

Process Strategies for Recovery of Sugars, Lipids, and Lignin from Oilcane Bagasse Using Natural Deep Eutectic Solvents (NADES)

Background/Objective

Sugarcane is being enhanced as a bioenergy crop by engineering it to accumulate and store lipids and polymeric sugars in vegetative tissues. However, no existing process allows for processing this new crop to recover both lipid and cellulosic sugars from the oilcane bagasse. We investigated the suitability of two pretreatment methods, natural deep eutectic solvents (NADES) and chemical-free hydrothermal pretreatment (HT), for recovering fermentable sugars, lipids, and high pure lignin from bagasse.

Approach

Two NADES, choline chloride: lactic acid (ChCl:LA) and betaine: lactic acid (BT:LA), using a 1:2 M ratio, were evaluated for pretreatment of oilcane bagasse with varying 10, 20, and 50% (w/w) solids, followed by enzymatic hydrolysis at 10% (w/w) solids. NMR-HSQC and GPC were used to characterize lignin β -O-4 linkages.

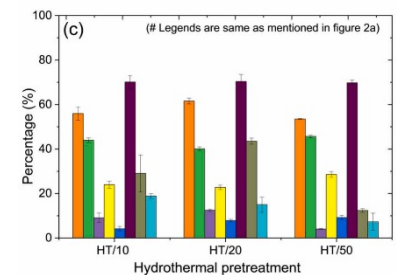
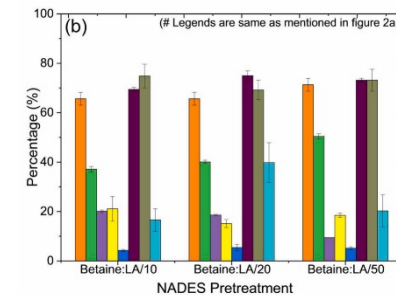
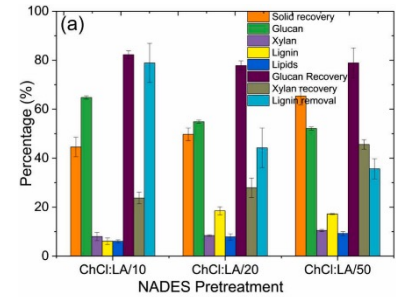
Results

The optimum ChCl:LA NADES pretreatment was 10% solids at 140 °C for two hours, which solubilized 78.8% lignin and 80.4% hemicellulose and yielded 82.7% enzymatic glucose, compared to the HT pretreatment that solubilized 87.6% hemicellulose and yielded 69.7% enzymatic glucose. The 50% solids loading ChCl:LA pretreatment enriched lipids 2.6-fold (9.2 wt%) in recovered solids compared to the HT (6.4%) and BT:LA (5.1%) pretreatments. The ChCl:LA pretreatment also cleaved the most lignin linkages and demonstrated lower molecular weight compared to HT and recovered high pure lignin.

Significance/Impacts

This study demonstrates the effectiveness of NADES pretreatment for processing bioenergy crops for fractionation of vegetative lipids and fermentable sugars for economically viable integrated biorefinery process development at high solid loading (50% w/w).

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Compositional analysis of untreated and pretreated oilcane bagasse.