Biomanufacturing of Value-Added Products from Oils or Fats: A Case Study of Yarrowia lipolytica

Na Liu[1], Ya-Hue Soong[1], Iman Mirzaee Kakhki[1], Andrew Olson [1], Peng Yu[1], Hsi-Wu Wong[1], and DONGMING XIE[1]

[1]University of Massachusetts Lowell

October 22, 2020

Abstract

The United States produces more than 10 million tons of waste oils and fats each year. This paper aims to establish a new biomanufacturing platform that convert waste oils or fats into a series of value-added products. Our research employs the oleaginous yeast Yarrowia lipolytica as a case study for citrate production from waste oils. First, we conducted the CFD simulation of the bioreactor system and identified that the extracellular mixing and mass transfer is the first limiting factor of an oil fermentation process due to the insolubility of oil in water. Based on the CFD simulation results, bioreactor design and operating conditions were optimized and successfully enhanced oil uptake and bioconversion in fed-batch fermentation experiments. After that, we investigated the impacts of cell morphology on oil uptake, intracellular lipid accumulation, and citrate formation by overexpressing and deleting the MHY1 gene in the wild type Y. lipolytica. Fairly good correlations were achieved between cell morphology and productivities of biomass, lipid, and citrate. Finally, fermentation kinetics with both glucose and oil substrates were compared and the oil fermentation process was carefully evaluated. Our research results suggest that waste oils or fats can be economical feedstocks for biomanufacturing of many high-value products.

Hosted file

`BB Manuscript - Biomanufacturing from Oils - UML 2020.pdf` available at https://authorea.com/users/369402/articles/488270-biomanufacturing-of-value-added-products-from-oils-or-fats-a-case-study-of-yarrowia-lipolytica