

Natural Deep Eutectic Solvents (NADES) Assisted Deconstruction of Oilcane Bagasse for High Lipid and Sugar Recovery

Background/Objective

Genetically engineered sugarcane, or oilcane, was developed to divert its carbon from making sucrose to lipids, but plant cell wall recalcitrance, low lipid content, and limited enzymatic accessibility of bagasse are key valorization obstacles to produce biodiesel and bioethanol. Traditional extraction techniques are either costly or use toxic chemicals. Natural deep eutectic solvents (NADES), eutectic mixtures of naturally derived metabolites containing hydrogen-bond donors (HBD) and acceptors (HBA), meet green solvent criteria, are cheaper, and have advantageous solvent characteristics. Here, we investigated using NADES to increase fractionation of lipid and cellulose-rich oilcane bagasse.

Approach

Six combinations of NADES, using choline chloride (ChCl) as HBA and lactic acid (LA), oxalic acid and glycerol as HBDs, were used to pretreat oilcane bagasse. The impact of NADES ratio, biomass loading (10-50%), residence time (1-2 hours), and temperature (90-140 °C) were evaluated for delignification, lipid content, and sugar release after enzymatic hydrolysis. The recyclability of the NADES was evaluated.

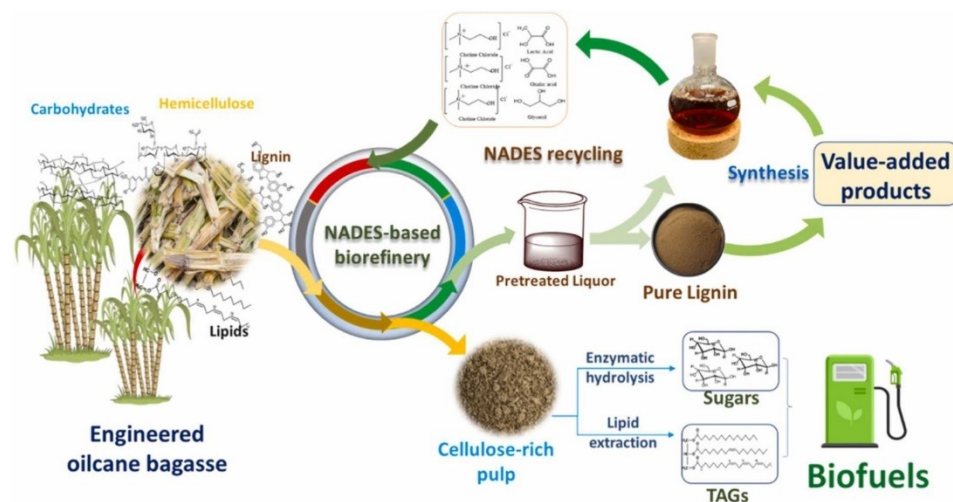
Results

Under the optimal condition of ChCl:LA (1:2 molar ratio) at 140 °C with 2 h retention time, lipid recovery from pretreated bagasse increased 2.5-fold (~8% w/w) and > 80% glucose yield was achieved from hydrolysis of pretreated bagasse after 72 hours. Furthermore, 95-98% NADES could be recycled up to five cycles without significant loss in amount or activity.

Significance/Impacts

This demonstrated the feasibility of NADES pretreatment for valorization of oilcane feedstocks. This brings new opportunities for both bioprocess development and for oilcane to be used as a bioenergy crop.

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Graphical illustration of oilcane processing using NADES.