Enzymatic and microbial solubilization of brewers' spent grain for sugar and phenolic compound extraction

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FOOD CHEMISTRY

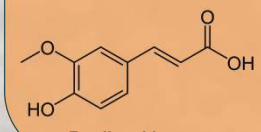
Introduction

- Brewers' spent grain (**BSG**) is a sidestream of beermaking.
- BSG gets produced during beermaking at a rate of 20 kg for each hectoliter liters of beer.
- Contains the insoluble parts of barley grain, namely the pericarp, husk and root.
- The enzymes used for processing were three commercial enzymes used for processing plant fibre: Cellulase, Viscozyme and Laccase. (**Visc**, **Cell** and **Lacc**)
- Lactiplantibacillus plantarum is a lactic acid producing bacteria (**LAB**) commonly used in beermaking.

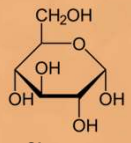
Freshly lautered BSG in a 500 liter kettle.

Aim

Creating and optimising a low-cost method to process BSG directly after beer production with the goal of extracting sugars and flavor compounds to reintroduce back into beer production.



Ferulic acid



Glucose

Methods

1. BSG is collected fresh from the brewing process. Local breweries donated BSG.
2. Mechanical processing: using an immersion blender to coarsely blend the BSG, more surface area of the grain is exposed to enzymes and microbes.
3. Addition of water, enzymes and *lactiplantibacillus plantarum.* Storage in a closed container for 20 hours at room temperature.
4. Sample collection was done by separating the liquid fraction of BSG using centrifuge.
5. Samples were analysed using liquid chromatography with a diode array detector (DAD) and evaporative light scattering detector (ELSD).
6. Results between samples were compared to determine the best mixture of enzymes to use in upcoming brewing recipes.

Unprocessed BSG

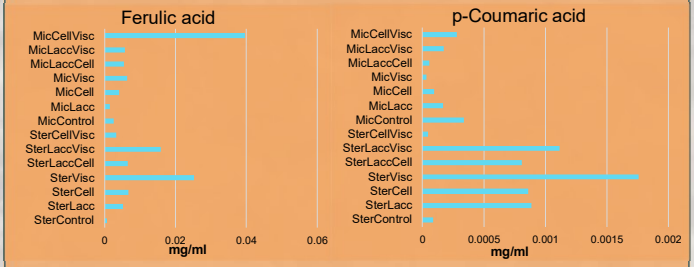
BSG milling with an immersion blender

BSG sample in water

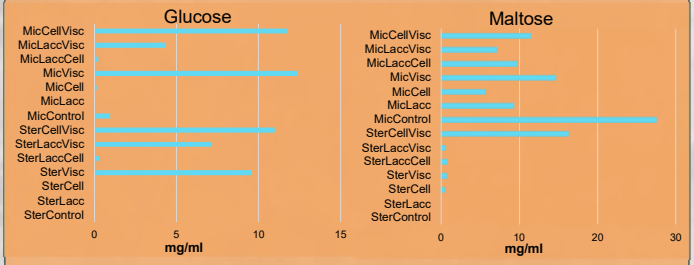
Results

Samples without LAB are marked "**Ster**" and those with LAB are "**Mic**". Samples were also labeled by what enzymes they contained. (**Visc**, **Cell** and **Lacc**)

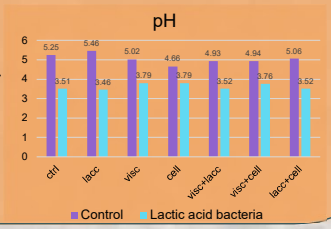
Analysis using UHPLC-DAD revealed in increase in ferulic acid and p-Coumaric acid



Analysis of sugars using HPLC-ELSD displayed increased concentrations of glucose and maltose within samples.



The pH of samples was significantly lower with samples containing lactic acid bacteria.



Conclusion

Enzymatic bioprocessing led to an increase in phenolic acids and fermentable sugars. The enzymes that provided the best yield for sugars and phenolic acids was a combination of viscozyme and cellulase.

Fermenting the BSG using Lactiplantibacillus plantarum lead to an increase in maltose but a reduction in phenolic acids.

Sources

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