9 November 2016

**Inhibition of Microbial Biofuel Production in Drought Stressed Switchgrass Hydrolysate**

Excess sugars made during periods of drought are converted to inhibitors during biomass pretreatment.

**The Science**

The effects of variable precipitation on downstream processing and fermentation of biomass to biofuels have not been well studied. This study demonstrates that increased plant soluble sugars produced during drought stress are made into pyrazines and imidazoles during ammonia-based pretreatment and are inhibitory to microbial growth.

**The Impact**

Variation in environmental conditions during the growth of bioenergy crops could have significant detrimental effects on the microbes used in biofuel production. These findings have implications for growth of crops in drought-prone regions or on marginal lands with poor water holding capacity.

**Summary**

To examine how precipitation impacts bioenergy crops and downstream processing, we collected corn stover and switchgrass samples during three years: a major drought year (2012) and two years with average precipitation over the entire season (2010 and 2013). We then AFEX (ammonia fiber expansion)-pretreated and enzymatically hydrolyzed the biomadd, and assessed fermentation performance using either bacteria (*Zymomonas mobilis*) or yeast (*Saccharomyces cerevisiae*). While most hydrolysates were readily fermented to biofuels, the growth of yeast (but not *Z. mobilis*) was completely inhibited in hydrolysate generated from drought stressed switchgrass. Biomass and hydrolysate compositional analysis revealed that switchgrass accumulated greater concentrations of soluble sugars in response to the drought and that these sugars were degraded to pyrazines and imidazoles during AFEX pretreatment. Moreover, supplementation of normal switchgrass hydrolysates with pyrazines and imidazoles recapitulated the growth inhibitory effect. These findings indicate that environmental variation can have significant effects on biomass hydrolysate properties and subsequent fermentation to biofuels. Knowledge of how these factors impact biofuel production can guide pretreatment and biocatalyst choices to mitigate inhibitory effects.

**Contacts (BER PM)**

N. Kent Peters  
Program Manager, Office of Biological and Environmental Research  
[kent.peters@science.doe.gov](mailto:kent.peters@science.doe.gov), 301-903-5549

**(PI Contact)**

Rebecca Garlock Ong  
Assistant Professor, Chemical Engineering - Michigan Technological University  
<rgong1@mtu.edu>

**Funding**

This work was funded by the DOE Great Lakes Bioenergy Research Center (DOE BER Office of Science DE-FC02-07ER64494). Additional funding was provided by DOE OBP Office of Energy Efficiency and Renewable Energy (DE-AC05-76RL01830).

**Publications**

Ong, R. G. *et al.* Inhibition of microbial biofuel production in drought stressed switchgrass hydrolysate. *Biotechnology for Biofuels* (2016) DOI:10.1186/s13068-016-0657-0.

**Related Links**

**PM Recommendation for SC Web Publication**

[Yes or No]