

Biocatalytic Conversion of Vanillic Acid to Vanillin by a Carboxylic Acid Reductase with High Activity

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Vanillin is a value added aromatic aldehyde with a characteristic vanilla-like odor utilized in food, fragrance and pharmaceutical industries. Reduction of vanillic acid, a product from degradation of lignin, can lead to the aldehyde formation, but the reduction process is energetically unfavorable with a high activation energy barrier. This may be overcome by employing carboxylic acid reductase (CAR) enzymes, which use ATP and NADPH to drive the reduction. Therefore, fourteen CAR candidates were recombinantly expressed in *Escherichia coli* and examined for the conversion of vanillin. As a result from in vitro experiment, a CAR from *Mycobacterium abscessus* BIMLD gene was selected with 8.6-fold larger in vitro activity than the CAR from *Nocardia iowensis* Q6RKB1 with the highest previously known activity. The reaction conditions such as substrate concentration and supply of reducing power via glucose addition were investigated to optimize the yield while suppressing the formation of the by-product, vanillyl alcohol. 2.86 g L⁻¹ vanillin was produced by the whole cell conversion. Molecular modeling has also been carried out to relate the enzyme activity to the structural information.