

Beer Clarity

SOCIETY OF BARLEY ENGINEERS 8/2/17

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Should You Care About Clarity?

- For the most part, clarity has little to no influence on beer flavor*
- In certain styles, haze is either encouraged/tolerated or largely unnoticeable - for example with wheat beers or very dark styles
- For those that compete, appearance makes up a whopping total of 3 out of 50 points.
- However, if you decide clear beer is important to you, then you may find that you've just entered...

*This is the official line given by most sources regarding clarity. Let's not derail into a hop polyphenol/haze craze discussion and start throwing hop sludge at each other until after the presentation.

The Miss Barley Beauty Pageant



Sources of Haze



■ Primary Sources:

1. Protein
2. Polyphenols (tannins)
3. Suspended Yeast

■ Secondary Sources:

1. Wheat derived adjuncts
2. Oxalates from calcium deficient wort
3. Beta glucans from inadequately modified malt
4. Dead bacteria
5. Carbohydrates and proteins from damaged yeast



Protein

- Malt includes various types of protein that serve a variety of functions in the kernel
- Most modern varieties of barley malt have been bred and malted to be well modified and have low protein content for optimal brewhouse performance
- A typical malt analysis sheet can be seen at right

Briess Pale Ale Malt

TYPICAL ANALYSIS

Mealy / Half / Glassy	98% / 2% / 0%
Plump	80%
Thru	2%
Moisture	4.0%
Extract FG, Dry Basis	80.0%
Extract CG, Dry Basis	78.5%
Extract FG/CG Difference	1.5%
Protein	11.7%
S/T	42.0
Alpha Amylase	45
Diastatic Power (Lintner)	85
Color	3.5° Lovibond



Polyphenols



- Often referred to as tannins
- Present in both malt and hops, thereby introduced both during the mash and the boil
- Typically about 20-30% of the polyphenols come from hops, with the remainder coming from the grain
- Will form bonds with proteins that can either help both particles fall out of solution or can result in visible haze in finished beer
- Can also contribute astringency in finished product



Chill Haze vs. Permanent Haze

- Chill haze occurs when polyphenols and protein compounds in finished beer form loose bonds at cold temperatures and become larger, visible particles. Once the beer warms, the bonds break and the haze clears.
- Permanent haze is noticeable at all temperatures.
- Chill haze will eventually become permanent given enough time. The process can be sped up when oxygen is introduced after fermentation.



Paul's Kolsch Experiment

- Brewed a kolsch and used three finishing techniques: control, gelatin, and polyclar
- OG 1.045 and FG 1.010 in gelatin and ployclar versions and 1.012 in control
- Fermented for 2 weeks at 58 degrees, 1 week at 68, then crashed to 45 for 3 weeks
- Finings were introduced during the cold conditioning stage





Paul's Kolsch Experiment



Left to Right: Control, Gelatin, Polyclar



Mash

Reduce the introduction of haze forming particles during the mash by:

1. Promoting the formation of a good stable filter bed
2. Performing a “vorlauf” or recirculation of wort at the outset of lautering
3. Maintaining proper mash pH throughout to avoid excess tannin extraction
4. Avoiding oversparging or raising the temperature of the mash above 170 degrees during sparging





Boil



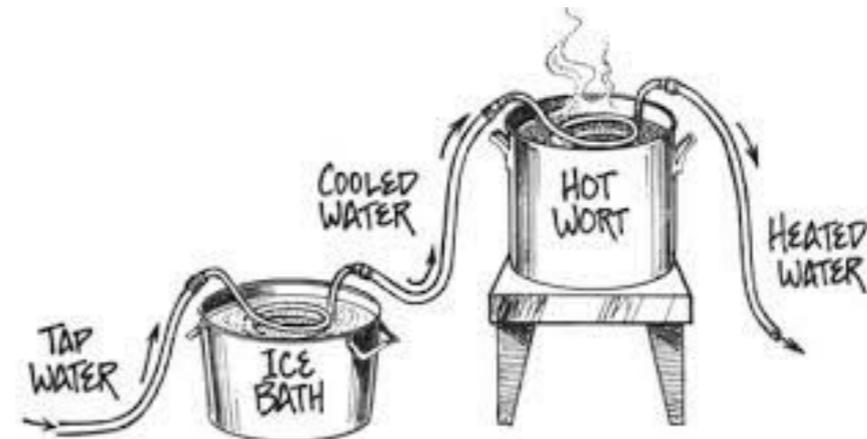
Encourage the precipitation of protein and polyphenols:

1. Conduct a sufficiently vigorous boil to produce “hot break” - proteins and some polyphenols coagulate into larger particles that are heavy enough to fall out of solution
2. Boil for at least 60 minutes to encourage those haze forming particles to group up



Chilling

- Rapid chilling of wort helps promote the formation of “cold break”^{B3}
- Cold break is similar to hot break - coagulated protein and polyphenol particles
- Typically forms smaller particles that can be more difficult to remove from solution
- Formation of large particles capable of precipitating out of solution can be aided by rapid cooling and kettle finings



Kettle Finings



- Typically added with 10-15 minutes remaining in the boil
- Introduce positively charged ions that promote the coagulation of both protein and polyphenol compounds
- Most common kettle finings:
 - Irish Moss^{B1}
 - Whirlfloc^{B2}





Separate Wort from Solids

- Once all those proteins and polyphenols have grouped up, it's important to separate the wort from them on its way to the fermenter^{B4}
- A whirlpool step can be included either prior to or after cooling (depending on your chiller setup) to encourage all solids, including any hop matter, to settle at the bottom of the kettle
- Use a siphon or ball valve with dip tube when collecting wort from the kettle to help leave solid matter behind



Gaggioli Blonde Experiment

- Mike valiantly carried home 5 gallons of wort from Booze Brothers
- We pitched two vials of WLP029 (rumored to be somewhat powdery)
- Began fermentation at 65 degrees, and after a few days let it slowly rise to 70, reaching FG of 1.016
- Dry hopped with 2 oz. of El Dorado
- Crashed to 40 degrees after 4 days of dry hopping, and split the batch into two kegs after 24 hours, one of which contained gelatin solution

Ferment Well, My Friends!



- Remember! A strong, clean fermentation with ample healthy yeast will avoid most of the undesirable secondary causes discussed previously and allow you the luxury of nitpicking about things like clarity





Post Fermentation



Once fermentation is complete, steps can be taken to package clear beer:

1. Cold crash - rapidly chill beer to lagering temperatures to encourage precipitation of solids (proteins, polyphenols, yeast, and hop matter)
2. Use cold side finings
3. Filter
4. Store properly - warm temperatures and temperature fluctuations after packaging should be avoided if possible



Cold Side Finings

- Gelatin^{B5,B6} - flavorless compound with a positive charge, encourages precipitation of proteins and polyphenols in finished beer.
- Polyclar (PVPP) Plastic - non soluble plastic that helps remove polyphenols and proteins as well as promote flavor stability; sometimes used by commercial breweries
- Isinglass - similar to gelatin, derived from fish bladders; effective at removing proteins and yeast and promotes foam stability
- ClarityFerm^{B7} - enzyme that unlike finings actually breaks down haze causing proteins and polyphenols, including gluten; can be used to make “gluten reduced” beer.



Results of Brulosophy's
Gelatin Exbeeriment

Filtration



- Various filtration devices are available to homebrewers
- Typically involves pushing cold beer from one keg, through a filtration device, to a second keg
- Most popular devices:
 - Canister filter (pictured) - beer is forced to pass through a filter; various size filters are available
 - Plate filter - spreads beer across larger surface area filter pads, before passing through to exit the filter

Brulosophy Experiments

B1: Irish Moss improved clarity slightly and had better head retention without any detectable impact to flavor/aroma

<http://brulosophy.com/2015/03/16/the-irish-moss-effect-exbeeriment-results/>

B2: Whirlfloc improved clarity compared to control without any impact to flavor/aroma

<http://brulosophy.com/2017/03/27/the-whirlfloc-effect-exbeeriment-results/>

B3: Rapid Chilling vs. No Chill: improved clarity when beer was rapidly chilled, with noticeable flavor differences. Tasters found a “wet hay” character in the no chill beer while the rapidly chilled beer was much cleaner.

<http://brulosophy.com/2015/11/09/cooling-the-wort-pt-1-no-chill-vs-quick-chill-exbeeriment-results/>

B4: Minimal trub vs. excessive trub: the extra trub was actually noticeably clearer.

<http://brulosophy.com/2014/06/02/the-great-trub-exbeeriment-results-are-in/>

B5: Gelatin noticeably improved clarity. The author finds the beer reduces hop character slightly but creates a crisper, more refined beverage.

<http://brulosophy.com/2015/01/05/the-gelatin-effect-exbeeriment-results/>

B6: Adding too much gelatin actually negatively impacted clarity vs. adding the correct amount.

<http://brulosophy.com/2016/04/25/the-gelatin-effect-pt-4-standard-vs-a-lot-exbeeriment-results/>

B7: Gelatin compared to Clarity Ferm: no detectable difference in flavor, gelatin was more effective as a clarifying agent.

<http://brulosophy.com/2015/07/27/clarity-ferm-vs-gelatin-exbeeriment-results/>