Synthetic biology for producing value-added molecules in Yarrowia lipolytica

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Abstract

Yarrowia lipolytica possesses natural and engineered traits that make it a good host for the industrial bioproduction of diverse molecules such as lipids, proteins, terpenes, and so on. Leveraging its inherent lipid metabolism, metabolic engineering has been employed to produce odd-chain fatty acids (OCFA), which find applications in pharmaceuticals, cosmetics, foods, and the fine chemical industry. To enhance OCFA production, pathway engineering strategies, including competitive pathway inhibition, precursor pool optimization, and enhanced carbon flux towards lipid accumulation, were implemented. These efforts resulted in improved titer and content of OCFA in total lipids (reaching 0.99 g/L and 65.9%, respectively). The distribution of OCFA across various lipid classes within the cells was further confirmed through a lipidomic study. Y. lipolytica also demonstrates a remarkable ability to redirect flux towards acetyl-CoA, making it a promising host for the production of various lipid derivatives and terpenes. Terpenes, with their diverse molecular architectures, hold significant value across different industries. Traditional terpene sources, plants, often face limitations such as low yield, high production costs, and environmental pollution during extraction. Consequently, microbial production of terpenes through synthetic biology approaches has gained considerable interest. Several strategies aimed at enhancing the production of specific terpene in *Y. lipolytica*, including improving precursor pools, modulating the expression level of target genes, and compartmentalization of terpene production will be presented.

Keywords: Synthetic biology, Yarrowia lipolytica, lipid, terpene

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