Biomass augmentation through thermochemical pretreatments greatly enhances digestion of switchgrass by Clostridium thermocellum

Background

- The thermophilic anaerobic bacterium *Clostridium thermocellum* capable of enzyme production, saccharifcation, and fermentation is central to the consolidated bioprocessin (CBP) strategy of fermenting lignocellulosic biomass without enzyme supplementation.
- However, complete solubilization requires treatment to open up recalcitrant biomass for biological digestion.
- Here, the response of *C. thermocellum* and fungal cellulases to senescent switchgrass prepared by four distinctive pretreatments revealed relationships between biomass substrate composition and its digestion.

Approach

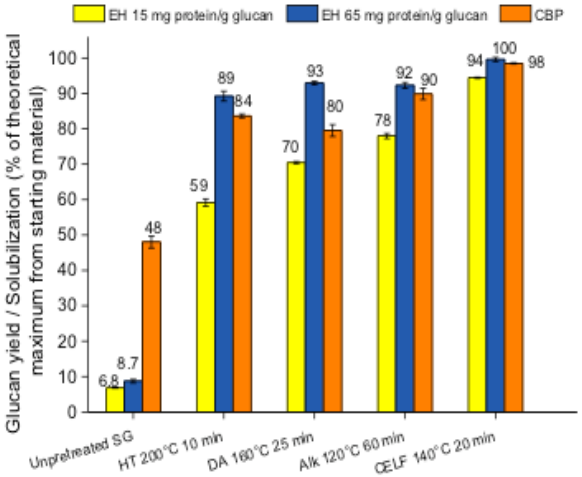
- Alamo switchgrass was pretreated by hydrothermal, dilute acid, dilute alkali, and co-solvent-enhanced lignocellulosic fractionation (CELF) to produce solids with varying glucan, xylan, and lignin contents.
- These solids were subjected to deconstruction by *C. thermocellum* and fungal enzymes.

Outcome

- *C. thermocellum* achieved 100% glucan plus xylan release from CELF pretreated switchgrass while performance was lower for solids from dilute acid and hydrothermal pretreatments with higher xylan than lignin removal.
- Overall, *C. thermocellum* performed equivalent to 65 and better than 15 mg protein/g glucan fungal enzymatic hydrolysis on all substrates except CELF pretreated substrates that were highly digestible by both *C. thermocellum* and fungal enzymes.

Significance

- CELF and dilute alkali pretreatments of switchgrass resulted in the greatest sugar release and metabolite production by *C. thermocellum* demonstrating lignin presents a greater barrier to deconstruction than hemicellulose.
- CELF proved more effective than other pretreatments with both *C. thermocellum* and fungal enzymes.



Comparison of 7 day release of glucan by *C. thermocellum* and fungal enzymes from unpretreated switchgrass (SG) and solids prepared by hydrothermal (HT), dilute acid (DA), dilute alkali (Alk), and co-solvent enhanced lignocellulosic fractionation (CELF) pretreatments at conditions that gave the highest sugar release from each.

Kothari N, Holwerda E, Cai CM, Kumar R, Wyman CE. 2018. "Biomass augmentation through thermochemical pretreatments greatly enhances digestion of switchgrass by *Clostridium thermocellum*," *Biotechnology for Biofuels* 11:219. https://doi.org/10.1186/s13068-018-1216-7.

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