CELF Pretreatment Enhances Conversion of Biomass to Renewable Fuels

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Project Goals: The BioEnergy Science Center (BESC) is focused on the fundamental understanding and elimination of biomass recalcitrance. BESC's approach to improve accessibility to the sugars within biomass involves (1) designing plant cell walls for rapid deconstruction and (2) developing multi-talented microbes or converting plant biomass into biofuels in a single step [consolidated bioprocessing (CBP)]. BESC researchers provide enabling technologies in biomass characterization, 'omics, modeling and data management in order to (1) understand chemical and structural changes within biomass and (2) to provide insights into biomass formation and conversion mechanisms.

The University of California Riverside recently developed a novel pretreatment called Co-solvent Enhanced Lignocellulosic Fractionation (CELF) that applies renewable tetrahydrofuran (THF) in a monophasic solution with water and dilute acid to dramatically reduce biomass recalcitrance and enhance enzymatic, biological, and catalytic conversion of lignocellulosic feedstocks into renewable fuels and fuel precursors. CELF achieves unprecedented recovery of total sugars (C5 + C6) from multiple feedstocks using 90% less enzymes than conventional dilute sulfuric acid (DSA) pretreatment while boosting ethanol yields (>90%) and titers (>58 g/L) for high solids simultaneous saccharification and fermentation (SSF) operation at low enzyme loadings (<15 mg-enzyme/g-glucan). We also demonstrate the successful first integration of CELF pretreatment with enzyme-free consolidated bioprocessing (CBP), achieving almost 100% sugar conversion from *Populus* wood or corn stover in two days. During the CELF reaction, 90% or more of the native lignin from most lignocellulosic substrates is extracted and dissolved into the liquid hydrolysate. The dissolved lignin can then be precipitated as a purified low-molecular weight lignin product (CELF lignin) upon the removal and recovery of THF from the hydrolysate by room-temperature vacuum distillation. CELF lignin is highly suitable for valorization into renewable chemicals and fuels.

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