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Cooperation between a Laccase and an Amine Transaminase in the Biocatalytic Valorization of 5-(Hydroxymethyl)furfural

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PURPOSE OF THE ABSTRACT

5-(Hydroxymethyl)furfural (HMF) is an essential renewable building block that may be used in various transformations to produce high-value compounds.[1] Its oxidation enable the formation of a variety of derivatives, many of which have uses in the pharmaceutical and polymer industries.[2] Nevertheless, the constant and affordable supply of HMF from renewable resources is still insufficient to move its transformation processes to an industrial scale, being energy demands, operating costs and processes efficiency the main hinders.[3] Scalable and economically advantageous approaches are therefore needed to face these issues. The severe reaction conditions and low yields make inorganic and acid catalysis for furan oxidation less than convincing. However, bioprocesses have demonstrated their ability to successfully offer sustainable solutions for bio-based derivatives from an environmental and economical point of view.[4] Also, the efficient synthesis of amino-furan compounds is highly appealing due to their relevance as precursors of, e.g. pharmaceuticals and polymers. Amongst the most appealing biocatalysts for furan transformations, our focus has been put on amine transaminases,[5] from the transferase enzymatic family, and laccases[6]. Transaminases are considered one of the most versatile biocatalysts for amino furan synthesis, while laccases can mediate the selective oxidation of alcohol and aldehyde functionalities.

After proving the combination of laccases and amine transaminases in a first study for the scalable production of furfuryl amine from furfuryl alcohol through furfural as intermediate,[7] herein we propose a similar strategy to effectively transform HMF into 5-aminomethyl-2-furancarboxylic acid (AMFC, Figure 1). This compound was synthesized via 5-formyl-2-furancarboxylic acid (FFCA) accumulation. Reaction conditions were individually investigated, focusing on e.g., pH adjustment and buffering powder influences, for an efficient set-up.

FIGURES

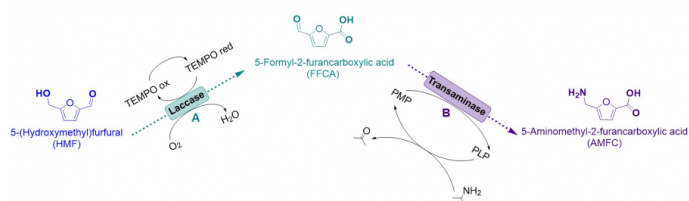


FIGURE 1

Figure 1.

One-pot/two-step catalytic process for the direct synthesis of furan-based amino derivative AMFC from HMF combining a laccase-mediated oxidation (A) and a transamination (B) step.

FIGURE 2

KEYWORDS

laccase | transaminase | HMF | biocatalysis

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