Rhamnogalacturonan I (RG-I) – A Target for Improving Solubilization of Poplar Biomass by Clostridium thermocellum

Background

- Consolidated bioprocessing (CBP) by the cellulolytic thermophile *Clostridium thermocellum* offers a single step microbial platform without pretreatment for production of via simultaneous solubilization of carbohydrates from lignocellulosic biomass and conversion into biofuels and biochemicals. Complete CBP solubilization may be limited to low solids loadings.

Approach

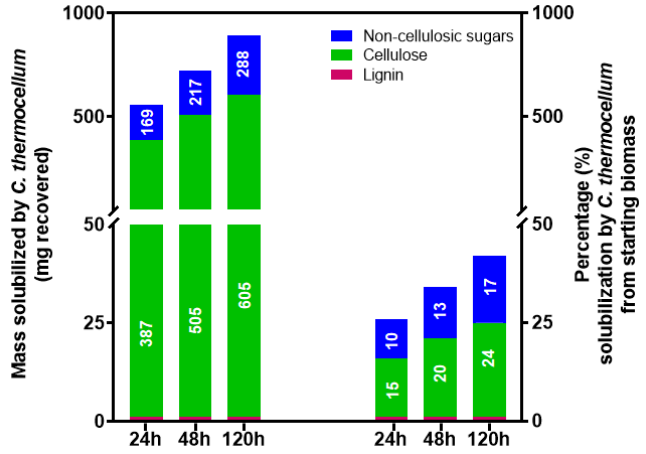
- We identified components of the poplar biomass that limit carbohydrate solubilization during CBP of poplar by *C. thermocellum* using a comprehensive set of chemical and MS-based analytical tools was used to measure the sugar composition and yield of cellulosic, hemicellulosic, and pectic polysaccharides in the aqueous liquor and solid CBP residues.

Results

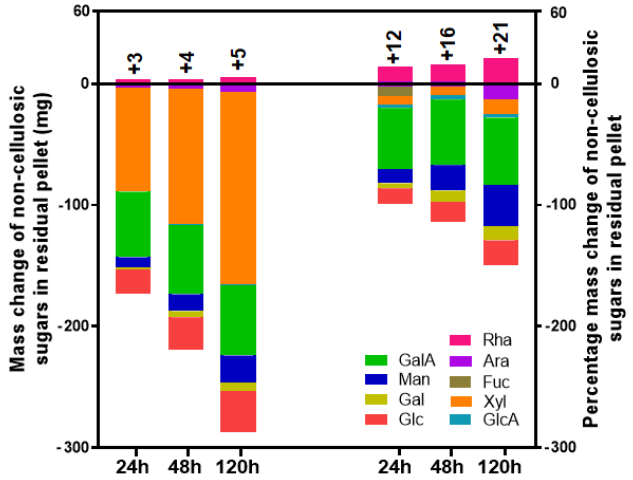
- *C. thermocellum* solubilized 24% of cellulose and 17% of non-cellulosic sugars from non-pretreated poplar (added at 5 g/L glucan content) after 120 h CBP.
- The noncellulosic sugars solubilized included 13-36% of the initial arabinose, xylose, galactose, mannose, and glucose, along with 15% fucose and 3% glucuronic acid.
- No rhamnose (Rha) was solubilized; while 71% of the galacturonic acid (GalA) was solubilized. After 120 h, the relative amount of Rha in the solid residues increased 21% indicating that the Rha-containing polymer rhamnogalacturonan I (RG-I) was not effectively solubilized by *C. thermocellum* CBP. This was confirmed by enzyme-linked immunoassays of RG-I content in the residues.

Significance

- *C. thermocellum* is unable to effectively degrade the RG-I component of pectin in poplar biomass. This may slow solubilization of other polymers as well. This makes RG-I a potential target for improving the enzymatic ability of *C. thermocellum* to effectively solubilize woody biomass.



Mass (left) and percentage (right) of non-cellulosic sugars, cellulose and lignin solubilized by *C. thermocellum* into liquor.



Mass change and percentage of mass change of net non-cellulosic sugars solubilized by *C. thermocellum*.

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