Green Manufacturing of Biopolymers in Extremophilic Consolidated Mini Cell Factories

Rajesh Sani

Departments of Chemical and Biological Engineering & Chemistry, Biology, and Health Sciences
South Dakota School of Mines and Technology, Rapid City, SD 57701, USA

ABSTRACT

This talk provides screening for and isolating unique thermophiles with the dual capability of i) utilizing unprocessed lignocellulosic biomass as a sole carbon source and (2) producing biopolymers. On the upstream side, the thermophiles *have been adapted to depolymerize >65* wt.% of the unprocessed (not subjected to physical, chemical, and enzymatic pretreatment) agri-residues. A comparative analysis of the transcriptomes of a thermophile on different carbon sources corroborates phenotypic observations at the genotypic level. Genomic insights identify essential candidate genes expressing the necessary ligninolytic enzymes and participating pathways for degrading and metabolizing lignin, xylan, cellulose, starch/pullulan by cnambio1. On the downstream side, with Single-Step Biomass-to-Biopolymer property, the thermophile can synthesize a semi-crystalline medium chain length PHA (mcl-PHA) in unprocessed corn stover-containing medium. The produced mcl-PHA shows exceptional thermal stability of 420°C and a relatively high final melting point of 210°C and is capable of thermally induced crystallization. A deletion mutant of the thermophile for the PHA depolymerase gene (*phaZ*) is being tested to improve the PHA titers and demonstrate it as a strategic industrial platform for carbon-optimized conversion of agri-residues to biobased chemicals. Further, work is in progress to rewire the depolymerization of corn stover to PHA by the thermophile, to simultaneous manufacture of exopolysaccharide, nitrocellulose, and other green biopolymer precursors. Together, the vision and future of this work are to systematically move the biomanufacturing pipeline of this novel form of consolidated bioprocessing from lab scale in SD Mines to ultimately end up at the 2000L commercial scale production system.

Keywords: Bioplastic, Omics, Non-model host, Synthetic biology, Thermophilic bioprocessing

How to Cite

Rajesh Sani, “Green Manufacturing of Biopolymers in Extremophilic Consolidated Mini Cell Factories”, *AIJR Abstracts*, p. 14, Mar. 2025.

DOI: 10.21467/abstracts.177 ISBN: 978-81-984081-3-6 (eBook), 978-81-984081-9-8 (Paperback)