'Invisible' protein structure explains the power of enzymes

July 3 2015

From left are Michael Kovermann, Elisabeth Sauer-Eriksson, Uwe Sauer and Magnus Wolf-Watz. Credit: Johan Gunséus

A research group at Umeå University in Sweden has managed to capture and describe a protein structure that, until now, has been impossible to study. The discovery lays the base for developing designed enzymes as catalysts to new chemical reactions for instance in biotechnological applications. The result of the study is published in the journal *Nature Communications*.

Enzymes are extraordinary biocatalysts able to speed up the cellular, chemical reactions several million times. This increase of speed is completely necessary for all biological life, which would otherwise be limited by the slow nature of vital chemical reactions. Now, a research group at the Department of Chemistry has discovered a new aspect in enzymes that, in part, explains how enzymes manage their tasks with unmatched efficiency and selectivity.

So-called high-energy states in enzymes are regarded as necessary for catalysing of chemical reactions. A high-energy level is a protein structure only occurring temporarily and for a short period of time; and these factors collaborate until its state becomes invisible to traditional spectroscopic techniques. The Umeå researchers have managed to find a way to maintain a high-energy state in the enzyme, adenylate kinase, by mutating the protein.

"Thanks to this enrichment, we have been able to study both structure and dynamics of this state. The study shows that enzymatic high-energy states are necessary for chemical catalysis," says Magnus Wolf-Watz, research group leader at the Department of Chemistry.

The study also indicates a possibility to fine-tune the dynamics of an enzyme and this possibility can be useful for researchers in developing new enzymes for catalysis of new chemical reactions.

"Research on Bioenergy is an active field at Umeå University. An important, practical application of the new knowledge can be enzymatic digestion of useful molecules from wooden raw materials," says Magnus Wolf-Watz.

The discovery has been made possible thanks to a broad scientific approach where numerous advanced biophysical techniques have been used; Nuclear Magnetic Resonance (NMR) and x-ray crystallography being the main techniques.

"One of the strengths of Umeå University is the open cooperative climate with low or no barriers between research groups. It means that exciting research can be conducted in the borderland of differing expertise," says Magnus Wolf-Watz.

More information: Michael Kovermann, Jörgen Ådén, Christin Grundström, A. Elisabeth Sauer-Eriksson, Uwe H. Sauer & Magnus Wolf-Watz: Structural basis for catalytically restrictive dynamics of a high-energy enzyme state. *Nature Communications*. DOI: 10.1038/ncomms8644

Provided by Umea University