197. Comparative Solubilization of Minimally Pretreated Lignocellulose as Impacted by Choice of Feedstock and Biocatalyst

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Project Goals: The BioEnergy Science Center (BESC) is focused on the fundamental understanding and elimination of biomass recalcitrance. BESC's approach to improve accessibility to the sugars within biomass involves 1) designing plant cell walls for rapid deconstruction and 2) developing multi-talented microbes or converting plant biomass into biofuels in a single step (consolidated bioprocessing). BESC research in biomass deconstruction and conversion targets CBP by studying model organisms and thermophilic anaerobes to understand novel strategies and enzyme complexes for biomass deconstruction.

Following reports of solubilization of minimally-pretreated lignocellulose by *C. bescii* (Yang AEM 2009, Kataeva 2013), we undertook controlled experiments to determine how widespread such ability is and how it is impacted by the choice of feedstock. We find that many anaerobic bacteria are able to achieve substantial solubilization of minimally pretreated lignocellulose, with *Clostridium thermocellum* giving among the highest yields - but not uniquely high yields - relative to other cultures tested. Solubilization yields were about two times higher for *C. thermocellum* cultures than for commercial fungal for minimally-pretreated switchgrass harvested at both mid-season and late-season. Performance of fungal enzymes was not significantly improved by addition of yeast, higher enzyme loading, increased hydrolysis temperature, or lower substrate loadings. For both *C. thermocellum* and fungal cellulase, conversion is twice as high for switchgrass harvested at mid-season as compared to late season. For poplar, *C. thermocellum* cultures achieve higher solubilization yields than fungal cellulases, although conversion for both is lower than that seen in grasses. Solubilization yields declined only slightly with increasing particle size for all feedstock-biocatalyst combinations except fermentation of minimally-pretreated wood by *C. thermocellum*, for which a sharp decline was observed. Fermentation residues were analyzed to develop a better understanding of the underlying cause for the substantial differences observed.

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