Bioconversion of Low-Value Biomass into Microbial Oil: Postprint

Authors: Fei Qiang

Date: 2017-09-20T00:00:00+00:00

Abstract

The current crisis of global warming is primarily attributed to CO2 production from excessive use of fossil fuels during recent decades, and has increased demand for renewable biofuels tremendously. Lipids are drawing considerable attention in relation to the production potential of biodiesel on the basis of their nontoxic, sustainable, and energy efficient proprieties. However, the high cost of microbial lipid produced by oleaginous microorganisms mainly stems from the high cost of glucose, which is estimated to be about 80% of the total medium cost. Therefore, considerable efforts have been directed toward minimizing the carbon source cost and finding new alternative carbon sources. In this report, several low-cost biomass including food-waste-derived volatile fatty acids, lignocellulose-based sugars, and methane derived from biogas were investigated for lipid production. After developing the culture modes and optimizing the culture conditions, both high lipid titer and productivity were achieved in high cell density cultures of different microorganisms using various carbon sources.

Full Text

Bioconversion of Low-Cost Carbon Sources for the Production of Microbial Lipids (生物转化低值生物质制备生物油脂)

Qiang Fei, Professor and Doctoral Supervisor
School of Chemical Engineering, Xi' an Jiaotong University
Email: feiqiang@xjtu.edu.cn | Tel: +86-187-0089-5167

Research Summary

The current crisis of global warming is primarily attributed to CO2 emissions from the excessive use of fossil fuels in recent decades, which has tremendously

increased demand for renewable biofuels. Lipids have drawn considerable attention for their potential in biodiesel production due to their nontoxic, sustainable, and energy-efficient properties. However, the high cost of microbial lipids produced by oleaginous microorganisms mainly stems from the expense of glucose, which accounts for approximately 80% of total medium costs. Therefore, considerable efforts have been directed toward minimizing carbon source costs and identifying alternative feedstocks. This report investigates several low-cost biomass sources, including food-waste-derived volatile fatty acids, lignocellulose-based sugars, and methane from biogas, for lipid production. By developing culture modes and optimizing conditions, high lipid titers and productivity were achieved in high-cell-density cultures of various microorganisms using these carbon sources.

Biography

Prof. Qiang Fei, born in 1980, is a professor and doctoral supervisor at Xi' an Jiaotong University, where he was recruited in 2016 through the university' s High-Level Talent Program. He holds a Ph.D. in biochemical engineering.

Dr. Fei earned his master' s degree in 2006 from the School of Chemical Engineering at Northwest University, where he was supervised by Professors Daidi Fan and Long' an Shang. In 2007, he pursued his doctoral studies at the Korea Advanced Institute of Science and Technology (KAIST) under the guidance of Professor Ho Nam Chang, a member of both the Korean Academy of Science and Technology and the National Academy of Engineering of Korea. After obtaining his Ph.D. in biochemical engineering in 2011, he moved to the United States, where he worked as a postdoctoral researcher and staff engineer at the Massachusetts Institute of Technology (MIT), the U.S. National Renewable Energy Laboratory (NREL), and the National Bioenergy Center (NBC). During his time in the U.S., he participated in several major projects funded by the Department of Energy, Department of Defense, and biotechnology companies.

Prof. Fei' s research focuses on the development and exploration of renewable, low-value biomass and the construction of efficient bioconversion platforms. His work centers on optimizing fermentation processes and engineering genetically modified microorganisms. Utilizing biological manufacturing technologies—including biocatalysis, synthetic biology, and microbial cell transformation—he converts low-value biomass such as straw, biogas, and food waste into microbial lipids for biofuel production. He currently serves on the Youth Scholars Committee of the Biochemical Engineering Professional Committee of the Chinese Chemical Industry Society and on the Biochemical Engineering Professional Committee of the Shaanxi Chemical Industry Society.

Prof. Fei has been actively engaged in constructing and developing biocatalysts for biofuel production, including bioethanol, biodiesel, isobutanol, and jet fuel. He has been involved in several projects funded by DARPA, ARPA-E, and the DOE, focusing on biofuel production from recombinant microbes using sugars,

natural gas, and CO2 as carbon sources. Currently, his research emphasizes developing fermentation processes that use biogas and lignocellulosic feedstock as substrates for producing bio-based products, as well as building techno-economic analysis (TEA) models for converting renewable carbon sources into value-added products.

Note: Figure translations are in progress. See original paper for figures.