Thermophilic enzymes as industrial biocatalysts

Jennifer A Littlechild
University of Exeter, UK

There is an increasing demand for new enzymes with enhanced performance and/or novel functionalities that provide savings in time, money and energy for industrial processes in the areas of high value chemical production and other "white" biotechnology applications. There is limited understanding of the metabolic capacity of life and only a small proportion of nature's catalysts have been utilised for industrial biotechnology. There are new metabolic pathways and enzyme activities to be discovered and many of which could be identified within the large proportion of micro-organisms that cannot be cultured and within their associated viruses. The number of enzymes explored to date remains within the range of 1-2% of known microbial diversity. Enzymes used for commercial biotransformation reactions are required to be stable under the industrial conditions employed. The use of naturally thermostable enzymes isolated from hot environments can be a source of enzymes that are more stable to high temperatures, extremes of pH and exposure to organic solvents. By using both genomic and metagenomic approaches within the projects, HotZyme and THERMOGENE, we have identified hydrolase and transferase enzymes of industrial interest isolated from high temperature environments around the world. A selection of these novel enzymes including esterases, cellulases, epoxide hydrolases, transketolases and transaminases have been characterized both biochemically and structurally. In case of the epoxide hydrolases, two new enzymes with interesting substrate specificity and stereo-selectivity have been discovered from thermophilic metagenomes. Applications of these new epoxide hydrolases have been demonstrated at industrial scale for the production of new chiral chemical building blocks. A new thermophilic cellulase enzyme with activity at pH 5.0 and active under high salt conditions has been isolated which has potential applications for breakdown of biomass.

Biography

Jennifer A Littlechild is a Professor of Biological Chemistry and has established the Henry Wellcome Centre for Biocatalysis at Exeter University in 2003. Her research studies involve the structural and mechanistic characterisation of a range of enzymes from thermophilic bacteria and archaea that have industrial applications. She has a particular interest in thermophilic carbonic anhydrase enzymes and has carried out a project with Statoil from 2011-2013. She has published over 200 publications in high impact journals and has presented her research work internationally. She is the UK Representative and Vice-Chair of the European Section of Applied Biocatalysis and member of EU Advisory Committee for Industrial Biotechnology.

J.A.Littlechild@exeter.ac.uk

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