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Bioenergy production from biorefineries waste using super yeasts

The Challenge

Bioethanol refineries generate large amounts of liquid waste called vinasse (10-15L of vinasse per litre of distilled ethanol). However, current methods of disposal of vinasse can lead to major environmental issues.

The main component of vinasse is glycerol, a potentially inexpensive alternative substrate to glucose for fermentation processes. Identifying yeast strains capable of using glycerol-based products, such as vinasse, would reduce the environmental impact of bioethanol sugarcane refineries, reduce the toxicity of this by-product and be cost-effective for fermentation industries.

The challenge is to identify yeast strains that combine enhanced ability to grow in glycerol-based products with the ability to produce added-value products, such as free fatty acids/neutral lipids.

The Research

Dr Vincent Postis is a Reader at Leeds Beckett University. The research in his laboratory focuses on a wide range of transporters of biomedical interest with a particular emphasis on the structure/ function relationship of nucleoside transporters and biofermentation processes.

Dr Postis and his collaborators Dr Celia Ferreira (University of Leeds) and Dr Carine De Marcos Lousa (Leeds Beckett University) applied for a CBMNet Proof-of-Concept award.

The project aimed to identify yeast strains adapted for growth on distillery waste and capable of converting these glycerol-based feedstocks into added-value products.

Dr Vincent Postis – Lead PI

Research Assistants

J. Ali A. Araoyinbo

CBMNet
Proof-of-Concept Award

The Result

Three yeast strains were subjected to random mutagenesis to identify strains better adapted for growth on medium mimicking vinasse: *Saccharomyces cerevisiae* (grows poorly on glycerol but is the preferred organism used in industrial biotechnology) and two strains of *Yarrowia lipolytica* (efficiently metabolizes glycerol with high yields of neutral lipids).

Random mutagenesis of *Y. Lipolytica* identified three strains that grow better on synthetic medium mimicking vinasse; preliminary data suggests they also have enhanced growth on vinasse. Random mutagenesis of *Saccharomyces cerevisiae* did not identify potential strains of interest, but progress has been made towards directed metabolic engineering of *S. cerevisiae*.

The microbiome of mature vinasse (sourced from Longueteau Distillery) was also investigated as a potential source of novel strains, with one yeast strain being isolated. Identification of this strain is currently underway.

The Future

Y. Lipolytica strains of interest are being sequenced in order to identify the relevant mutations. The Whole Genome Sequencing approach being taken has resulted in a new collaboration between Dr Postis and other researchers. Engineering *S. cerevisiae* to optimise growth on vinasse and production of fatty acids is in progress.

This collaboration has formed the basis of an ongoing MRes project, building on these initial results. Dr Postis and his collaborators have applied for follow-up funding to use these strains for fermentation of agricultural wastes in Cote d'Ivoire as a part of the GCRF for Industrial Biotechnology and Bioenergy in the developing world.

The prospect of being able to reuse the vinasse for biofuel production was of great interest to industrial collaborators, paving the way for future collaboration.

"Biofermentation processes have been at the heart of human life since Egyptian times with wine and bread. Our understanding of molecular mechanism of fermentation is now the basis for the development of sustainable energy"

Vincent POSTIS
Leeds Beckett University

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