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CENTER FOR ADVANCED BIOENERGY AND BIOPRODUCTS INNOVATION

A Consolidated Bioprocess Design to Produce Multiple High-Value Platform Chemicals from Lignocellulosic Biomass and its Technoeconomic Feasibility

Background/Objective

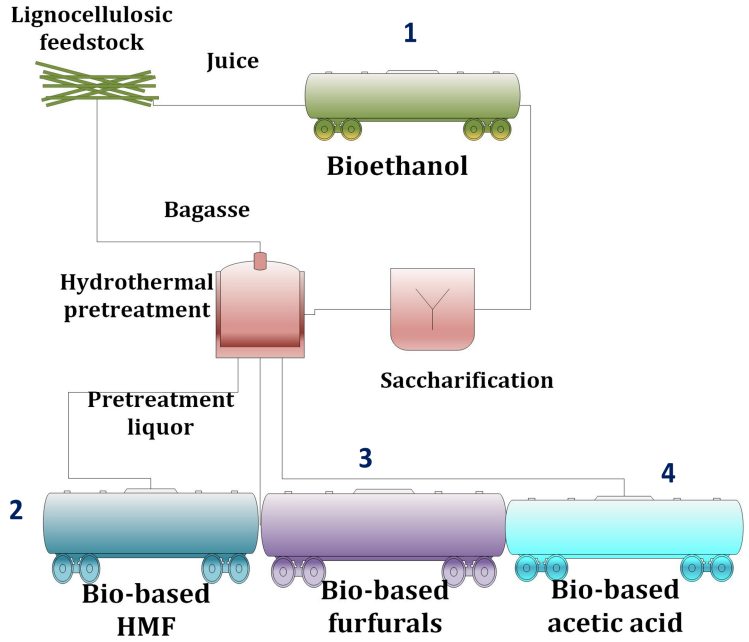
5-Hydroxymethyl furfural (HMF) and furfurals are DOE-listed platform chemicals that can be derived from lignocellulosic biomass. However, the high cost of substrates and solvents limit the economic feasibility of large-scale bio-based HMF production. We studied an optimized chemical-free protocol for maximizing the production of HMF, furfurals, and acetic acid without lowering the total yield of cellulosic sugars from lignocellulosic biomass and proposed a consolidated bioprocess design for these chemicals to improve profitability.

Approach

- Optimized the chemical-free hydrothermal pretreatment conditions to maximize the yield of HMF, furfurals and acetic acid without affecting the yield of total fermentable sugars.
- Evaluated the technoeconomic feasibility of a consolidated bioprocess design to produce and recover four high-value chemicals (HMF, furfurals, ethanol, and acetic acid) from *Saccharum* bagasse considering HMF as the main product.

Results

- Chemical-free hydrothermal pretreatment at 210 ºC for 15 min. was the optimized pretreatment condition.
- Technoeconomic analysis showed that additional revenue streams from the diversified coproducts improves profitability and aids in lowering the minimum selling price (MSP) of the primary products.
- The MSP of HMF was estimated to be 930.60 USD/ton, which is competitive with its petroleum-derived precursor alternative *p*-xylene.



Consolidated bioprocess design to recover four high-value chemicals from lignocellulosic biomass.

Significance/Impacts

The proposed design will add advantageous dimension to the bioprocessing by removing the most potent fermentation inhibitors, i.e., HMF, furfurals, and acetic acid, produced during pretreatment. Recovering these high-value chemicals adds to the revenue stream, thereby improving the profitability of the biorefinery.

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