CBMNet

CROSSING BIOLOGICAL MEMBRANES NETWORK, A BBSRC NIBB

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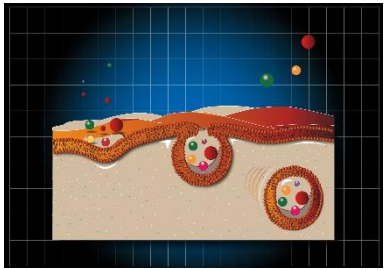
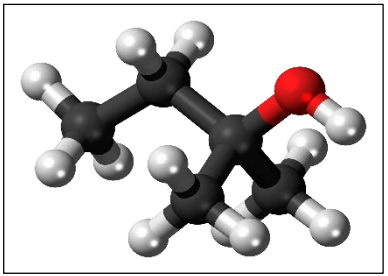
Understanding the effects of n-butanol on biological membranes





The Challenge

Solventogenic Clostridia are used by Green Biologics to generate n-butanol from a variety of feed-stocks providing sugars for fermentation. However, n-butanol is expensive to purify from the fermentation broth. The cost of *in-situ* solvent removal is greatly decreased by fermenting at higher concentrations of n-butanol. The transporter (if any) for export of n-butanol from cells is unknown – it is possible that n-butanol can diffuse across membranes. n-butanol is also toxic to Clostridia although the mechanism remains largely uncharacterised. Two possibilities are membrane disruption or deleterious effects on membrane proteins. It is possible that by altering the membrane composition or modifying transport activity we will be able to increase the extracellular n-butanol concentration and reduce production costs.

The Research

Dr Alan Goddard is a Senior Lecturer in the School of Life Sciences at the University of Lincoln. The research in his laboratory focusses mainly on molecules that bind to, and/or cross biological membranes. He uses a variety of model membrane systems and whole cell assays.

Dr Goddard applied for a CBMNet Business Interaction Voucher with Green Biologics Ltd who are based in Oxfordshire. The project aimed to determine the mechanism of toxicity of n-butanol to Clostridia focussing on various aspects of the lipid membrane.

CBMNet Business Interaction Voucher

The Result

Dr Goddard's lab obtained results indicating that n-butanol is disruptive to biological membranes, both those synthesised from single lipids and those made from lipids extracted from Clostridia from both high and low n-butanol concentrations. Interestingly, the disruption seems to be most significant at concentrations exceeding the toxic level observed in biofuel generation, suggesting that this may reflect a biologically-relevant toxicity mechanism.

Whilst some of the research was conducted by Dr Goddard, a student on the MSc Biotechnology degree at Lincoln also undertook their dissertation project in this area and gained valuable experience working with model lipid systems and a variety of assays.

The Future

The collaboration and data that has come out of this project will lead to further collaboration between Dr Goddard and Green Biologics Ltd, for example, further CBMNet Proof of Concept funding, Innovate UK funding and, in the longer term, possible Knowledge Transfer Partnership funding.

Dr Goddard and members of Green Biologics Limited attended the CBMNet Membrane Stress Meeting in September 2015, and successfully applied for Proof of Concept funding to build on the data from this Business Interaction Voucher.

They are now carrying out research to Identify and characterise protective lipid changes under solventogenic stress in Clostridia.

"With the help of a CBMNet Business Interaction Voucher we have been able to start working with the Goddard lab on artificial and reconstituted plasma-membrane. This system has helped us better understand various aspects of butanol toxicity. I hope we can strengthen the collaboration and this will allow us to improve the renewable process for n-butanol production."

Dr. Preben Krabben, Green Biologics Ltd

"The funding awarded by CBMNet has provided and exciting opportunity for the Goddard lab to begin industrially-relevant collaborations with Green Biologics Limited. The award has benefited the research of Green Biologics Limited as well as providing new opportunities for members of the Goddard lab. I hope that this collaboration will continue to develop based on the findings of this work."

Dr Alan Goddard, University of Lincoln

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