Identification of Membrane Transporters of Lignin monomers

CBMNet Proof-of-Concept

The Challenge

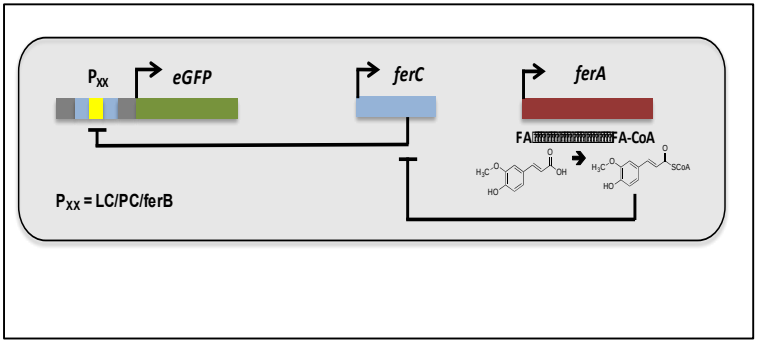
A critical bottleneck to the economic viability of industrial biotechnology and bioenergy (IBBE) processes is the transportation of substrates/product across the cell membrane. The ability to identify novel transporters and enhance cellular transport mechanisms would thus aid IBBE process optimisation and may result in some bioprocesses that are not currently viable, becoming so.

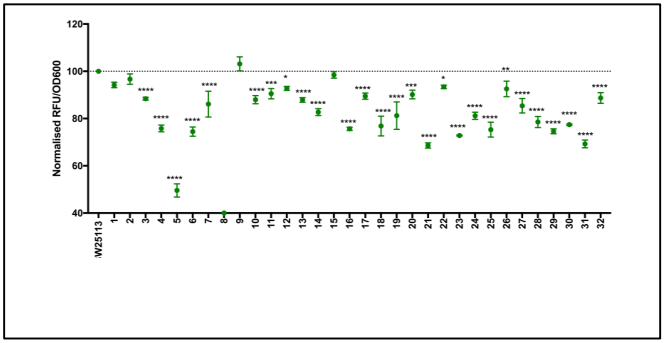
The Research

Dr Neil Dixon is a Senior Lecturer at the University of Manchester. The research in his laboratory focuses mainly on the use of gene regulation for biotechnology and biomedical applications. Previous work in his lab has led to the development of a whole-cell biosensor, that enables the in situ, intracellular detection of aromatic molecules from the degradation of lignin biomass[1].

Oxford BioTrans Ltd develop and commercialise enzymatic process technologies that yield high-value chemical compounds. The Centre for Process Innovation Ltd (CPI) helps companies to develop, prove, prototype and commercialise next generation products and processes.

Dr Dixon applied for a CBMNet Business PoC with Oxford BioTrans Ltd and the CPI to produce preliminary data that could be built on in future funded projects. The project aimed to identify key transporters of plant-based degradation products of significant IBBE interest, that would aid in the economically viable scale-up of a number of whole-cell and cell-free biotransformation reactions.





[1]Machado, Dixon, *Chem Commun* 2016

The Result

The project identified a selection of knock-out strains/transporters (n=25), that display significant change (~10-50%) in substrate transport that require further analysis and validation. We suspect this selection will include a number of false positive hits, where for example the knock-out strains have altered host metabolism, thus negatively affecting the biosensor expression indirectly.

However, this list includes a number of probable aromatic acid transporters, in addition to annotated amino acid, aliphatic acid and cyclic acid transporters and permeases. Interestingly three knock-out strains/transporters demonstrate ~30% homology to plant transporter involved in lignin biosynthesis.

The Future

As a follow-on to this study Dr Dixon is in the process of validating the putative roles of these transporters in the transport of lignin derived aromatic monomers. In advance of this validation further analysis of gene annotation and homology searches of the hits, indicate some interesting candidates.

The Dixon lab has also started a 5 year UK-Brazil collaboration funded by the BBSRC and FAPESP, utilising the methods and techniques developed during this project.

Dr Dixon hopes to continue the collaboration with CPI and Oxford Biotrans and apply for further funding.

"This PoC funding from CBMNet has allowed us to identify a number of putative ferulic acid acid transporters in E. coli. In addition, the interaction with the industrial partners and the wider network has broaden the exposure of the methods developed to a wider audience, and has led to on-going discussions and collaboration plans."

Dr Neil Dixon,
The University of Manchester

"Identifying putative aromatic acid transporters is one of the first steps in designing viable synbio production routes. As such, the results from this PoC provide a valuable foundation for Industrial Biotechnology."

Dr Matt Hodges,
Oxford Biotrans Ltd

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