203. Revealing Nature's Cellulase Diversity: The Digestion Mechanism of the Hyperactive Cellulase *Caldicellulosiruptor bescii CelA*

Roman Brunecky,[1,3] Markus Alahuhta,[1,3] Qi Xu,[1,3] Bryon S. Donohoe,[1,3] Michael F. Crowley,[1,3] Irina A. Kataeva,[2,3] Sung-Jae Yang,[2,3] Michael G. Resch,[2,3] Michael W. W. Adams,[2,3] Vladimir V. Lunin,[2,3] Michael E. Himmel,[1,3] Yannick J. Bomble[1,3*] (Yannick.Bomble@nrel.gov) and **Paul Gilna[2] (BESC PI)**

[1]National Renewable Energy Laboratory, Golden, Colorado; [2]University of Georgia, Athens; [3]BioEnergy Science Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee

http://bioenergycenter.org

Project Goals: The BioEnergy Science Center (BESC) is focused on the fundamental understanding and elimination of biomass recalcitrance. BESCS's approach to improve accessibility to the sugars within biomass involves 1) designing plant cell walls for rapid deconstruction and 2) developing multi-talented microbes for converting plant biomass into biofuels via consolidated bioprocessing. BESC research in biomass deconstruction and conversion targets CBP by studying model organisms and thermophilic anaerobes to understand novel strategies and enzyme complexes for biomass deconstruction.

The thermal tolerant CelA from *Caldicellulosiruptor bescii* is the most active cellulose degrading enzyme we have tested to date. In the saccharification of a common cellulose standard, Avicel, CelA outperforms mixtures of commercially relevant exo- and endoglucanases. We have solved the crystal structures of the two catalytic domains of CelA and modeled the solution structures of the unbound enzyme. From transmission electron microscopy studies of cellulose following incubation with CelA, we discovered morphological features that suggest CelA is capable of not only the common surface ablation/fibrillation strategies driven by processivity, but also of forming extensive cavities of roughly the size of the enzyme. It is proposed that CelA, and possibly other multi-functional glycoside hydrolases, act in this completely novel manner and thus, when combined with more common cellulases, will result in significant improvements in mixed cocktails. These results suggest that Nature's repertoire of cellulose digestion paradigms remain only partially understood.

The BioEnergy Science Center is a U.S. Department of Energy Bioenergy Research Center supported by the Office of Biological and Environmental Research in the DOE Office of Science.