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Thermophilic enzymes with applications for industrial biocatalysis

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. Only a small proportion of nature's catalysts have been utilised for industrial biotechnology. The number of enzymes explored to date remains within the range of 1-2% of known biodiversity. A problem with using enzymes for industrial biocatalysis reactions is often their stability under the harsh conditions employed. The use of naturally thermostable enzymes isolated from hot environments are more stable to high temperatures, extremes of pH and exposure to organic solvents. The projects HOTZYME and THERMOGENE have identified hydrolase and transferase enzymes of industrial interest isolated from high temperature environments around the world. These have been isolated from thermophilic bacterial and archaeal genomes and metagenomes. A selection of these novel thermostable enzymes including cellulases, carboxylesterases, lactonases, epoxide hydrolases, transketolases, hydroxymethyl transferases and transaminases have been characterized both biochemically and structurally. Transaminase enzymes have received special attention for the production of chiral amines which are important building blocks for the pharmaceutical industries. These enzymes catalyse the reversible transfer of an amino group from a donor substrate onto a ketone/aldehyde or sugar acceptor molecule. They can be subdivided into 6 classes. The less studied class 4 (branched chain) (R) selective, class 5 (S) selective and class 6 (sugar) enzymes have been identified. An example of the archaeal class 4 enzyme from *Archaeoglobus fulgidus*; a thermostable class 5 archaeal transaminase from *Sulfolobus solfataricus* and class 6 sugar transaminase from *A. fulgidus*. Two new enzymes with interesting substrate specificity and stereo-selectivity have been discovered which have already been demonstrated at industrial scale for the production of new chiral chemical building blocks.

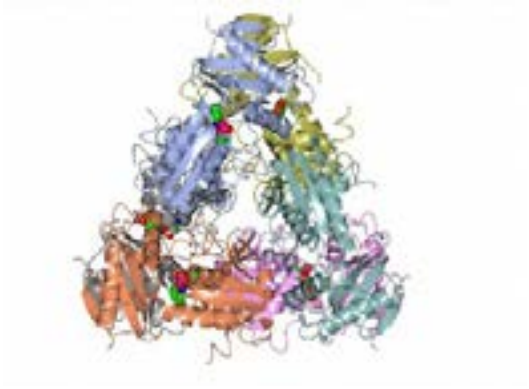

Figure 1: Hexameric structure of branched chain transaminase from A. fulgidus. An inhibitor bound to the cofactor pyridoxal phosphate at the active sites shown in spheres.

Biography

Jennifer A Littlechild is an Emeritus 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 published over 200 publications in refereed high impact journals and presented her research work internationally. She has coordinated EU related project THERMOGENE and was a partner in a consortium grant HOTZYME. In UK she is funded from BBSRC and Innovate UK. These grants involve both large industrial companies and SME enterprises. She has supervised over 40 PhD students and acts as External Examiner for other PhD and Masters Students. She is the UK representative and Vice Chair of the European Section of Applied Biocatalysis and a Member of EU advisory committees for Industrial Biotechnology.

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