Exploitation of novel fungal oxidative biocatalysts for the sustainable production of valuable monomers from biobased furans

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The dependence on fossil fuels for the production of chemical building blocks with significant interest to the polymer industry has drawn attention not only in the utilization of renewable resources such as lignocellulosic biomass, but also in the application of biocatalysis to replace chemical reagents toward the development of greener and sustainable processes. Furans, such as 5-hydroxymethylfurfural (HMF) and furfural (FA) obtained from the lignocellulose-derived polysaccharides, have emerged as crucial precursors in chemical synthesis reactions, since they can be transformed to a wide range of derivatives (2,5-furandicarboxylic acid, 2-furancarboxylic acid etc.) with exceptional applications. Biocatalytic oxidation of furans with redox enzymes offers a facile and regioselective route of reaction under mild conditions [1]. The current study targeted at the enzymatic biotransformation of HMF and FA using novel fungal biocatalysts from the Auxiliary Activity AA3 and AA5 families of CAZy database [2]. Through intelligent exploration of *Ganoderma lucidum* genome, it was possible to retrieve one sequence with putative glyoxal oxidase activity (*Gl*GlyOx1) and one with aryl-alcohol oxidase (*Gl*AAOx1) activity based on their homology with known furan-transforming fungal catalytic activities. The genes were heterologously expressed in yeast *Pichia pastoris*, the respective enzymes were purified to their homogeneity and biochemically characterized. *Gl*GlyOx1 and *Gl*AAOx1 were evaluated, both individually and synergistically (along with the presence of *in-house* produced galactose oxidase *Fo*GalOx from *Fusarium oxysporum* [3] and a commercially available horseradish peroxidase HRP), for their ability to act on furans and produce value-added oxidized derivatives. Our results demonstrate the potential of *G. lucidum* enzymes for obtaining furan-based monomers from lignocellulosic biomass residues, which can be used as building blocks for the production of biobased polymers.

Keywords: Biotransformation, Enzyme catalysis, Oxidases, CAZymes, Furans, Basidiomycete

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