

Systems biocatalysis for renewable biomasses valorization: dream and/or reality?

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Developing a sustainable biobased process to convert low-value substrates of natural origin to high-value products is an increasingly attractive strategy due to the lower ecological footprint as compared to chemical synthesis. At the industrial level, lignin is a by-product of papermaking industry, currently under-utilized and routinely combusted: its effective valorization is essential for environmental sustainability and to enhance the economics of lignocellulose-based biorefineries. Moreover, wheat bran is an agricultural inexpensive by-product obtained in large amounts worldwide: most of it is used as a low value ingredient for livestock feed. Wheat bran can be processed to extract ferulic acid, a precursor of valuable fine chemicals such as vanillin and/or *cis,cis*-muconic acid (ccMA), a building block for the synthesis of plastic materials. Recently, we developed an efficient green process for producing such valuable compounds based on: a) the optimization of the extraction procedures of vanillin from lignin and of ferulic acid from wheat bran; b) the genetic engineering of an *E. coli* strain to modulate the expression of up to seven recombinant enzymes, previously published in: Molinari et al. (2023) ACS Sustain Chem Eng 11, 2476-2485. In detail, when the optimized whole-cell biocatalyst expressing all seven enzymes was used, ccMA was produced in one-pot with a >95% conversion yield starting from ferulic acid in 10 h, corresponding to 0.73 g of ccMA/g of ferulic acid, and 2.2 mg of ccMA/g of wheat bran biomass. The proposed bioconversion system generating ccMA from different natural and renewable feedstocks (instead of petroleum) represents a starting tool to develop further innovative synthetic biocatalytic processes aimed at generating bioproducts towards a sustainable and biobased economy.

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