

PROCESS CONTROL FOR BEER PHYSICAL STABILITY: CHILLPROOFING & TARGETING HAZE PROTEINS BY ENZYMES, TANNINS OR FININGS!

Enzymes or Tannins

"Tannic Acid" is a fully oxidized polyphenol....addition rate is in the 1-5 g/hl rate

Siebert: does use of PSP as chillproofer increase beer flavor stability by not taking out PPs?

Brewers using barley enzyme products at mashing need only little SHG to stabilize.

"Brewers Clarex."...proline specific protease claimed to be superior to PVPP. Prevents **PP-Prot interaction** & precipitation.....can be added at mashing, fermentation or aging! **An additive though as carries into finished product.**

Siebert and thought of the day: as PSP is used during fermentation, is aging even needed as a process step if chillproofing is the only function?

Novel Endoproteinases Enzymes (Int Patent # WO 03104382 A1)...use of any of following three groups of enzymes: a) **proline specific endoproteinases**, b) hydroxypropyl specific endoproteinases and c) alanine specific endoproteinases.apply treatment to **mash or wort or post-fermentation**.....specific to haze protein, no impact on foam.

Tannic Acid is derived from Chinese gallnuts.....complexes with protein haze precursors thereby precipitating with tannin-protein flocs when added after fermentationflocs though are substantial, making subsequent filtration difficult and beer losses high. Adding to brewhouse therefore preferred.

Gallotannin ppt of sensitive proteins (+)

Enzymes or Tannins

Siebert & Proline Specific Protease (PSP).....food grade derived from *Aspergillus niger*....endoprotease active over pH 4.0-5.0 which does not increase wort FAN as cleaves only next to prolines....prevents haze formation.....studied two levels of PSP - 1.25 & 2.50 PPU/kg malt added during fermentation compared to a control PVPP at 30 grams PVPP/hL.....test and control beer stored for 8 months at 20°C and no increase seen in PSP treated beer (EBC remained at < 2, even when extended out 13 months!), whereas PVPP treated beer had an EBC haze of 7.0 units! PSP survives pasteurization (60°C for 20 minutes), but no effect on foam as foam proteins are mostly low in proline. Commercial product is **Brewers Clarex**.

Siebert.....3-D models show that **proline in peptides** makes them rigid, elongated and restricted in conformational freedom, and as such proteins containing more proline have more **exposed** areas.....dimeric PPs (e.g. proanthocyanidin B₃) fit into these exposed, extended areas, leading to haze. Monomeric PPs less active....most condense into dimers to have haze-inducing ability....**maximum haze development when the # of 3-OH sites in polyphenols are = to the # of protein binding sites.**

Effect on Beer Physical Stability

Kettle finings (e.g. carrageenan = Irish Moss) has little impact on hot wort clarity, but does yield bright cold wort and better beer filtration. Finings very pH sensitive... worts of pH < 4.5 will not fine....need at least pH 5.0 to get an efficient settling....in some worts variability of only 0.3 pH can significantly impact effectiveness!!

Fosters: use of finings from fruit pectinremove redox active cations.....increase ESR lag times by 30%

Finings: come in forms of powders, tablets, granules or liquid.....grades include Irish Moss, Semi-Refined or Refined, with % k-carrageenan increasing with degree of refinement and as go from powder to tablets to granules.

Liquid product denatures above 23°C and is therefore not very effective or practical.

Finings

Irish Moss finings, traditionally derived from *Chondrus crispus* from Atlantic.....modern sources mostly from the Pacific warm water seaweed (*Eucheama cottonii*) rich in carrageenan - the active ingredient in all finings.....add as powder 10 minutes prior to end of boil..... 10-20 if use hop pellets.....only removes charged proteins, therefore hydrophilic proteins untouched.....removes only small fraction of total protein.....add at 10-50 ppm level.....neutralizes charge or zeta potential on proteins.... important dose rate is correct as too much can result in "repulsion", yielding fluffy, amorphous flocs, significantly increasing process losses. Too little also ineffective as floc does not settle....need to find the plateau [] that is "just right" in terms of floc density and minimizing losses.

SHG addition rates : 80-200 g/hL
PVPP addition rate: 20-60 g/hL....can decrease flavor stability if use excessive levels and remove too much catechin?
Combination of SHG + PVPP in maturation is in 40 - 100 g/bbl rate
Papaya derivative: add at rate of 1-4 g/hL....can hurt foam though as it stays active in product

Papain is not selective for only haze proteins. Survives pasteurization as well, thus package foam deteriorates over time.

Enzymes

**No. XXXIIf
(Casey;
May/06)**