Adaptive evolution of a yeast for palm oil replacement: genotype-phenotype relationships by nanopore sequencing

This project is one of a number that are in competition for funding from the South West Biosciences Doctoral Training Partnership (SWBio DTP) which is a BBSRC-funded PhD training programme in the biosciences, delivered by a consortium comprising the Universities of Bath, Bristol, Cardiff and Exeter, along with the Rothamsted Research Institute. The partnership has a strong track record in advancing knowledge through high quality research and teaching, in collaboration with industry and government.

Studentships are available for entry in September/October 2019.

All SWBio DTP projects will be supervised by an interdisciplinary team of academic staff and follow a structured 4-year PhD model, combining traditional project-focussed studies with a taught first year which includes directed rotation projects.

Lead supervisor:	Dr Daniel Henk, Department of Biology & Biochemistry University of Bath, email d.a.henk@bath.ac.uk
Co-supervisors:	Dr Stefan Bagby (University of Bath), Prof Dorothy Buck (University of Bath)
Non-academic CASE Supervisor:	Dr Daniel Turner, Oxford Nanopore Technologies

Project description

The main goal of our research is to make evolutionary and genomic tools work for industry and to improve the outcomes of fungal interactions that matter for people. Currently we are working on Metschnikowia pulcherrima, a ubiquitous species of yeast that produces high concentrations of an oil with properties similar to those of palm oil. Palm oil is the most commonly produced vegetable oil and is used in a vast range of products including processed foods, cosmetics, cleaning products and biofuels, but palm oil production is environmentally and socially deleterious. Metschnikowia pulcherrima could provide a route to a more sustainable alternative to palm oil, but this requires significant advancement of the capabilities of this yeast.

We are using adaptive laboratory evolution to improve the productivity and utility of Metschnikowia pulcherrima. The aim of this project is to understand the genetic changes underlying phenotypic changes in Metschnikowia pulcherrima when it is subjected to a series of adaptive evolution scenarios. These scenarios are focused on improving the properties of Metschnikowia pulcherrima for industrial exploitation, including inhibitor and fungicidal resistance, and ability to thrive in a heterogeneous environment; the scenarios include inhibitor tolerance, temperature, microbial competition, and substrate conversion.

The genetic changes underlying phenotypic changes in fungi are strongly linked to copy number fluctuation, genomic restructuring, and epimutation (a heritable change that affects gene expression without a change in DNA sequence, including base modification). Since such genetic changes are relatively difficult to detect with standard sequencing technology, we will exploit the capacity of nanopore sequencers (e.g. the MinION™) to make very/ultra long reads and to detect base modifications to elucidate the genetic changes in Metschnikowia pulcherrima during adaptive evolution. Data-informed mathematical modelling will be used to enhance understanding of

evolutionary mechanisms. Although industrial utility is the focus of these adaptive evolution experiments, the evolutionary mechanisms elucidated can additionally be used as a point of comparison to the near relative and emerging pathogen Candida auris, the marine pathogenic yeast Metschnikowia bicuspidata, and the biocontrol yeast Metschnikowia fructicola.

This PhD project will provide broad, multidisciplinary training encompassing yeast biology, fungal genetics, basic molecular biology, nanopore sequencing, bioinformatics, and mathematical modelling of genetic changes. The project is sponsored by Oxford Nanopore Technologies (ONT). In addition to regular update meetings with ONT staff and technical support from ONT, the studentship will incorporate a placement of at least three months with ONT.

Funding

Studentships provide funding for a stipend at the standard UKRI rate (currently £14,777 per annum, 2018/19 rate), research and training costs and UK/EU tuition fees for 4 years.

UK and EU applicants who have been residing in the UK since September 2016 will be eligible for a full award; a limited number of studentships may be available to EU applicants who do not meet the residency requirement. Applicants who are classed as Overseas for tuition fee purposes are not eligible for funding.

Applications

Applicants must have obtained, or be about to obtain, a First or Upper Second Class UK Honours degree, or the equivalent qualifications gained outside the UK, in an appropriate area of science or technology.

Applications should be submitted on the University of Bath's online application form for a PhD in Biosciences. Please ensure that you quote the supervisor's name and project title in the 'Your research interests' section. You may apply for more than one project if you wish but you should submit a separate personal statement relevant to each one.

The deadline for the receipt of applications is Monday 3 December 2018.