Optimizing biocatalyst-feedstock combinations to achieve high solubilization with minimal pretreatment

U.S. DEPARTMENT OF ENERGY
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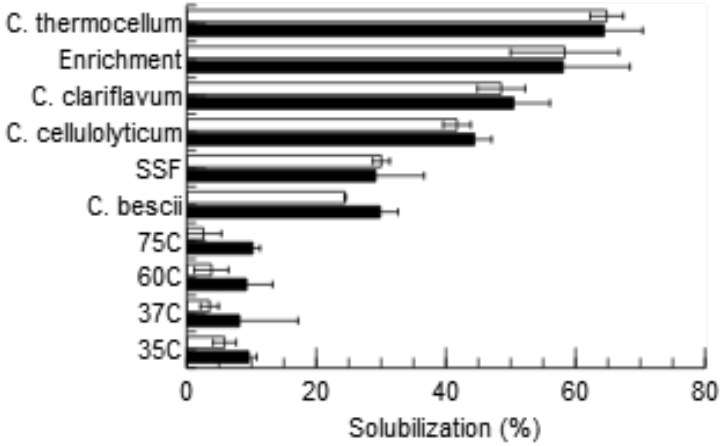
Background and Approach

We carried out the most comprehensive controlled comparison to date of lignocellulosic solubilization by various biocatalysts, and report initial exploration of enhancing microbial solubilization of cellulosic biomass via mechanical disruption (cotreatment).

Outcomes

Trends drawn from time-course and end-point data for six conversion systems and three substrates were:

1. Greater-than-expected differences in the effectiveness of various biocatalysts;
2. Lower yields and greater dependence on particle size for *Populus* as compared to green or senescent switchgrass;
3. Equal fractional solubilization of glucan and xylan with no biological solubilization of the non-carbohydrate fraction of biomass; and
4. Two-fold increase in solubilization via mechanical disruption with greater benefits on partially-fermented feedstock.



Solubilization of washed mid-season switchgrass by various biocatalysts. Xylan (white) and glucan (black) solubilization from washed mid-season switchgrass by various bacteria or SSF with yeast and fungal cellulase after 5 days. Enrichment was selected at 60C on Avicel from horse manure compost. Uninoculated controls (75C, 60C, 37C and 35C) for each incubation temperature were analyzed to account for non-biological solubilization. Results are expressed as mean ± SD (n≥2).

Significance

- Some biocatalysts, some feedstocks, and some combinations are more effective than others at achieving high solubilization with minimal pretreatment. In particular, we observed a five-fold difference between the most and least effective combinations, and substantially higher solubilization for several bacterial systems compared to industry-standard fungal cellulases.
- Microbial solubilization of biomass selectively targets the carbohydrates.
- Starting with nature's best biomass-solubilizing systems may enable a reduction in the amount of non-biological processing required, and in particular substitution of cotreatment for pretreatment.

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Paye, Julie M.D., et al., "Biological lignocellulose solubilization: comparative evaluation of biocatalysts and enhancement via cotreatment," *Biotechnol Biofuels,* 9:8, 2016. **DOI 10.1186/s13068-015-0412-y**