Improving bioavailability of carbohydrate to *C. bescii* in natural and transgenic switchgrasses

U.S. DEPARTMENT OF ENERGY | Office of Science

Background

- Approaches for improving microbial accessibility to the plant's sugars, has primarily focused on either developing genetically modified plants with reduced lignin composition or pretreating the plant biomass. Non-chemical treatments, like hydrothermal, are typically preferred because of their better economics and lack of inhibitor generation.

Approach

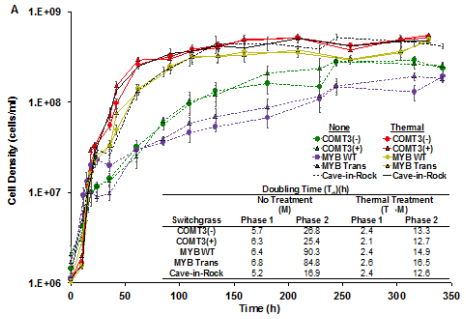
- The bioavailability of carbohydrates to *C. bescii* was evaluated in the switchgrass lines unmodified Cave-in-Rock (CR), transgenic COMT-KD and Myb4-OE, and their corresponding parental lines.
- Each switchgrass line was examined as either hydrothermally treated (180ºC for 25 min) or untreated.
- *C. bescii* growth and carbohydrate solubilization (cellulose and hemicellulose) were determined for each treatment scheme (microbial, hydrothermal, or a combination of both).

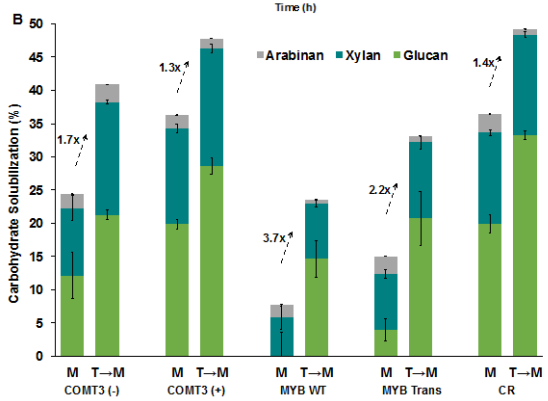
Outcomes

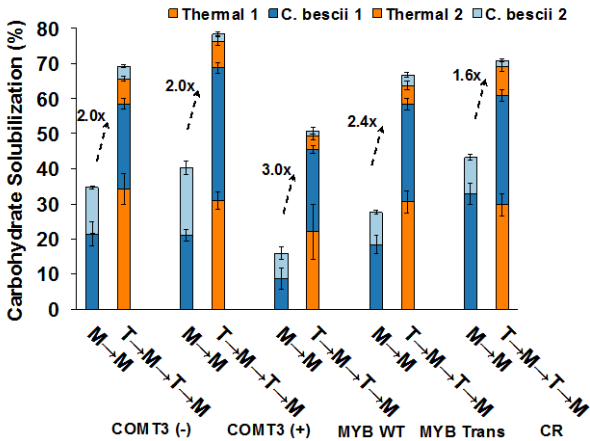
- Transgenic modification improved carbohydrate solubilization by *C. bescii* to 15% (2.3-fold) for MYB, and to 36% (1.5-fold) for COMT, comparable to the levels achieved for the natural variant, CR (36%).
- Hydrothermal treatment prior to fermentation improved carbohydrate solubilization 3.7-fold for the most recalcitrant line (MYB WT), and increased carbohydrate solubilization to nearly 50% for the least recalcitrant lines (COMT3(+) and CR).
- Alternating microbial and hydrothermal steps (T→M→T→M) further increased bioavailability, achieving carbohydrate solubilization above 70% for COMT3(-), COMT3(+) and CR.

Significance

- While *C. bescii* could significantly solubilize the transgenic switchgrass lines, including Cave-in-Rock, hydrothermal treatment was needed to solubilize 50% or more of the carbohydrate content.







BESC BioEnergy Science Center

Zurawski et al., "Bioavailability of carbohydrate content in natural and transgenic switchgrasses for the extreme thermophile *Caldicellulosiruptor bescii*." *Applied and Environmental Microbiology*. (Accepted)