Biochemical Society support in action: the Eric Reid Fund for Methodology

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Endowed by Emeritus Member Dr Eric Reid, this fund awards grants with an emphasis on methodology and a preference for cellular or bioanalytical work. Awarded to Dr Stephen Wallace, Michelle Marufu, a student in his lab, reports on the supported work.

I have always been fascinated by how microbes can be genetically programmed to produce chemicals of industrial value. During my undergraduate degree, this inevitably drew me to subjects such as molecular biology and industrial biotechnology.

Last year, I was presented with a unique opportunity to work in the laboratory of Dr Stephen Wallace at the Institute for Quantitative Biology, Biochemistry and Biotechnology ("IQB3" for short) at the University of Edinburgh. Stephen had recently established the lab earlier in 2017, and was researching how engineered microbes and chemical catalysts could be interfaced to make novel compounds. My summer research project involved optimizing the production of bacterial metal nanoparticles (BNPs) with the aim of exploring their potential as catalysts in the field of organic chemistry to synthesize the infamous industrial small molecule adipic acid (AA). The lab had recently developed a microbial pathway to produce the precursor to AA, muconic acid (MA). We believed that BNPs could be used to catalyse the non-enzymatic reduction of MA to AA. This reaction involves a simple C=C bond reduction, which is relatively easy to achieve in organic chemistry, and difficult to achieve using enzymes.

During my 10 weeks in the lab, I developed aerobic and anaerobic procedures for the production of BNPs from *E. coli* BL21(DE3) cells using various Pd^{2+} salts and balloons of H_2(g). I was surprised to discover that *E. coli* could use Pd^{2+} as a terminal-electron acceptor under aerobic conditions and that the yield of BNPs increased under these conditions. I also tested BNP production in the presence of a MA precursor molecule, and made the unexpected discovery that the *E. coli* cells were exceptionally tolerant to this molecule using OD_{600} and cell viability (CFU/mL) measurements. This result suggested to us that this pathway in E. coli could potentially be used to make >7 g/L of adipic acid!

As I left the lab, Stephen and his postdocs were planning to image the BNP-producing cells via transmission electron microscopy and were conducting the first set of experiments to test whether my isolated BNPs could indeed reduce MA in the presence of a reductant.

Over such a short period, I feel incredibly lucky to have been exposed to such a variety of chemical and biological techniques. The summer project in the Wallace lab had an enormous positive effect on my honours dissertation the following semester—not just by giving me practical experience in the lab, but enabling me to ask scientific questions and to then design experiments to test my own hypotheses, for the very first time.

I'm still fascinated by the field of industrial biotechnology. The use of engineered microorganisms is inevitably going to transform the chemical industry, especially as the field of synthetic biology continues to grow. As a biologist, we're taught about the negative environmental effects of the petrochemical industry (quite rightly!) and how engineered biology is the answer to this issue. However, my time in the Wallace lab has given me some insight into the amazing science that can be done, and the solutions that can arise, when you combine tools from different disciplines.

Awardees:

Ms Michelle Marufu and Dr Stephen Wallace, School of Biological Sciences, University of Edinburgh, UK
Chair of the Education, Training and Public Engagement Committee; University of Plymouth, UK