Engineering 1-Alkene Biosynthesis and Secretion by Dynamic Regulation in Yeast

Microbial production of fatty acid-derived hydrocarbons offers a great opportunity to sustainably supply biofuels and oleochemicals. One challenge is to achieve a high production rate. Besides, low efficiency in secretion will cause high separation costs, and it is therefore desirable to have product secretion. Here, we engineered the budding yeast Saccharomyces cerevisiae to produce and secrete 1-alkenes by manipulation of the fatty acid metabolism, enzyme selection, engineering the electron transfer system and expressing a transporter. Furthermore, we implemented a dynamic regulation strategy to control the expression of membrane enzyme and 1-alkene production and cell growth by relieving the possible toxicity of overexpressed membrane proteins. With these efforts, the engineered yeast cell factory produced 35.3 mg/L 1-alkenes with more than 80% being secreted. This represents a 10-fold improvement compared with earlier reported hydrocarbon production by S. cerevisiae.