CABBI
CENTER FOR ADVANCED BIOENERGY AND BIOPRODUCTS INNOVATION

Chemical-Free Production of Multiple High-Value Bioproducts from Metabolically Engineered Transgenic Sugarcane 'Oilcane' Bagasse and Their Recovery Using Nanofiltration

Background/Objective

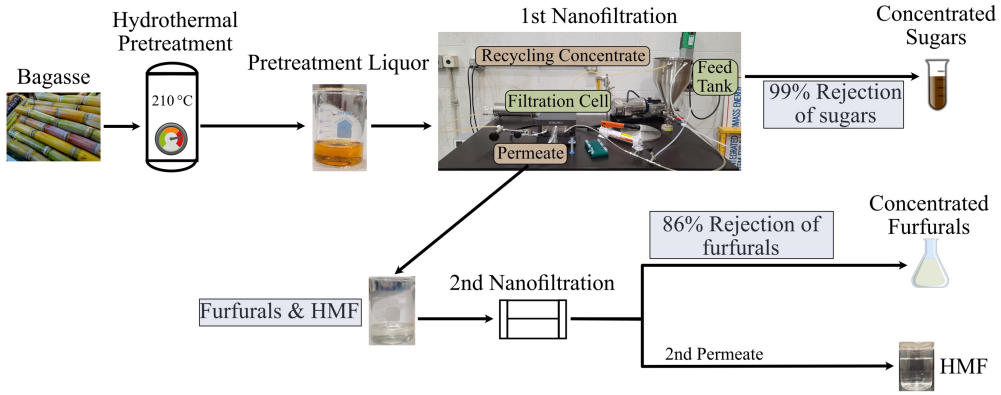
Plant cell walls contain lignocellulosic carbohydrates, recalcitrant structures of cellulose, hemicellulose, and lignin that require pretreatment to convert them to fermentable sugars. However, pretreatment generates sugar degradation compounds, such as furfural, HMF, and acetic acid, that are toxic to the enzymes and microorganisms used in subsequent bioprocess steps. If recovered, however, these compounds are valuable chemicals to other industries. Thus, recovering these valuable chemicals after pretreatment would increase plant cost-efficiency through additional revenue streams. This study examines recovering furfural, HMF and acetic acid generated during hydrothermal pretreatment of genetically modified sugarcane (aka "oilcane") using nanofiltration, a chemical-free membrane-based separation technique.

Approach

- Pretreatment was optimized to maximize recovery of furfural, HMF and acetic acid from lignocellulosic biomass without affecting cellulosic sugar and vegetative lipid yields.
- A novel two-step nanofiltration in-series was designed to recover cellulosic sugars, furfural, HMF and acetic acid from the pretreatment liquor (Fig. 1).

Results

- Determined the optimized hydrothermal pretreatment conditions as 210 °C for 5 min.
- Two-step nanofiltration separated cellulosic sugars and recovered furfural, HMF, and acetic acid from the pretreatment liquor.
- Approximately 99% of cellulosic sugars were retained by filtration (Fig.1).



Schematic representation of processing oilcane bagasse by hydrothermal pretreatment followed by two nanofiltrations arranged in-series.

Significance/Impacts

This study demonstrates the feasibility of coproducing and recovering furfural, HMF, acetic acid, cellulosic sugars, and vegetative lipids from lignocellulosic biomass.

Jia, Y., Maitra, S., Singh, V. 2023. "Chemical-Free Production of Multiple High-Value Bioproducts from Metabolically Engineered Transgenic Sugarcane 'Oilcane' Bagasse and Their Recovery Using Nanofiltration." *Bioresource Technology* 371:128630. DOI: 10.1016/j.biortech.2023.128630.