OP1.11 - HARNESSING *SACCHAROMYCES CEREVISIAE* FOR SUSTAINABLE FDCA PRODUCTION: OPTIMIZING 5-HMF DETOXIFICATION AND DERIVATIVE SYNTHESIS

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ABSTRACT

The escalating demand for energy and chemicals necessary in various daily routines allied to climate change and the increase in greenhouse gas emissions has been pushing the need to substitute their source from fossil fuels to biological processes. The establishment of a biorefinery for the manufacture of biofuels and other chemicals from renewable feedstocks, such as lignocellulosic biomass is essential to this goal. The yeast *Saccharomyces cerevisiae* has been widely studied for its ability to detoxify 5-HMF, a toxic by-product of hexoses degradation. However, its capability as a whole-cell biocatalyst to produce 5-HMF derivatives has not been sufficiently investigated [1]. 5-HMF is a versatile compound and an attractive chemical because of its unique properties and multiple applications, being reduced or subsequently oxidized to a variety of products. These HMF-derivatives have a wide range of applications such as synthesising polymers (BHMF), synthesising surfactants and resins (FFCA) and producing plasticisers, polyurethanes, polyesters or polyamides (FDCA), among others [2]. Here, a robust industrial *S. cerevisiae* strain was used as host for the development of genetically engineered strains to produce heterologous enzymes, HMF/Furfural oxidoreductase or HMF oxidase, envisioning FDCA production. We further investigated and optimised the ability of the modified strains to convert 5-HMF into its derivatives, especially FDCA. All recombinant strains were screened for their ability to detoxify 5-HMF, with the best-performing strain exhibiting efficient detoxification of 40 mM of 5-HMF, which led to the production of 12 mM of FDCA. Afterwards, bioconversion conditions were optimised by assessing the impact of oxygenation conditions, as its fine-tuning is deeply connected to 5-HMF detoxification and FDCA production. Lastly, a synthetic hemicellulosic hydrolysate, with glucose and fructose as carbon sources, was successfully used to generate FDCA. This study helps to the establishment of a sustainable bio-based process to produce 5-HMF derivatives.

References:

[1] J. T. Cunha, A. Romaní, and L. Domingues, "Whole Cell Biocatalysis of 5-Hydroxymethylfurfural for Sustainable Biorefineries," Catalysts, vol. 12, no. 2, pp. 1–15, 2022, doi: 10.3390/catal12020202.
[2] K. Saikia et al., "Recent advances in biotransformation of 5-Hydroxymethylfurfural: challenges and future aspects," J. Chem. Technol. Biotechnol., vol. 97, no. 2, pp. 409–419, 2022, doi: 10.1002/jctb.6670.