ALBERTA INNOVATES

AGRICULTURE AND ENVIRONMENT

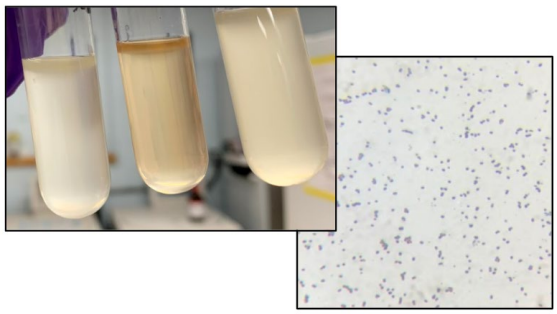
BIOINDUSTRIAL AND CIRCULAR INNOVATION

BIOENERGY

Bio-Processing of Amallin Lignin for the Production of Lipids for Drop-In Diesel and Bio-Jet Fuels

The aviation industry would be the 8th largest carbon emitter globally if it were considered as a country, and thus there is a desperate need to identify sustainable and cost-effective pathways to biojet fuel. Studies have shown that cultivation of specialized microbes can accumulate significant quantities of lipids, which then can be used as a lipid feedstock for renewable gasoline, diesel, and jet fuel. In this project, microbes isolated from woodchip piles in the pulp mill area was selected for lipid accumulation properties when grown on lignin monomers. In parallel, novel strains of bacteria was found to produce polyhydroxyalkanoates (PHA), a specialty lipids that can be used for the biojet production process.

Microbial Growth on Lignin Monomers



Sudan B Staining
(Lipids are stained black)

RECIPIENT:
Dr. David Bressler
University of Alberta

PARTNERS:
CONACYT-SENER
InnoTech Alberta
Trinity Western University
WestJet
Future Energy Systems

TOTAL BUDGET:
$603,666

AI FUNDING:
$240,667

PROJECT DATES:
Mar 2019 – Mar 2023

PROJECT TRL:
Start: 1
End: 3

APPLICATION

This project aims to develop innovative and scalable approaches that can increase the utility of lignin, with a focus on biological conversion routes for lignin-derived compounds to lipids. These lipids could be converted to biojet and renewable plastics through existing technologies. Furthermore, this research could benefit other established markets that demand highly pure lipid feedstocks such as cosmetics, coatings, inks, surfactants, leathers, and hydraulic fluids.

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PROJECT GOALS

- Collecting and identifying lipid-producing microbes from waste streams of the pulp and paper industry.
- Determining the various microbial growth conditions that will enable maximal microbial conversion of lignin to lipids at higher yields.
- Assessing the suitability of the various microbe-derived lipids for the production of drop-in gasoline, diesel, and biojet fuels as well as investigation of the fuel streams generated through lipid pyrolysis.
- Developing a strategy to facilitate increased production of PHA from lignin-derived feedstocks and/or byproduct streams from lipid pyrolysis.
- Training of HQP in the expanding fields of lignin and bioproducts.

BENEFITS TO ALBERTA

- The conversion of lignin to lipid feedstock for fuel production not only enhance the value of lignin which traditionally regarded as waste, but also creating a sustainable long-term partnership between the forestry and the oil and gas industry.
- The additional revenue stream for kraft pulp mills is expected to create additional jobs that are critical to Alberta “pulp-mill driven” communities.
- Reduction of greenhouse gas emission through the development of biojet from lipids derived from abundant lignin resources in the province.

4 research publications and 4 conference and poster presentations

2 Students Trained

CURRENT STATUS

March 2023 - Complete

This project was completed in March 2023. This project has advanced oleaginous lipid production through lab-scale production and has positioned the lab to be a leader in the development of oleaginous microbial systems for industrial lipid applications. The succession of this project has led to major project development and investment from the government, focusing on the optimization of the oleaginous system. As the project is still on an experimental phase, no metrics regarding patents, jobs, or greenhouse gas reduction were obtained.