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Effect of Lignin Variation on Biomass Conversion: An analysis of treatment methods for poplar samples

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ABSTRACT

The conversion of lignocellulosic polysaccharides has been studied as an alternative to petroleum for producing fuels and chemical products, such as those in plastics. However, biomass lignin has been shown to inhibit polysaccharide conversion. Lignin, an organic polymer, surrounds biomass polysaccharides, hemicellulose and cellulose, making the biomass resistant to deconstruction and limiting polysaccharide conversion yields. Increases in polysaccharide conversion yields are seen when using physical or chemical pretreatment methods that increase convertible cellulose, remove lignin, and restructure biomass. A physical pretreatment, liquid hot water (LHW), solubilizes hemicellulose and melts lignin using hot, pressured water. A chemical treatment, sodium-chlorite acetic acid (SCAA), uses a strong oxidizing agent coupled with acid to chemically remove the lignin. This study analyzed LHW and SCAA pretreatments, each at two levels of severity, for aiding in deconstruction of wild type poplar biomass and poplar genetically modified for increased lignin digestibility. Following pretreatments, biomass composition was analyzed via a standard method using a combination of acid hydrolysis deconstruction and biomass fractionation. We report that increasing length of SCAA treatments shows sequential reduction in total lignin (11.8%, 8.0%) when compared to untreated biomass (23.1%) and provides an average 27.3% increase in the portion of total lignin that is acid digestible. LHW pretreatments increase the proportion of available glucan for conversion while minimally changing biomass structure in contrast to the SCAA treatment which largely alters biomass composition. Reported biomass composition changes suggest that pretreatments used with previously studied biomass conversion methods increase polysaccharide conversion yields to value added chemicals.

KEYWORDS

Biomass, Lignin, Poplar, Value Added Chemicals, Thermochemical conversion