Business Interaction Vouchers Round 3 (October 2020)

Extracting value from agri-food waste	
Lead applicant's name	Dr Diganta Das
University/ research institute	Loughborough University
Industrial partner	Joel Hardingham
Company	Chips Board

Project abstract: Chip[s] Board produces bioplastics through the fermentation of industrial agricultural food wastes. Using industrial food waste as a feedstock diverts waste from landfill and reduces reliance on virgin crops for biochemical production. This project addresses the challenge of extracting desirable chemicals from a mixed-source feedstock fermentations. Loughborough University will work with Chip[s] Board on a feasibility study to investigate filtration and reverse osmosis as a sustainable method for downstream-processing of fermentation broth to extract purified organic acids. This grant will reduce manufacturing costs by simplification of the downstream-process, resulting in increased extraction efficiency and allowing for utilisation of a wider range of feedstocks.

Successful completion of this project will rapidly accelerate Chip[s] Boards route to market. Proving the viability of these systems for lactic acid extraction will provide a cost effective and sustainable methodology which can be translated into pilot scale production. With these systems, Chip[s] Board can satisfy the demand for samples that our range of partners and end-users require, and position them at the forefront of the sustainable bioplastics market.

Business Interaction Vouchers are an essential tool for connecting industry with academia. With this partnership, Chip[s] Board gain access to state-of-the-art facilities and expertise from Loughborough University. Dr Das has recommended using this project as a stepping-stone for a project focussed on designing bespoke membranes specific to Chip[s] Board's process requirements. As well as maximising the effectiveness of downstream processing, the resulting process will generate value through new IP in this area.

Summary of Project outcomes: This business interaction voucher (BIV) project aimed to investigate membrane processes as a sustainable separation method as part of downstream processing of fermentation broth to extract highly purified organic acids. During the literature review stage of this project, a range of different membrane processes was evident because of their cost effectiveness, simple operating conditions and high output production for organic acid separation. A review of technoeconomic assessment of the membrane processes helped this project to identify the key features of a model for requiring further development and testing. Experiments were conducted to test selected ultrafiltration and nanofiltration membranes for the measuring the flux of fermentation broth containing lactic acid. The results of the experiments demonstrated that, the permeate flux achieved with UF membrane was always higher than the permeate flux achieved with NF membrane and possible fouling affect the flux values particularly for nanofiltration membranes. A larger project dealing with process design, fouling control, membrane selection would be required in the future to answer many interesting questions that have come out of this project. These results of this project can subsequently reduce the manufacturing costs of downstream-process and resulting in increased extraction

efficiency. In short, it will reduce their energy costs, increase turnover time, reduce chemical waste disposal, and enable avoidance of many negative environmental impacts associated with alternative DSP methods.

Identifying novel chemical reactivities to green industrial processes using culture collections	
Lead applicant's name	Dr Stephen Wallace
University/ research institute	University of Edinburgh
Industrial partner	Judith Huggan
Company	NCIMB

Project abstract: There are an estimated one trillion species of microbes on Earth. However, 99.99% of these have yet to be discovered, meaning that the fraction of microbial diversity sampled to date is effectively zero. The microbes that are known are held in culture collections globally and little is known about the genomic data or metabolic function of the strains they contain. This severely limits our ability to identify new microbes to address current industrial needs.

In the face of climate change resulting from industrial activity, and as the drive towards diminishing our reliance on fossil fuels continues to gain momentum, we must accelerate our efforts to discover new sustainable solutions to the biological production of high value chemicals. This is where accessing the untapped potential held within culture collections and exploiting the functional reactivity of microorganisms is critical.

In this project, we will explore one of the largest and most diverse collections of industrial and environmentally useful microorganisms on Earth, housed here in the UK within the NCIMB culture collection, for new chemical reactivities that can be directly applied to provide solutions to persistent problems facing the traditional synthesis of high-value chemicals in the UK. The project aims to replace current traditional synthetic methods with bio-transformations and will include the recycling of persistent chemical wastes, an environmental and economically costly problem on a large scale, for which there is currently no biological solution.

Summary of Project outcomes: The project has successfully screened 78 strains from the NCIMB culture collection and has identified a novel biotransformation that is being further optimised to enable access to an industrial chemical that is currently manufactured from fossil fuels. Crucially, this reaction could not have been predicted using a knowledge of existing enzymatic chemistry or through bioinformatic searches, thereby demonstrating the unique and untapped chemical potential of this microbial resource. This study should inspire future endeavours to mine this collection for additional chemical reactivity with the aim of identifying new biotechnologies that can be used to create sustainable solutions for the UK chemical industry.