Title: Redefine the Role of Lignin in Enzymatic hydrolysis of lignocellulosic biomass

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Abstract:
The electrostatic and hydrophobic interactions between lignin and enzymes play essential roles in the effective enzymatic hydrolysis of lignocellulosic biomass. The negative effect of lignin has been closely associated with pretreatment efficiency and substrate hydrolysability. However, remarkably we have found contrasting effects of hardwood organosolv lignin (EOL-SG) and softwood organosolv lignin (EOL-LP) on enzymatic hydrolysis of lignocellulose. The addition of EOL-SG significantly improved the 72 h hydrolysis yields of organosolv pretreated sweetgum (OPSG) and loblolly pine (OPLP) from 49.3% to 68.6% and from 41.2% to 60.8%, respectively. In contrast, the addition of EOL-LP decreased the 72 h hydrolysis yields of OPSG and OPLP to 42.0% and 38.1%, respectively. A strong correlation between the distribution coefficients of cellulase enzymes on lignin and the changes of hydrolysis yields indicated that the inhibitory or stimulatory effects of organosolv lignin on enzymatic hydrolysis were governed by the distribution coefficients (R). In this study, we will further quantitate the effects of softwood and hardwood organosolv lignin (EOL) on enzymatic hydrolysis of Avicel based on the initial hydrolysis rate and the 72-h hydrolysis yield. Organosolv lignin will be collected from ethanol organosolv pretreatment of Cottonwood, Willow, Aspen, Eucalyptus and Loblolly pine. In addition, we will examine the functional groups and structural features of organosolv lignin by ^{1}H and ^{13}C NMR. Our study will elucidate the distinct role of lignin in enzymatic hydrolysis of lignocellulosic biomass. This research has great potential to improve the effectiveness of enzymatic hydrolysis and redefine the role of lignin in biochemical conversion.