NOVEL FUNGAL OXIDATIVE BIOCATALYSTS FOR THE BIOTRANSFORMATION OF FURANS TO HIGH ADDED VALUE MONOMERS

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The ever-growing concerns of climate change and the depletion of fossil fuels has led to the demand for renewable feedstock alternatives to produce building blocks for green chemistry. A promising substitute emerging in recent years is lignocellulosic biomass, which can be converted through biocatalysis into high added value bioproducts. Among the substances resulting from the degradation of the individual components of plant biomass, furans such as 5-hydroxymethylfurfural (HMF) produced by dehydration of hexoses (sugars of lignocellulosic biomass) are of great interest. Further biotransformation of HMF leads to the formation of 2,5-furandicarboxylic acid (FDCA), which is a dicarboxylic acid compound widely used as a monomer to produce a variety of biobased polymers[1,2]. This study aims to exploit the facile and regioselective route of reaction under mild conditions of biocatalysis by using novel fungal enzymes for the biotransformation of HMF and its oxidative derivatives to valuable monomers such as FDCA. Two sequences were retrieved through intelligent exploration, one of them having a putative glyoxal oxidase activity (*Gl*GlyOx) and one with a galactose oxidase activity (*Fo*GalOx), both belonging to the revisited Auxiliary Activity AA5 family of CAZy database and subfamilies AA5_1 and AA5_2 respectively. The genes were expressed heterologously in the methylotrophic yeast *Pichia pastoris*, the respective enzymes were purified to their homogeneity and biochemically characterized. Moreover, the enzymes were evaluated for the biotransformation of furans and the production of value-added oxidized derivative compounds both individually and synergistically (along with the presence of a commercially available horseradish peroxidase HRP). Outcomes demonstrated *Fo*GalOx catalyzes the bioconversion of most furanic compounds, while the activity of *Gl*GlyOx was more specific for the oxidation of 5-hydroxymethylfurfural (HMF) to 5-hydroxymethyl-2-furancarboxylic acid (HMFCA) and furan-2,5-dicarbaldehyde (DFF) to 5-formylfurancarboxylic acid (FFCA). In both cases, the presence of HRP favors the reaction and enzyme synergism occurs and the oxidation was significantly enhanced by the addition of catalase which consumed the produced H_2O_2 and relieved the system from the adverse effects of its overaccumulation. Therefore, our results demonstrate the potential of these enzymes of oxidizing furan substrates derived from lignocellulosic biomass to produce compounds with high added value and diverse industrial applications.

KEYWORDS: biocatalysis, oxidase, furans, HMF, FDCA

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