

BIOTRANSFORMATION

THE IMPORTANCE OF YEAST IN DRY HOPPING

Biotransformation is defined as the chemical modification made by an organism on a compound. Although this term is commonly used in pharmacology and toxicology, from the brewer's perspective it refers to the interaction of a hop compound and a *Saccharomyces* spp., which leads to a new aromatic compound through an enzymatic reaction (hydrolysis).

Recent studies have revealed the importance of biotransformation based on the catalysis of glycosidic bonds in the production of hoppy beers. Figure 1 shows the mentioned breakage (hydrolysis) of a non-aromatic compound into a glucose molecule and a linalool (hop oil), obtaining more aromatic compounds and fermentable sugars derived from an inert compound found in hops.

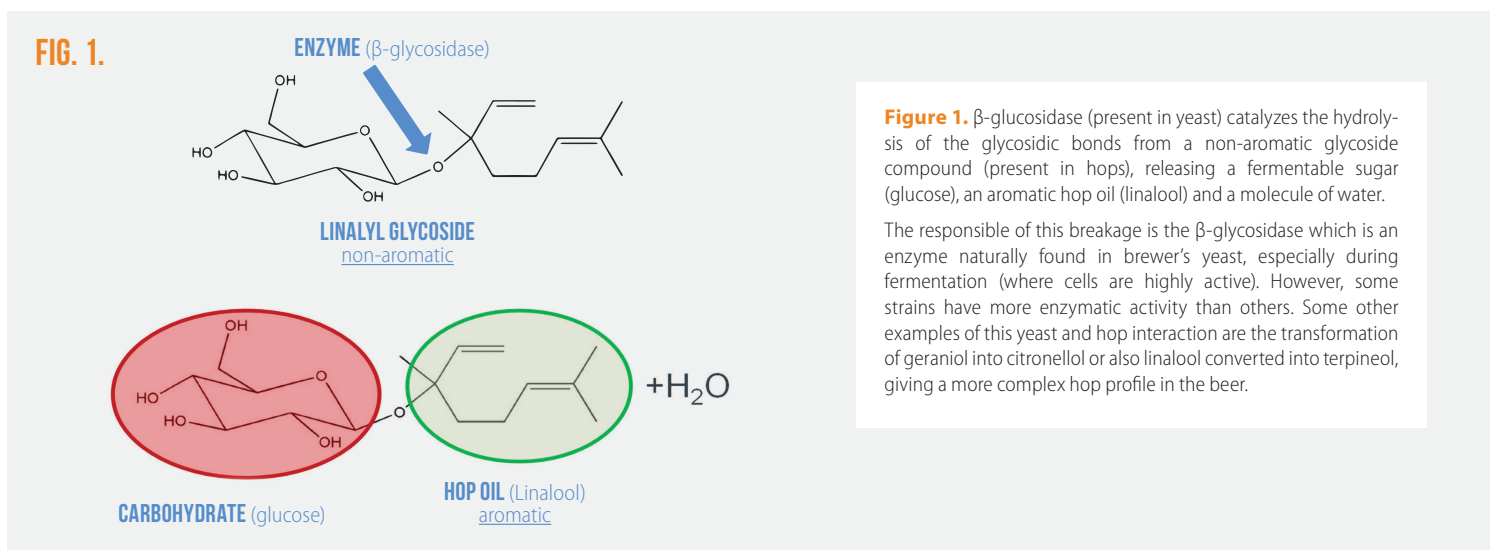


Figure 1. β -glucosidase (present in yeast) catalyzes the hydrolysis of the glycosidic bonds from a non-aromatic glycoside compound (present in hops), releasing a fermentable sugar (glucose), an aromatic hop oil (linalool) and a molecule of water.

The responsible of this breakage is the β -glucosidase which is an enzyme naturally found in brewer's yeast, especially during fermentation (where cells are highly active). However, some strains have more enzymatic activity than others. Some other examples of this yeast and hop interaction are the transformation of geraniol into citronellol or also linalool converted into terpineol, giving a more complex hop profile in the beer.

Figure 2. β -glucosidase activity in each Lallemand Brewing yeast strains.

As shown in Figure 2, the Lallemand Brewing yeast strains that contain highest β -glucosidase activity are BRY-97, New England and Belle Saison. This would suggest that they are the most suitable yeast strains for promoting the biotransformation in yeast.

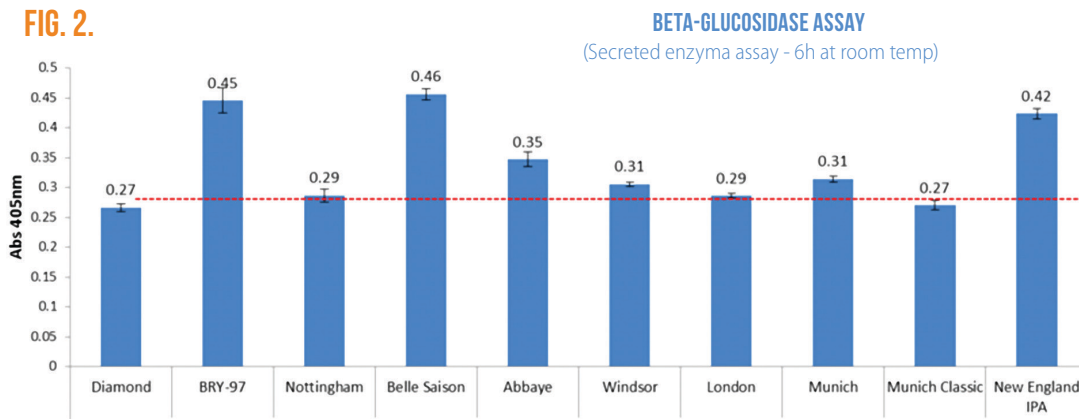
It is also important to note that this interaction may have unfavorable effects if we dry hop our beers under active fermentation (e.g. first fermentation) will lead to the reduction of hop oils by:

- CO_2 stripping (hop oils are very volatile)
- Masking (fermentation compounds may mask the hop oil aroma)
- Adsorption (hop oils adsorbed by yeast membrane, which is removed later on)

However, if dry hopping is performed at the very end of the fermentation, where there is lower CO_2 production (which kept within the tank) but yeast is still very active, the following benefits occur:

- Less CO_2 stripping (more hop oils kept in the beer matrix)
- Reduction of dissolved oxygen (DO) by active yeast during dry hopping
- Ethanol presence (more hop oil solubility)
- Higher temperature (more solubility)
- Some fermentation left (mixing effect due to beer turbulence)
- Biotransformation

FIG. 2.



BIBLIOGRAPHY:

- Sharp, Daniel; Vollmer, Dan and Shellhammer, Thomas. Understanding how to control flavor and aroma consistency in dry hopped beer. Presentation at the Craft Brewers Conference 2015 (Portland, OR)
- Sharp, Daniel and Shellhammer, Thomas. Recent advances in controlling flavor and aroma in hoppy beers. Presentation at the Craft Brewers Conference 2016 (Philadelphia, PA)
- Fowle, Zach. Hop compound biotransformation: What's it mean and what's it taste like? DRAFT Magazine (<http://draftmag.com/hop-compound-biotransformation/>)

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