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Clostridium thermocellum ethanol stress responses and tolerance mechanisms

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Clostridium thermocellum, a candidate industrial biocatalyst for cellulosic fuel ethanol production, is relatively sensitive to ethanol compared to current industrial yeast and relatively little is known about its physiological response and the coordinate regulatory response to ethanol. In this study, the wild-type *C. thermocellum* ethanol stress response was dynamic and involved about 500 genes that were significantly differentially expressed between different conditions over time via microarray, which represented every functional category. Cellobiose was accumulated within the ethanol-shocked *C. thermocellum* cells, as well as the sugar phosphates such as fructose-6-P and glucose-6-P. The comparison between intracellular metabolites, proteomic and transcriptomics profiles will be discussed. The integrated responses lead us to propose that *C. thermocellum* may utilize nitrogen metabolism to bypass the arrested carbon and energy metabolism in responding to ethanol stress shock, and the nitrogen metabolic pathway especially the urease genes and redox balance may be the key targets for ethanol tolerance and production improvement. We also resequenced the genomes of several independent ethanol tolerant mutant strains using microarray comparative genome sequencing (CGS) and next generation sequencing (NGS)-based approaches to gain fundamental insights into process related traits and compare approaches. Genetics data showed mutations within the alcohol dehydrogenase gene (*adhE*) conferred the enhanced mutant ethanol tolerance phenotype and provide insights into this complex phenotype. AdhE biochemical and modeling studies are underway to provide further mechanistic insights into ethanol tolerance.

Biography

Steven Brown was awarded his doctorate from the University of Otago, New Zealand. He completed his postdoctoral studies at Oak Ridge National Laboratory, where he is now a staff scientist. He will discuss some of his studies funded by the U.S. Department of Energy BioEnergy Science Center.