

DOE Office of Science Early Career Awardees in CBI

Elucidating Aromatic Catabolic Pathways in White-Rot Fungi during Lignin Decay Dr. Davinia Salvachúa Rodríguez (NREL)

Lignin is a heterogeneous polymer found in the cell walls of terrestrial plants and accounts for 30% of the organic carbon in the biosphere. White-rot fungi are undoubtedly the most efficient lignin-degrading organisms in Nature and are thus responsible for a substantial amount of carbon turnover on Earth. Lignin conversion to carbon dioxide and water by these organisms has been studied for decades and is very well accepted. However, the biochemical pathways that allow white-rot fungi to deconstruct and further metabolize lignin remain largely unknown. Indeed, it is still a matter of controversy whether or not these organisms utilize lignin degradation products as a carbon and/or energy source. Furthermore, the chemical units that constitute lignin could be used as precursors of valuable compounds. However, due to its complex nature and the difficulty to break it down into smaller components, lignin is an undervalued substrate for biorefineries that use plant biomass to produce biofuels. This research will apply systems biology and computational modeling approaches to elucidate the metabolic pathways for lignin conversion in white-rot fungi and understand the biological roles of lignin degradation. The knowledge gained through this work will serve as a foundation to employ white-rot fungi in lignin bioconversion into value added bioproducts, advancing towards a sustainable plant-based bioeconomy.

<https://www.nrel.gov/news/program/2019/the-role-fungi-will-play-in-nrels-biomass-research.html>

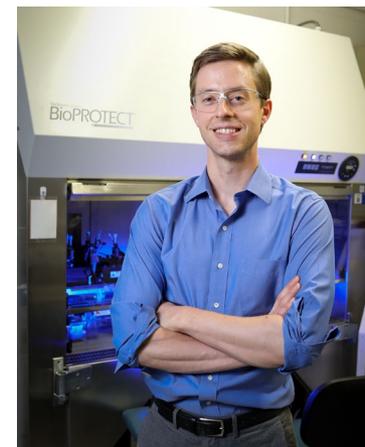
Systems metabolic Engineering of *Novosphingobium aromaticivorans* for Lignin Valorization Dr. Josh Michener

In a typical biorefinery, sugars derived from plant material (or biomass) are fermented to fuels by microorganisms. However, a substantial fraction of the plant biomass that contains a polymer called lignin cannot be easily degraded and is instead burned for heat. Lignin could be converted into value-added bioproducts, offering a potential source of additional revenue to improve the economics of biofuel production. Chemical conversion of lignin is challenging, but specialized bacteria with the necessary biochemical capabilities could potentially produce desired compounds from different mixtures of lignin-rich mixtures. Although bacteria that are suited for lignin conversion are known, they have not been extensively studied or manipulated. This project will characterize the biochemical pathways for assimilation of lignin-derived compounds in a bacterium that can metabolize a wide range of such compounds. New pathways will then be engineered into this bacterium to convert depolymerized lignin into valuable bioproducts. To achieve this goal, a novel genetic method will be used to build a predictive systems biology model and identify additional genetic targets for further metabolic optimization. These efforts will result in new methods to predictively model and engineer a promising microbe for lignin valorization that can ultimately be applied to a wide range of emerging microorganisms relevant for BER's mission in sustainable bioenergy.

<https://www.ornl.gov/news/seven-ornl-researchers-receive-doe-early-career-funding-awards>



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