173

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The Use of a Functional Carbohydrate to Positively Impact the Sensory Characteristics of Beer

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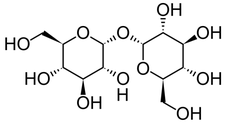
Abstract

The production of good tasting balanced beers that can be enjoyed by the consumer is the brewer's goal. However, as the limits of styles are pushed, imbalanced products with off flavors and aromas may be created. Areas of sensory challenge may include excessive bitterness, alcohol burn, astringency, poor mouthfeel, etc. The use of functional carbohydrates, that are not fermentable, have been found to positively affect the sensory attributes of beer. This poster will:

- Show how a functional carbohydrate, trehalose, when added to a finished beer, impacts the sensory experience of a group of expert tasters in a variety of beer styles
- Address the impact of this functional carbohydrate on low calorie, high alcohol, and highly hopped beer styles

Trehalose molecule



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Overview

Trehalose, a disaccharide found in nature, has become an ingredient of interest to the food industry for its potential impact on flavor modification, e.g., perception of bitterness or alcohol burn.[2,3] The use of trehalose in beer as a modifier of sensory characteristics including taste, aroma and mouthfeel, is not obvious since most studies focused on its influence in yeast stress. Why investigate an ingredient that ferments? Until now, it wasn't known how trehalose, as an unfermented sugar in finished beer, might impact the sensory characteristics of the finished product.

First screening

The merit of adding trehalose to beer was established courtesy of a challenge put forth to a small, but experienced, group of Cargill employee craft brewers. Each brewer was provided with a sample of trehalose and asked to make a control and test beer. The style of beer was left to creative license of the brewers. All the beers were then evaluated by certified beer judges. The results showed that beers made using trehalose scored higher than the "control". This first test demonstrated that there may be an opportunity for trehalose to positively impact the sensory characteristics of beer.

Confirmation of craft brewing results

Does trehalose impact the sensory characteristics of beer? Or was the craft brewer experiment an isolated incident? To answer the question, Cargill's expert tasters (4-7), but not expert beer panelists, evaluated beers spiked with trehalose at levels of 0.5% and 1%. Thirteen different beers and one wine were sampled. The sensory testing protocol used was difference-from-control for: Aroma, Appearance, Overall Flavor, Mouthfeel, Overall Impression (liking).

A 6-point evaluation scale was used

Largely Less > **Moderately Less** > **Slightly Less** > **SAME AS CONTROL** > **Slightly More** > **Moderately More** > **Largely More**

Type or Style	Number of types	ABV (alcohol by Volume)	IBU (International Bitterness Units)
Light Beer	1	4.2	unknown
Ale	1	4.5	7
IPA	1	6.2	60
Double IPA	1	8.4	85
Citrus	1	5.4	9
Lager	3	4.5 – 6.0	14 – 30
Pilsner	1	5.2	40
Dark	4	4.9 – 10.0	20 - 100
Pinot Noir	1	13.5	NA
Total	13 Beer; 1 Wine	4.2 – 10.0; 13.5	4.2 – 100; NA

Conclusions from spiked sample evaluation

- Difference in flavor and mouthfeel were noted in both 0.5% and 1.0% trehalose inclusions
- No strong conclusions drawn due to small n=4-7 panelists
- No correlation was found between ABV and Trehalose inclusion level
- No correlation was found between IBU and Trehalose inclusion level

References

1. Shah, P; Milner, B. Process for enhancing the body and taste of malt beverages, U.S. Patent 20050163884 A1, July 28, 2005
2. Evans, J.; Guthrie, B.; Sweeney, J.; Eilert, S. Trehalose and suppression of off-flavors notes, U.S. Patent WO 2005/079516 A1, Nov. 10, 2005
3. Sweeney, J.; Guthrie, B.; Kim, C. H. P.; Naber, T.; Friedrich, J.; Aimutus, W. Methods for reducing astringency, European Patent EP 1 653 815 B1, May 5, 2010

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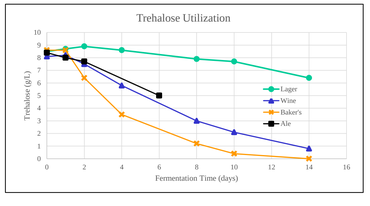
Where in the brewing process should trehalose be introduced?

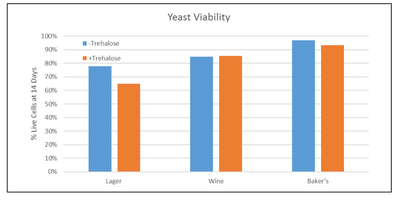
Understanding how yeast use trehalose would determine if it is added in the kettle, during fermentation or prior to packaging. A literature search suggested that many yeast have the molecular machinery to metabolize trehalose, but some of the enzymes involved may be pH-sensitive under acidic conditions, such as those employed in brewing. To answer this question, small scale fermentations were carried out using malt extract as a nutrient source and initial trehalose concentrations of 5g/l and 10g/l. Ale, Lager, bakers and wine yeast, purchased at a local brewery supply store, were used. The initial inoculation rate was 1g dried yeast /2.25l.

Fermentation temperatures were 11ºC for lager, room temperature for ale, 21ºC for wine and 29ºC for bakers. Fermentations were carried out for 14 days. Samples were taken over the course of the fermentations and carbohydrates and ethanol were measured by HPLC and trehalose by a Dionex column. Viability of cells was measured by methylene blue staining and cell counting in a hemocytometer.

Results from this work show

- Trehalose is absorbed and metabolized by ale, wine and baker's yeast
- Lager yeast only slowly absorbs trehalose
- Trehalose is likely converted to ethanol
- No improvement in cell viability or numbers was observed





Conclusions

- Trehalose in small concentrations appears to affect mouthfeel and flavor
- Trehalose is absorbed by ale yeast
- Trehalose is weakly absorbed by lager yeast
- Trehalose may have to be added post fermentation if used as a flavor modifier

Next steps

- Conduct pilot scale brewing trials to determine practical application
- Conduct more detailed sensory evaluation using beer trained sensory panel