New routes to the sustainable manufacturing of chemicals

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University of Manchester researchers have developed a novel biocatalytic system that potentially allows for the efficient and environmentally benign production of organic chemical compounds used in many everyday products. The findings are published in the leading journal *Science*.

Amines are key intermediates for the synthesis of a plethora of chemical compounds at industrial scale used in the production of active pharmaceutical ingredients, fine chemicals, agrochemicals, polymers, dyestuffs, pigments and plasticising agents. But these requisite amines are scarce in nature.

Although various methods have been developed in the past decade to produce these specialised high-value chemicals, they require long chemical synthetic routes involving complex reaction steps with potentially toxic side-products and waste streams.

Researchers at the Manchester Institute of Biotechnology (MIB), in collaboration with BASF, have developed a system that replaces these methods with a clean biocatalytic route whereby high value amines are synthesised from low cost alcohols by the coupling of two enzymes, namely an ADH (alcohol dehydrogenase) and an AmDH (amine dehydrogenase) in the presence of ammonia. Normally these enzymes would require excessive amounts of expensive co-factors to drive the individual reactions but these co-factors are recycled through the coupling of ADH and AmDH in a one-pot reaction whose sole by-

product is water.

This new route offers potential economic as well as environmental benefits and will provide opportunities for industrial exploitation, including the synthesis of new chemical libraries that will support industrial and academic drug discovery programmes. Developing the use of biocatalysts within the chemical manufacturing industry could lead to efficient production routes to high yields of complex chemicals, whilst using less energy and generating less waste than conventional processes.

Professor Nicholas Turner explains the importance of this process: "This fundamental research builds on the MIB's expertise in biocatalysis and forms the basis for the development of new applications in the sustainable manufacture of fine and speciality chemicals. The development of this new generation of biocatalysts should lead to economic and environmental improvements in the manufacture of a range of chemicals, including pharmaceuticals and polymers. It also offers the possibility of circumventing current industrial processes which are reliant on scarce natural resources."

More information: "Conversion of alcohols to enantiopure amines through dual-enzyme hydrogen-borrowing cascades." *Science* 25 September 2015: Vol. 349 no. 6255 pp. 1525-1529 DOI: 10.1126/science.aac9283

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