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Empowering enzyme characteristics through rational design

Ugur Uzuner
Karadeniz Technical University at Trabzon, TURKEY

Enzymes are the key players of modern biotechnology. Varying and rapidly augmenting industrial applications on human nutrition, animal feed and bio-based fuels necessitate the discovery, improvement and effective use of non-toxic and environmentally-friendly enzymes during different processing steps. The preference of highly efficient enzymes in biotechnology is thus of great interest due to obtaining cost-effective and higher outcomes. Further improving the characteristics of biocatalysts is therefore an indispensable need. Rational design-based enzyme engineering thus stands as a superior approach to enhance the adaptability and tolerance of enzymes over diverse processing conditions of industry. Recently developed numerous high-throughput bioinformatics software focusing on protein structure and dynamics analyses enable knowledge-based design of enzyme characteristics including increased thermostability and enhanced pH tolerance.

Through integrative and complementary bioinformatics analyses, 4 mutants of *Geobacillus_sp*._TF16 endoxylanase (optimum_pH_8.5) was developed to improve its pH optimum, through knowledge-based transferring large and negatively charged amino acid-rich peptides from *Bacillus_halodurans*_C-125 endoxylanase. Two of four *in silico* designed mutants were successfully expressed in *E.coli* and for their pH optima shifts towards alkaline conditions. This new approach enabled to improve pH optimum about 1.5 units and also enhanced the efficiency throughout broader pH range (7.0-10.0). In addition, optimum temperature of GeoInt3 mutant was improved by_5°C.

Consequently, current findings suggest that introduction of negatively charged amino acids onto protein surface may improve both pH optimum and thermostability of enzymes to alkaline conditions. Structure dynamics-based rational engineering of biotechnologically crucial enzymes could thus_be operated as a genuine strategy to invigorate current industrial bio-processes.

Biography

Ugur Uzuner is an Assistant Professor and Program Director of Biotechnology at the Department of Molecular Biology and Genetics in Karadeniz Technical University, TURKEY. He completed his PhD research at the Department of Plant Pathology and Microbiology of Texas A&M University, TX, USA in 2013. He has published several outstanding research articles on the structure dynamics analysis and rational design of enzymes in reputed journals. He has been serving as an editorial board member of Turkish Journal of Botany. His research interests are focused on structure dynamics analysis-based modeling and engineering of industrial enzymes, development of versatile and robust strains towards efficient bioremediation of various wastes from industrial power plants.

uguruzuner@ktu.edu.tr