Hydrophobins and Beer Gushing: Which Mechanism?

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Problem Statement



Explanation:

The gushing of a beer is the spontaneous and sometimes vigorous overfoaming of bottled beer when a non-shaken bottle is opened. This phenomenon may result in a bad brand image for breweries. There are two types of gushing: the primary gushing is malt-related (mainly due to the contamination by fungi) and the secondary gushing is technology-related (crystals of calcium oxalate, filter aids, …).

It is supposed that primary gushing is provoked by hydrophobins. Hydrophobins are small amphiphilic and suface-active proteins that are able to adsorb at the water/gas interface. These proteins are produced by filamentous fungi and are comestible for humans.

The weather conditions influence the quality of barley. High humidity and temperature during the culture and the harvest are favorable for contamination by filamentous fungi. These fungi produce hydrophobins on the field and/or during storage. As a consequence, the barley grains contain these proteins. The concentration of hydrophobins increases during the malting process and finished beer typically contains about 10% of the hydrophobins present in the malt. Hydrophobins are believed to interact with carbon dioxide microbubbles to provoke gushing when opening the bottle.

On the other hand, when the weather conditions are dry, there is no mould contamination, barley grains contain no hydrophobin and gushing does not occur at the opening of bottles.

Fundamental Research

Objectives:

- To understand the interaction between the hydrophobin amphipathic peptide and carbon dioxide
- To develop a molecular-thermodynamic model that allows to mathematically simulate the interaction in solution between carbon dioxide/hydrophobin/beer

In practice:

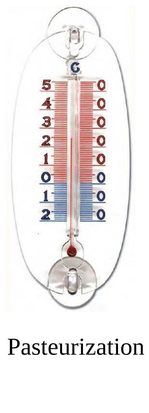
- Lab scale production of *Trichoderma reesei* and *Cladosporium fulvum* hydrophobins
- Study the interaction between hydrophobin and carbon dioxide in buffered water and in filtered beer following different parameters:
  - Temperature
  - Hydrophobin concentration
  - Carbon dioxide concentration
  - …

Techniques used: Dynamic Light Scattering
Modified Carlsberg Method

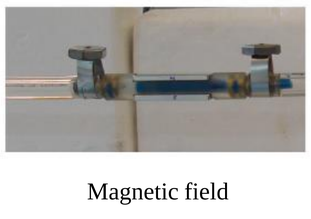
Applied Research

Objectives:

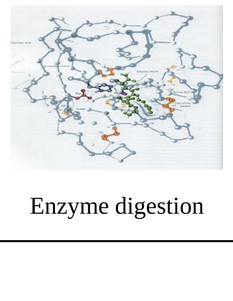
- Detection and identification of hydrophobins by mass spectrometry
- Find solutions to avoid gushing if hydrophobins are present:
  - Pasteurization
  - Magnetic field
  - Sonication
  - Enzyme digestion
  - High pressure
  - …



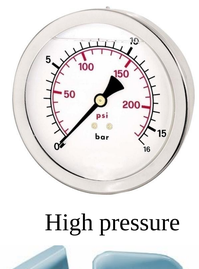
Pasteurization



Magnetic field



Enzyme digestion



High pressure



Sonication

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