# Can ammonia and its unique properties resolve major bottlenecks of lignocellulosic biofuels?

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**Abstract:**

Typical biochemical conversion of lignocellulosic biomass to fuels and chemicals requires a cell wall deconstruction phase, consisting of pretreatment and enzymatic hydrolysis, followed by fermentation and product purification. The deconstruction of lignocellulosic biomass into biofuel precursors presents various challenges that must be addressed for a viable and sustainable bioeconomy. Efficient saccharification currently requires high enzyme loading for achieving desirable sugar conversions, unless expensive and poorly recoverable chemicals are used during pretreatment (e.g., ionic liquids, phosphoric acid, etc.). Furthermore, conventional pretreatment technologies use acid and base catalysts under conditions that often degrade lignin, promoting undesirable condensation reactions, which reduce the potential of lignin for the production of bio-based chemicals. A novel biomass deconstruction strategy being developed at the GLBRC addresses the above mentioned issues facing the cellulosic biofuels industry. This novel Extractive Ammonia (EA) pretreatment uses liquid ammonia to convert native cellulose to a less recalcitrant crystalline allomorph called cellulose III and extracts up to ~50% of the total lignin in biomass for conversion to useful aromatic chemicals and materials. This pretreatment process has significant impact on improving enzymatic hydrolysis at high solid loadings (reducing the “solids effect”, i.e., the decrease of glucan and xylan conversion with increasing solid loadings), with reduced enzyme loadings (down to 7.5 mg/g glucan), allowing the generation of high ethanol titer during fermentation without detoxification or nutrient supplementation. Here, we highlight the processing details of EA pretreatment and its impact on lignin extraction and enzymatic deconstruction of pretreated biomass. We also show a detailed characterization of the extracted lignin and discuss its potential for value-added applications. This research is providing key insights into the factors that influence biomass deconstruction and lowering the cost of biofuel production.