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Cellulolytic enzymes of basidiomycetous white-rot fungi: potential tools for bioethanol and novel nanocellulose applications

Today the non-renewable natural resources are consumed with a reckless pace. Renewable natural resources such as wood and other lignocellulosic biomasses are diverse precursors for bio-based products, chemicals and fuels. Enzymes are the determining tools in bioprocesses that aim at greener applications. At the moment, efficient enzymes with suitable biochemical properties are needed for the applications such as the total hydrolysis of softwood cellulose and novel nanofibrillated cellulose products.

In nature basidiomycetous white-rot fungi are the most efficient wood-decaying organisms. They are shown to express a set of extracellular cellulolytic and oxidative enzymes that degrade all the wood polymers, i.e. cellulose, hemicellulose and lignin. White-rot fungi show different strategies in wood decay: non-selective species cause the simultaneous breakdown of all wood polymers whereas selective fungi decompose lignin and hemicellulose prior to cellulose. So far published whole genome sequences of white-rot fungi reveal that they have surprisingly high number of putative cellulase gene models (www.jgi.doe.gov) but only a few of which have been characterized either as genes or enzymes.

The focus of my Ph.D. project is to reveal the biotechnological potential of this still unused resource. First of all my study will help to understand how white-rot fungi are degrading cellulose in wood and why these fungi have multiple cellulase genes and isoenzymes. The understanding of different decay systems of these wood-rotting fungi simplifies the selection of suitable enzymes for industrial applications. Secondly I will study the properties of white-rot fungal cellulases in the hydrolysis of softwood Kraft pulp for ethanol production and in nanofibrillated cellulose applications.