WORT & BEER FILTERABILITY: GAUGE & MODELING

Predictive Tests: Malt

LT_m is a very quick whole kernel assessment.

Tepral procedure to predict lautering not well thought of in Australia!!!

BRI "Mash Filtration" Device/Test.

[Coaguable protein] has limited predictive value for beer filterability.

Correlation of **Kolbach Index** with barley/ malt modification: wort viscosity (.68)...wort **beta-glucan** (.57)...FAN (.77)...beta glucanase (.71).

Good correlation between filtration performance and LT_m values....positive slope and correlation between Malt LT_m (y-axis) and V_{max} in Congress worts (x-axis) is 0.9693!!!!

Malt friability.....positive correlates. with germinability, malt extract yield, and S/T.... **negative correlation** with grain size, raw grain [protein], **viscosity and β-glucan content** of Congress worts....mapping loci for these QTLs.

"Light Transflectance Meter"... reports LT_m values....light diffuses within a mealy endosperm and appears dark, while it is transflected out of a steely endosperm and appears light. ...a LT_m low value/slope = "mealy" endosperm structure... = more homogeneous modification....LT_m assesses whole kernel, providing a quick assessment of the homogeneity of modification.

Evan Evans, GRDC..."dogma" is that KI/viscosity/beta-glucan predict lautering performance....however these are only part of the story, with other compounds, including gels, small starch granules, other CHOs (e.g. **arabanoxylans**) involved."

Raible's filterability filtration test…treat wort with ethanol/citric acid/32°F….predicts production filterability…typically found **POLYSACCHARIDES** to be the main reason for slow filtration (after removing adsorbed material from DE) from either malt (typically), yeast (occasionally) or bacteria (rarely). Each source has characteristic **"saccharin fingerprint "** after hydrolysis and HPLC analysis.

Filtration Tests: Wort & Beer

PALL Method: see MBAA TQ 41(4) : 371-373, 2004.

The membrane filterability of beer is normally reported as the maximum volume of beer that can be filtered through a given area of membrane **(V_{max})** and the initial flow rate **(Q_{init}).**

"EsserTest"...predictive test for beer filterability...test beer pressured at 2 bar through a 0.2 µm membrane filter with the filtrate volume indicating relative filterability.

Schwarz: ....for **viscosity** uses **Brookfield Rotational Viscometer**....for **filterability**, uses **Esser Test**. Key finds: a) dextrin most important driver of viscosity; b) arabinoxylans, especially their MW not [ ], most important driver of filterability; c) viscosity a lousy predictor of filterability.

Darcy Permeability Index....a darcy is the permeability of a filter aid of 1 cm thickness passing a volume of 1 ml fluid with a viscosity of 1 mPa through a 1 cm^2 of surface at a pressure of 1 bar in 1 second.

Higher V_{max} values indicate better run-offs.

Beer Filterability

Speers *et al* and **Beer MembraneFiltratio**n:
a) higher MW beta-glucans lowers (V_{max}) and the initial flow rate (Q_{init})
b) shearing beer lowers (V_{max}) and the initial flow rate (Q_{init})...temperature independent
c) between pH 3.8 and 4.6, higher pHs improved filterability
d) adding 5-10% ethanol decreases Q_{init}, but increases V_{max}.....however if haze present, added ethanol lowers V_{max}.....*ergo* filtration problems with higher ethanol streams worsened by elevated malt-originating CHOs.

Kriesz:
main sources of polysaccharides and protein impacting filterability of wort and beer comes from either malt, yeast or bacteria. Describes five new methods to assay:

a) assaying wort to predict beer filterability,
b) ID polysaccharides after filtration by releasing from DE,
c) a method to estimate the risk of beta-glucan formation via intensive shearing of wort & beer,
d) a step control to ID the process risks for the formation of beta-glucan gels,
and
e) method to ID haze particles in filtered beer by use of specific enzymes in combo with haze measurement & staining.

Li, Lu, Gu & Mao: used CADE to optimize breakdown of arabinoxylan during mashing with the following variables: [endoxylanase], pH and [Ca^{++}]. Optimum degradation occurred at 38 U/g, pH 5.5 and 114 ppm of Ca^{++}. With these levels polymeric arabinoxylan in a 60:40 malt:wheat mash….saw decrease from 650 ppm (no enzyme) to 220 ppm – a drop of 66%.

Newport Scientific "RVA Super 3" rapid viscoanalyser: measures changes in malt viscosity in lab mashes

Kriesz:
a) malt beta glucan/friability/viscosity correlate with risk of formation of beta-glucan gels,
b) malt polysaccharides (alpha-glucan, beta-glucan & pentosans) drive wort filterability,
c) yeast can cause up to 2 EBC units of non-filterable haze....this type can be measured by the use of specific enzymes in combo with haze measurement & staining.

NDSU Filterability Modeling:
a) 0% by dextrin
b) **40% by arabinoxylans**
c) 3% by beta-glucan
d) 57% by other variables.

NDSU Viscosity Modeling:
a) **70% by dextrin**
b) 7% by arabinoxylans
c) 3% by beta-glucan
d) 20% by other variables.

"Filtration Capacity" = $hL/m^2 \times h^{-1}$

Modeling

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