Design of a biosynthetic pathway for curcumin production in Escherichia coli

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Abstract

Curcumin is the yellow pigment from turmeric, a well known culinary spice produced from the herb Curcuma longa. Research over the last years has shown that curcumin presents a wide range of pharmacological effects, including anti-inflammatory, anti-oxidant and anticarcinogenic activity. Given its potential application in cancer treatment, there is an interest for industrial production of this natural compound. This work consists on a synthetic biology approach for the design of a heterologous pathway for curcumin synthesis in Escherichia coli, a widely used microbe in industrial biotechnology. Using pathway databases and literature research we have selected the best gene candidates for heterologous expression of a curcumin synthesis pathway in E. coli. The DNA sequences for these genes were retrieved from public databases and can be readily synthesized for insertion into the host using molecular biology techniques. The inclusion of this pathway in a recent genome-scale reconstruction of the metabolism of E. coli has enabled the in silico analysis of the production capabilities for this host. We have analysed the theoretical production yields and biomass growth under different experimental conditions. Using this model we have also searched for potential gene knockouts that partially redirect the metabolic flux to the heterologous pathway without compromising cellular growth. In overall, the methods used in this work allow the selection of the most suitable combination of experimental conditions and genetic manipulations for the design of an efficient biosynthetic pathway for curcumin production in E.coli.

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