Caldicellulosiruptor bescii (C. bescii) degrades lignin in switchgrass as well as cellulose and hemicellulose

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Background:

Plant biomass is highly recalcitrant and harsh thermal or chemical treatments are required to solubilize the biomass and release sugars. While microbial deconstruction holds some promise, few anaerobic microbes utilize both cellulose and hemicellulose and none are known to solubilize lignin.

Approach:

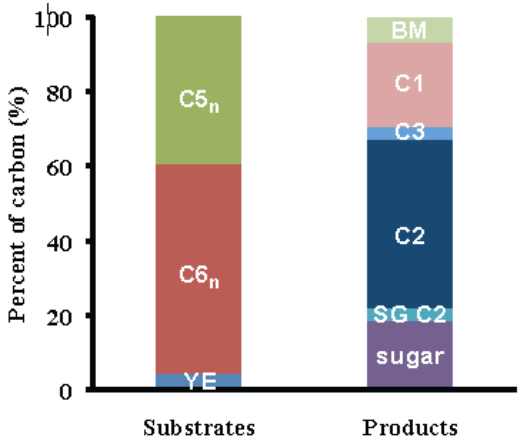
- Applied analytical and imaging technologies to evaluate structural and chemical changes in the solid and solubilized plant biomass before and during the microbial degradation process.
- Transcriptional microarray analyses of the microorganism used to gain insight into the types of enzymes involved in the deconstruction process.

Outcomes:

- *C. bescii* solubilized lignin at the same rate that it rendered soluble the carbohydrate components of switchgrass.
- *C. bescii* specifically up-regulates genes encoding key enzymes that degrade both major and minor components of plant cell walls.
- Carbohydrate in the solubilized switchgrass quantitatively accounted for the growth of C. *bescii*, indicating that the lignin was not assimilated by the microorganism.
- All reactions take place at 78°C.

Significance:

- Chemical and thermal pretreatment strategies for conventional cellulosic biofuels production contribute a significant cost overhead to the overall process.
- This unexpected result of simultaneous lignin and carbohydrate solubilization by *C. bescii* bodes well for complete industrial conversion by extremely thermophilic microbes of biomass that requires limited or no chemical pretreatment.



Mass balance of the solubilized and assimilated carbon. The results are expressed in % of total C1 units solubilized from washed switchgrass (wSG, 5.0 g/l) by *C. bescii*.

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Citation: Kataeva, *et al.,* "Carbohydrate and lignin are simultaneously solubilized from unpretreated switchgrass by microbial action at high temperature," *Energy and Environmental Science*, 6:7 (2186-2195) 2013. doi: 10.1039/c3ee40932e