A Chemical-Free Pretreatment for Biosynthesis of Bioethanol and Lipids from Lignocellulosic Biomass: An Industrially Relevant 2G Biorefinery Approach

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Background/Objective

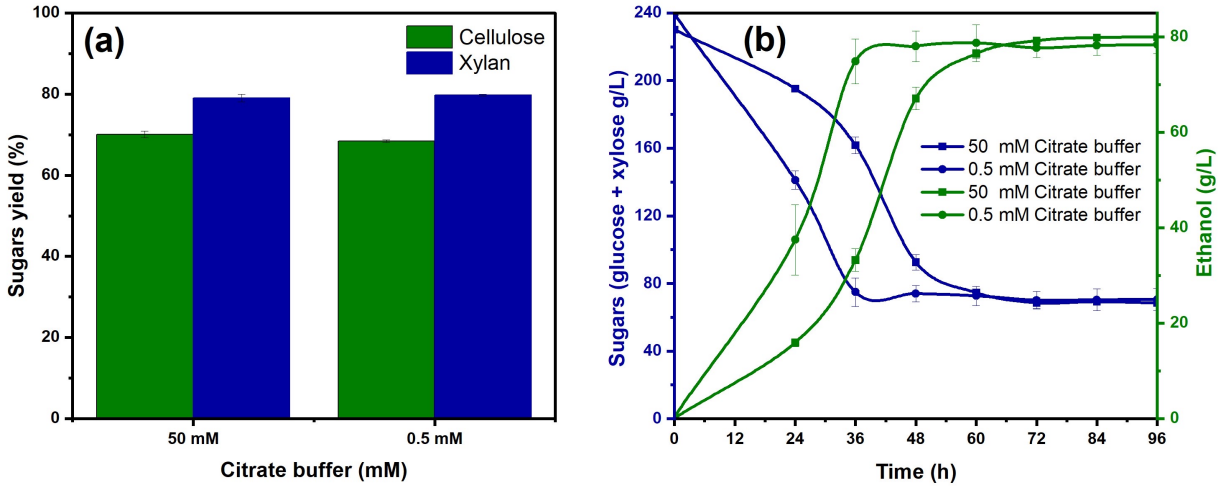
Plant cell walls consist of cellulose, hemicellulose, and lignin, collectively known as lignocellulosic biomass. Due to its recalcitrant nature, pretreatment is required to deconstruct the lignocellulosic biomass, followed by enzymatic conversion of cellulose and hemicellulose into sugars and their subsequent fermentation into targeted biofuels. The enzymatic conversion of pretreated biomass requires a citrate buffer solution to control pH, which deters the fermentability of hydrolysate. We previously developed a pretreatment process using dilute sulfuric acid to reduce citrate buffer strengths, but the washing step required a significant quantity of water that needed specialized wastewater treatment. This study examines hydrothermal pretreatment for sorghum biomass, which eliminates inorganic chemicals during pretreatment and generates negligible sugar decomposition products that would deter fermentability of the hydrolysate.

Approach

- Fed-batch enzymatic hydrolysis was performed without washing the pretreated biomass.
- Citrate buffer strength was reduced to 100-fold (50 mM to 0.5 mM) during the enzymatic hydrolysis.

Results

- Washing the pretreated biomass in high-strength citrate buffer may not be required to maintain an optimal pH during enzymatic hydrolysis.
- Reducing the citrate buffer strength during enzymatic hydrolysis and omitting inorganic chemicals from the pretreatment process enhanced the fermentability of hydrolysates.



(a) Sugars yield at 50% (w/v) solid loading; and (b) Bioethanol production profiles.

Significance/Impacts

Demonstrated that by redesigning the pretreatment process, it is possible to increase the cost-effectiveness of producing biofuels from sorghum biomass.

Deshavath, N.N., Dien, B.S., Slininger, P.J., Jin, Y.S., Singh, V. Dec. 21, 2022. "A Chemical-Free Pretreatment for Biosynthesis of Bioethanol and Lipids from Lignocellulosic Biomass: An Industrially Relevant 2G Biorefinery Approach." *Fermentation* 9(1), 5. DOI: 10.3390/fermentation9010005.