Canadian Grain Commission / Commission canadienne des grains

2009 ASBC Annual Meeting

Canada

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A laboratory fermentation method to determine the influence of micro-nutrient levels on wort fermentability.

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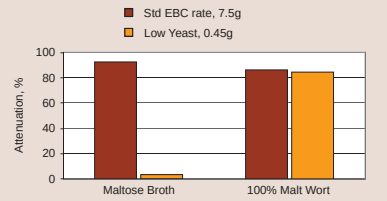
Introduction

- Wort fermentability is an important quality characteristic in the evaluation of the performance of malting barley varieties
- Standard laboratory tests (EBC Analytica) used for the determination of fermentability such as Apparent Attenuation Limit (AAL) do not always do a good job of predicting performance in the brewery
- The value of standard malt analysis in predicting fermentation performance of a malt is sometimes questioned. Standard malt analysis tends to rely heavily on the content of fermentable extract
- Yeast require micronutrients such as free amino acids and minerals to achieve an efficient fermentation
- All malt worts generally contain all of the micronutrients necessary for a successful fermentation
- However, ensuring adequate availability of amino acids and minerals is of special importance in high adjunct brewing, where non-carbohydrate nutrients are diluted by the addition of maltose syrup to the wort.
- Standard rapid methods for the determination of fermentability use a large excess of yeast.

Figure 1. Effect of pitching rate (standard EBC rate versus a significantly reduced rate) on attenuation of a maltose Broth and a Congress extract



- Laboratory tests (AAL conditions) revealed that a 10% maltose broth (no wort) was completely attenuated in 24hours (Figure 1). Decreasing the yeast pitching rate greatly reduced the ability to ferment the maltose broth.
- The attenuation of Congress wort was not greatly affected by the low pitching rate (Figure 1)
- These observations led to an investigation of appropriate conditions for a rapid high adjunct laboratory fermentation test (modified Broth test)

Methods

Apparent Attenuation Limit (Standard EBC Method)

- 100 mL Congress wort

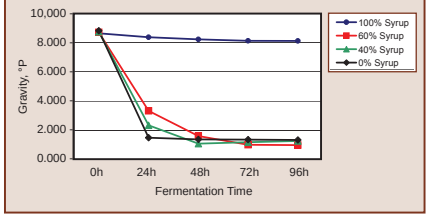
- 7.5 g compressed fresh yeast

- 24 hour fermentation @ 20° C with constant shaking

A 10% maltose broth was prepared as a weight/volume solution from high maltose syrup, and was intended to approximate the original density (8º Plato) of a Congress wort.

Optimum wort/adjunct ratios were investigated for optimizing a Broth method. Congress extract was prepared from AC Metcalfe and four wort:syrup (10% maltose broth) ratios were investigated, 0:100, 60:40, 40:60 and 100:0. Broths were allowed to ferment for 96 hours with density measurement every 24 hours.

Figure 2. Relationship of fermentation time to attenuation of worts and broths prepared using 4 different ratios; 0:100, 40:60, 60:40 and 100:0 (wort:syrup).



The Broth test was further tested using four malts from different barley varieties (Harrington, AC Oxbow, Schooner, Stirling) and with varying malt quality (Edney and Langrell). Congress extracts were prepared from the four malts and tested for fermentability using the standard AAL method and the modified Broth method as follows:

Final Conditions of the Modified Broth Method

- 60 mL congress wort
- 40 mL 10% maltose broth
- 0.47 g compressed fresh yeast
- 24 hour fermentation @ 20° C with constant shaking

Results and Discussion

The poor attenuation of the 10% maltose Broth (Figure 1) at the low pitching rate, was attributed to; 1) lack of micronutrients in the broth for yeast growth and 2) a need for yeast growth because of limited provision of yeast cells at the lower pitching rate. In contrast, at the higher pitching rate, yeast growth was unnecessary as sufficient yeast was already present for full attenuation. The EBC Congress extract fermented well at the low pitching rate because micronutrients were provided in the wort, allowing for yeast proliferation leading to more complete attenuation.

Results and Discussion

Figure 3. Effects of fermentable sugars and FAN on attenuation, as measured with the standard EBC method, for the four malts tested (AC Oxbow, Harrington, Schooner and Stirling).

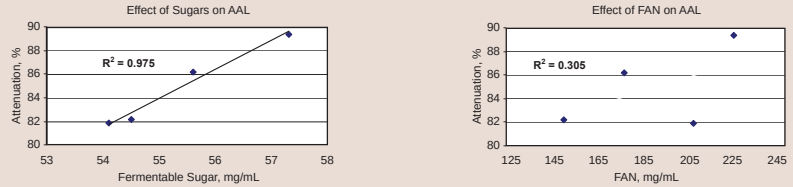
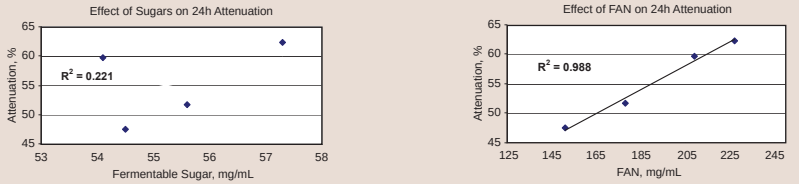


Figure 4. Effects of fermentable sugars and FAN on attenuation, as measured with the modified Broth method, for the four malts tested (AC Oxbow, Harrington, Schooner and Stirling).



The most appropriate fermentation time for a Broth test was investigated by measuring density change every 24 hours over 4 days. Broths, excluding the 0:100 (wort:syrup) broth which fermented poorly even at 96 hours, showed limited differences after 48 hours and no differences after 96 hours. The 24 hour fermentation time was selected as it provided the greatest contrast among the broths.

Four wort:syrup ratios were investigated, 0:100, 40:60, 60:40 and 100:0. The 60:40 ratio broth was selected for further testing because it was more commercial-like and it showed limited but significant attenuation after 24 hours (Figure 2).

When the standard AAL method (100% Congress extract and the high pitching rate) was used, attenuations, for the 4 malts of varying quality, correlated well with total fermentable sugar content but not with FAN (Figure 3).

When the modified Broth method (60:40 wort/syrup ratio and low pitching rate) was used, attenuations, for the 4 malts of varying quality, correlated well with FAN levels but not with levels of fermentable sugars (Figure 4). The Broth method was not limited by sugar levels as adequate fermentable sugars were supplied from the wort and syrup.

Conclusions

The EBC standard method and modified Broth methods provide different information with respect to the potential fermentability of a malt.

The EBC standard method correlates highly with total fermentable extract, but provides no information regarding the level of micro-nutrients provided in the wort.

The modified high adjunct/low yeast method favors malts that supply adequate micro-nutrients for the yeast.

The modified high adjunct/low yeast method could potentially be used in screening barley cultivars for marginal or inadequate FAN levels.

References

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