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Detection of Lactic Acid Bacteria (LAB) in Yeast Fermentations

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This project aims to develop a new diagnostic method which one can use to detect contamination of yeast fermentations by lactic acid bacteria at an early stage (at low bacterial numbers).

Yeast fermentations are involved in a number of applications such as fermentation of beer, wine and other foods and production of ethanol and other chemicals. Typically, it is desired that chosen strain(s) of yeasts alone be present in the fermentation broth, either to ensure highest productivity and/or to prevent by-products such as off-flavors. A problem often encountered is "infection" by undesired microbes, particularly lactic acid bacteria (LAB) that survive at low pH. Such infection is most consequential if present in the original inoculum. So, the inoculums into production fermenters (themselves generated smaller fermenters) are checked for the presence of LAB before loading. Current technology to detect LAB is indirect: and relies on detecting the presence of lactic acid using High Performance Liquid Chromatography (HPLC). Typical limits of detection for lactic acid are ~0.2 g/L, which corresponds to a LAB level of ~ 107 Colony Forming Units (CFU)/ml. Such high levels often result in lower productivity and in some cases "stuck fermentations". So, in some cases (presumably those with loads of ~10 6 CFU/ml, or lower of LAB present), adverse outcomes (lower productivity / stuck fermentations) are obtained despite the inoculums passing the quality control (check for presence of lactic acid). Industrial production units can consist of up to 1 million gallons of fluid, which is a large waste of resources and can be very costly.

The Sengupta lab plans to adapt an existing technology for detecting low levels of bacteria in blood cultures to this application, with a targeted limit of detection of ~ 102-3 CFU of LAB/ml. The adaptation involves developing a protocol to separate yeasts from bacteria in the aliquots collected from the fermentation and using microchannel Electrical Impedance Spectroscopy (m-EIS) to monitor the effects of antibiotics (which kill bacteria but not yeasts) on processed samples.

I will be involved in developing a prototype of the device to be used, designing and conducting both separation and m-EIS experiments using this prototype, and analyzing data generated to optimize the detection method.