How to make better bread (or beer or ...) with soft matter science?

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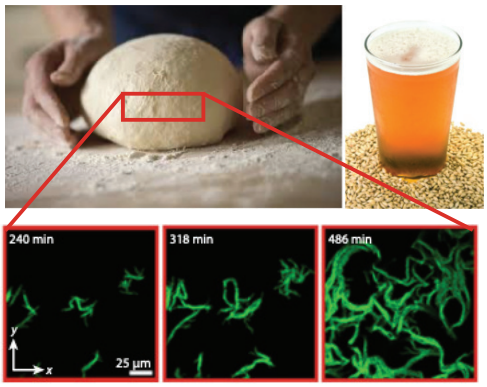
Microbial fermentation is the key mechanism by which microorganisms (e.g. bacteria, yeast) break down organic compounds (e.g. sugars) into simpler products, often producing gas (e.g. carbon dioxide) during the process as well. While microbial fermentation has historically been relevant for the production of edible products (e.g. bread, beer, kombucha, yoghurt), there has also been a recent surge in developing alternative protein sources (e.g. plant-based meat) using microbial fermentation.



Motion and growth of microorganisms are crucial for formation of structures during fermentation

Some of the primary requirements of microbial fermentation are that the microorganisms should be able to move in the liquid-like medium as they search for nutrients, they should be able to grow in number via cell division, and the material should be able to release gases (often in the form of bubbles) as fermentation proceeds. A complex interplay of these processes controls the formation of structures in the medium – crucial for the quality of the final product. For example, plant-based meat products are often unacceptable to the consumer if they do not "feel" like animal-sourced meat. **In this project, we will study how microorganisms move and grow in a medium during fermentation, and how such microscopic processes can dictate the macroscopic structure of the final product.**

Objectives

- **Characterize the motion of microorganisms in conditions mimicking fermentation**
- **Understand how microorganisms move and grow in a highly complex medium that also contain groowing gas bubbles**
- **Relate the microscopic behavior of microorganisms in complex media to the macroscopic structure formation during fermentation**

This interdisciplinary technique, while addressing a highly relevant societal challenge, will also let you gain hands-on experience in state-of-the-art experimental techniques such as:

- **Microfluidic systems**
- **High-speed optical and fluorescence microscopy**
- **Particle tracking and flow visualization**
- **Physical modeling**

This thesis project offers a unique blend of experimental innovation and biotechnological exploration, making it an exciting opportunity for students passionate about soft matter, biophysics, biotechnology, food science, or food technology. By participating in this project, students will:

- Gain hands-on experience with advanced experimental techniques
- Collaborate in a multidisciplinary research environment
- Contribute to a pressing global challenge

Are you ready to embark on a journey of discovery, innovation, and impact? Then this project awaits your curiosity and drive. **Together, let's explore the unseen world of microorganisms, and reveal how they are developing sustainable foods for the future.**