Advanced fluorescence techniques for studies of microorganisms

Associate Professor Robert Learmonth, University of Southern Queensland

Background:

This work involves development and application of advanced techniques and instrumentation in fluorescence spectroscopy and microscopy, applied to study of microbial cells and processes. These technologies have been applied to commercially important organisms and processes including yeast propagation and fermentation of beer and wine. Through better understanding of critical events in microbial adaptation we seek to improve stability and reproducibility of commercial fermentation processes. This is organised into several projects, as follows.

Yeast fermentation in brewing and winemaking utilises fluorescence spectroscopy and microscopy to determine membrane fluidity in yeasts. We focus on selection of growth supplements, yeast strains and assessing their metabolic and cell membrane status during beer and wine fermentations in relation to organic and inorganic nutrients. Work on mineral nutrition is conducted in collaboration with Prof Graeme Walker, University of Abertay Dundee.

Optical characterization of microorganisms, in collaboration with A/Prof Ewa Goldys of Macquarie University. We utilise fluorescence spectroscopy and microscopy of unlabelled microbes to characterise spectral fingerprints to distinguish between industrially important yeasts and bacteria.

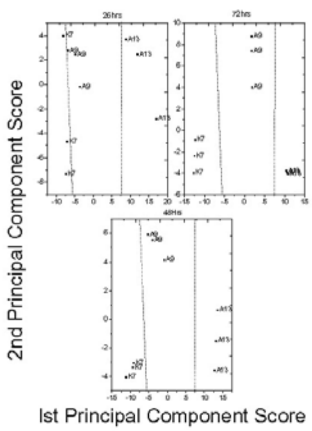
Mechanisms of yeast environmental adaptation, focusing on the role of cell membranes and metabolism in adaptation of yeasts to environmental changes. We particularly study membrane fluidity changes seen during adaptation to different nutrient sources. This involves analyses of membrane fluidity and function via fluorescence spectroscopy and microscopy.

Outcomes:

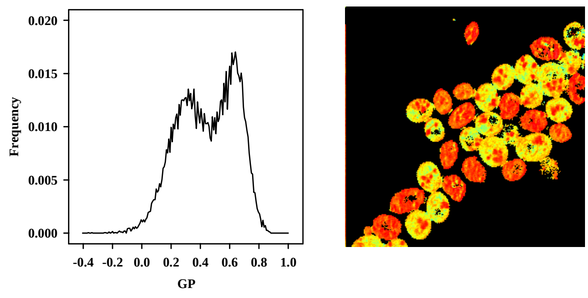
- methods for rapid identification of microbial purity industrial bioprocesses
- methods for monitoring of vitality and suitability of microorganisms for bioprocesses
- better selection of microbial strains and process parameters for efficient fermentations in brewing, wine making and other fermentative bioprocesses

Progress to date:

A major component has been the establishment of critical instrumentation and networking of this infrastructure to facilitate access. We have developed novel methodology for identification of species and assessment of membrane adaptability in yeasts and bacteria and begun trials in industrial media.



Principal component analysis of autofluorescence spectra for identification of yeast strains.



Generalized Polarization (GP) analysis of labelled bakers yeast indicating their membrane fluidity status.

Contact: Robert.Learmonth@usq.edu.au

Web: http://www.usq.edu.au/users/learmont/