BIV-01-warren-C1net-public-summary-report

PI Martin Warren, University of Kent

Cloning and metal analysis of recombinant aldehyde ferredoxin oxidoreductase (AOR)

Bio-based alternatives to petrochemical commodities, which are required as inputs into a variety of industrial applications such as polymers, coatings and surfactants, are predicted to rise from 2% to 25% of global production over the next ten years. The international chemical market is currently worth around $4 trillion with bio-production offering advantages such as environmental sustainability, cheaper production costs and protection from oil-price volatility. Approaches such as metabolic engineering and synthetic biology can be used to make bio-products and processes more efficient and cost competitive, and are fuelling innovation in the chemical industry. In this project we have explored the potential of bacterial microcompartments (BMCs) as a way to enhance the accumulation of acetaldehyde through the incorporation of a key enzyme, aldehyde ferredoxin oxidoreductase (AOR). This enzyme is able to convert acetate into acetaldehyde and we have shown that it is possible to produce this enzyme recombinantly in *E. coli* and also to target in to BMCs. In this respect, we have achieved the main objective of the BiV. It is now our intention to enhance this project by transferring this enzyme activity to specific bacteria that accumulate acetate, a group of bacteria called the acetogens. By redesigning and engineering some of the metabolic pathways in these organisms, bacteria that are able to grow on waste products such as gas emissions, it will be possible to convert these waste materials into commodity chemicals.

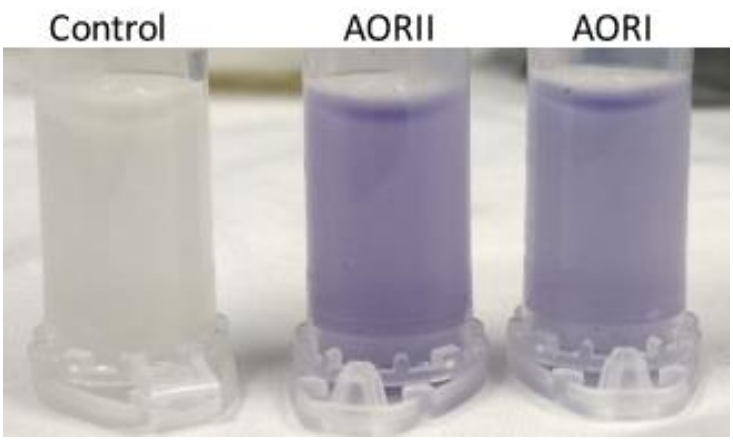

Figure showing the activity of recombinant AOR in *E. coli*. An increase in the blue colour demonstrate activity. Two (AOR) genes from *Clostridium ljungdahlii* were cloned into pET14b and transformed into *E. coli*. The second AOR, AOR II, appears to be slightly more active.

Current approaches for enhancing bio-based commodity production are restricted to known biosynthetic pathways and limitations to metabolite toxicity. However, many key bio-commodities are made via aldehyde-intermediates such as acetaldehyde, lactaldehyde and propanaldehyde and their production is often limited because of the inherent toxicity of their chemical reactivity. Ways to reduce this toxicity, for instance by the use of BMCs, offer a significant advantage to the commercial production of these materials. The results from this project are part of a strategy that show promise in being able to reduce the toxicity of key metabolic intermediates.