

New (Research) Methods for Barley Malt Quality Analysis

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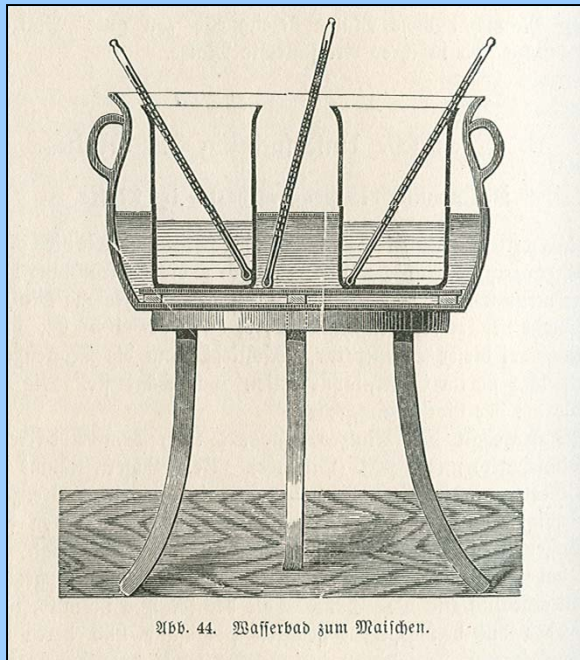
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Barley Malt Quality Methods

- **A frequent criticism is that “Official methods often do not address or accurately predict brewhouse performance”. Examples:**
 - Homogeneity of the sample
 - Filterability
 - Flavor
 - Flavor stability
 - Colloidal stability
 - Fermentability
 - PYF
 - Others?
- **Research and new methodology is required**

Barley Malt Quality Methods



Windisch, 1895

Also need to consider that many standard methods are old!

- Extract (Congress Mash), origins are in late 1800's
 - Original intent was only to determine maximum theoretical extract.
 - However, Congress wort is now used for all standard wort analyses.
 - Non-ideal mash conditions.
- Origins of ASBC alpha-amylase and DP methods is prior to 1920

New Methods for Barley Malt Quality Analyses

- Adaptation of New methods to official status often is slow
 - Test must be of interest to an adequate number of laboratories for collaborative testing to take place
 - Expense of required equipment
 - Wide variations in brewer's processing and products complicates standardization of many new methods.
 - Very specific process or product related tests may have limited applicability

Filterability/Lautering Performance

Research Methods

- Tepral Filtration, 1989
- VTT Buchner Filtration test, 1994
 - Better correlation with brewhouse performance
 - Methods require alternative lab mash procedures
 - Have not been widely adopted?

Flavor Stability

Methods

- LOX (lipoxygenase) (high throughput assay of Li)
 - Proprietary issues in breeding
 - LOX is not the whole story
- ESR (electron spin resonance)
 - ASBC has evaluated ESR(EPR) for beer oxidation
 - Applicability to malt?

Malt Enzymes

- Origins of Official methods for alpha-amylase and diastatic power were over 100 years ago!
 - Not simple, and have proven difficult to automate
 - Not direct assays in kinetic terms
- Newer methods using synthetic substrates (e.g. MegaZyme) can provide much more reliable and direct data
 - Alpha-amylase, beta-amylase, limit-dextrinase.
 - Partial automation with plate reader (Evans 2005)
 - Incorporation of other enzymes (beta-glucanase) is possible

Fermentability

- Rapid fermentation of Congress Wort
 - Poor discriminative power
 - 70 C saccharification rest lowers maltose levels
 - Dilute (8% P) mash and no adjunct means all factors (enzymes, FAN, etc) are likely in excess
 - Varying yeast amount (g) can slightly improve results
- Rapid fermentation of modified mash
 - Use of adjunct and thicker (alternative) mash
 - Better discriminative power (factors are limiting)
 - Modified mash is very brewer/product specific
 - Unlikely to be widely adopted?

Fermentability

- **Predictive**. E. Evans (2005,2008) has shown that AAL can be accurately predicted ($r^2=0.91$) by measuring:
 - Alpha-amylase (a)
 - Limit-dextrinase (b)
 - Kolbach index (c)
 - Beta-amylase (d)
 - Beta-amylase thermostability (e)

$$\text{AAL} = 69.9 + 0.017(a) + 0.010(b) + 0.195(c) + 0.007(d) + 0.538(e) - 0.001(d)(e)$$

Cell Wall Polysaccharides

- Beta-glucan
 - ASBC wort-18, EBC 3.10.2
 - Calcofluor-FIA
 - MW range measured depends on ionic strength of eluant.
 - Are we measuring the right range?
 - Is concentration sufficient or do we need MW data too?
 - Are we using the right standard?
- Arabinoxylans
 - Are they the culprit when “low beta-glucan” malts give lautering or filtration problems?
 - Should we be looking at these too?

Conclusions

- Existing Official methods are essential as a basis of trade and for routine quality assurance
 - However, they do not provide the “complete picture”
 - **Research and development of new methodology is essential**
 - Adoption of methods that predict performance is hampered by wide variations in brewer formulation, equipment and processing
 - Universal methods?
 - Adoption of methods for constituents/contaminants (DON, sprout damage, etc) is likely to be quicker

Conclusions

ASBC Malt-4 (Extract) is an issue (and has been for 100 years!)

- Method was never intended to duplicate the brewhouse, nor provide wort for analysis.
- However, the method is ingrained, and change is unlikely
 - A suitable replacement method that will satisfy the needs of all maltsters and brewers seems unlikely
- **Breeding programs could benefit from change in method**
 - Use of coarse grind in Congress mash, or an alternative mash procedures (Hot Water Extract) will provide better discriminative power

Conclusions

Methods for Alpha-amylase and Diastatic Power are also an issue

- Alpha-Amylase Malt-6 is an indirect assay based upon a change in substrate property
 - It is not free from interference from beta-amylase
 - (Official) Manual method is no longer used
 - Automated method has been extremely difficult to standardize
- Diastatic Power Malt -7 is not a direct measure of beta-amylase
 - Instances of high DP and poor conversion
- **Direct measure of individual enzymes would provide more reliable data and possibly an estimate of fermentability**