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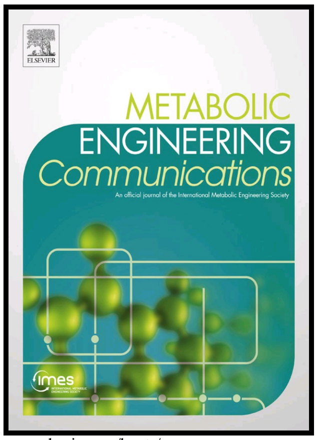

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CO_2 to Succinic Acid – Estimating the Potential of Biocatalytic Routes

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Abstract

Microbial carbon dioxide assimilation and conversion to chemical platform molecules has the potential to be developed as economic sustainable processes. The carbon dioxide assimilation can proceed by a variety of natural pathways and recently even synthetic CO_2 fixation routes have been designed. Early assessment of the performance of the different carbon fixation alternatives within biotechnological processes is desirable to evaluate their potential. Here we applied stoichiometric metabolic modeling based on physiological and process data to evaluate different process variants for the conversion of C1 carbon compounds to the industrial relevant platform chemical succinic acid. We computationally analyzed the performance of cyanobacteria, acetogens, methylotrophs, and synthetic CO_2 fixaton pathways in *Saccharomyces cerevisiae* in terms of production rates, product yields, and the optimization potential. This analysis provided insight into the economic feasibility and allowed to estimate the future industrial applicability by estimating overall production costs. With reported, or estimated data of engineered or wild type strains, none of the simulated microbial succinate production processes showed a performance allowing competitive production. The main limiting factors were identified as gas and photon transfer and metabolic activities whereas metabolic network structure was not restricting. In simulations with optimized parameters most process alternatives reached economically interesting values, hence, represent promising alternatives to sugar-based fermentations.