  - Tend to flocculate with age, chilling
  - Some yeast can remain suspended
- Mitigation
  - Choose high flocculation strains
  - Finings work well with yeast
  - Filtering – can remove almost all yeast
  - Yeast is rarely the cause of permanent haze or chill haze



Proteins and Polyphenols (Tannins)

- Proteins are present in grains
  - Most malt sheets show the percent protein
- Polyphenols (Tannins)
  - Come from both malt and hops
  - Hops accounts for approx 20-30% of polyphenols
  - Hop polyphenols tend to be less reactive than those from malt

Chill Haze

- Happens when a low molecular weight Polyphenol interacts with a Protein
  - Particle sizes range from 0.1 to 1 micron
  - Visible at room temperature, but not near freezing
- Prone to polymerization with other proteins
  - Leads to a permanent haze
  - Reaction is aided by oxygen in the finished beer

Ingredient Selection

- Malt Selection
  - Can select low protein malts
  - Tannins (polyphenols) come primarily from husk, and some grains have de-husked versions
  - Tradeoff in foam retention
    - Some proteins (polypeptides) promote foam retention
- Hops (20-30% of Polyphenols)
  - Aroma hops do deliver slightly more polyphenols
  - Select hops for flavor, not phenol content

Tips for the Boil

- Long, Rolling boil promotes precipitation of Proteins/Tannins
  - Recommend 60-90 minutes at a strong boil (90 is better!)
- Maximize Hot Break
  - Foam at beginning of boil is start of it (skimming?)
  - Chill as quickly as possible
- Oxygen in mash/boil not ideal
  - Effect is small – primarily a commercial concern

Beer pH and Mashing

- Strive for Clear Runnings (no turbidity)
  - Avoid disturbing mash bed (raking, mixing, etc..)
  - Do a Vorlauf (recirculate first runnings until clear)
- Avoid oversparging
  - Most tannins (polyphenols) are in late runnings
- Low Mash pH is Better
  - Target a mash ph = 5.2
  - Higher pH associated with more phenols/protein extraction
  - Treat your sparge water as well – lower pH is better

The Cold Break and Finings

- Cold Break with Rapid Chilling
  - Starts forming around 140F (60C)
  - Coagulation of proteins, tannins and hop matter (hop polyphenols precipitate faster)
  - Effective cold break promotes clarity and flavor stability
  - Best to separate the break from the wort if possible before fermenting
- Irish Moss – Boil 15 min
  - Positively charged ions aid coagulation of both proteins and polyphenols (tannins)
- Whirlfloc Tablets
  - Concentrated carrageenan
  - Similar effect, preferred by many Craft brewers

Lagering and Cycling

- Cold Crashing
  - Take the beer rapidly down to near freezing after fermentation is complete (kegged beers only)
  - Aids in precipitation, improves clarity
  - Often used to prepare beer for cold filtering
- Hot-Cold Cycling Test
  - Used by commercial brewers to test stability of beer (simulate aging)
  - Cycle beer to 100 F (37 C) for a week, then take it back down to storage temperature (and repeat)

Fermentation Finings

- Gelatin
  - Available in “jello” section at grocery (unflavored) – works on proteins and tannins
  - Prepare 1 pkg for 5 gal (19 l) batch in hot water, add a few days before bottling
- Polyclar (PVPP) Plastic
  - Effective against both proteins and tannins
  - Used both by home and pro brewers (1 tbsp per 5 gal)
- Silica Gels
  - Effective at binding proteins
  - Add 6-10 grams per 5 gal/19 liter batch
  - Can affect flavor/foam if done to excess

Fermentation Finings – Pro

- Isinglass
  - Derived from fish bladders, positive charge
  - Effective at removing yeast cells and proteins
  - Also removes some lipids, which improves foam stability
- Papain
  - One of the first finings used commercially
  - Negative impact on foam stability

Filtration

- Cold Filtering (kegging only)
  - Removes yeast, polyphenols and some proteins
  - Wait before filtering –
    - Important changes happen during late fermentation/lagering
  - Most home brewers place filter between two kegs with an inline, cartridge filter
  - Two stage filters (5 micro, 0.5 micron) less likely to clog

Cartridge Filter

Plate Filter

Storage

- Cold Store Your Beer
  - Warm temperatures or cycling temperature will make clarity worse over time
  - Can lead to permanent haze
  - Heat also leads to flavor instability
- Oxygen
  - Plays a significant role in permanent haze formation
  - Oxygen during transfers are the largest risk for most home brewers

Summary

- Key Points for Better Clarity
  - Select lower protein malts
  - Mash and sparge at a lower pH (5.2)
  - Don’t oversparge, don’t disturb grain bed (no turbidity)
  - Boil for 90 minutes, use a boil fining
  - Cool boil quickly for a good cold break
  - Consider cold crashing after fermentation, age cold
  - Use finings before kegging/bottling
  - Consider filtration
  - Avoid introducing oxygen – during transfers or kegging
  - Cold store your beer

Questions?

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