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Genes and Mechanisms for Improving Cellulosic Ethanol Production in *E. Coli*

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Patents pending; available for licensing.

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Background

Cellulosic biomass accounts for roughly 75% of all plant material, and can be used to produce biofuels. Sources of cellulosic biomass include agricultural plant waste, organic waste from industrial processes, and crops grown specifically for fuel production. Biological conversion makes use of enzymes and microorganisms to convert pretreated cellulosic biomass into biofuels. In particular, *Escherichia coli* is a well-studied micro-organism commonly used in large-scale fermentations. In addition to biofuels, *E. coli* is capable of mass-producing platform chemicals as a replacement for traditional petrochemicals. Pretreatment of cellulosic biomass produces inhibitory compounds such as acetate and furfural; these compounds reduce fermentation efficiency, resulting in higher production costs. Engineering hardier biocatalysts to produce fuels and chemicals faster and cheaper is vital for biofuel and biorefining applications.

Technology

A research group led by Dr. Ryan Gill of the University of Colorado has utilized genome-wide tools and analysis techniques to engineer bacterial strains with increased tolerance to acetate, furfural and ethanol, as well as strains with increased general tolerance to cellulosic hydrolysate. Acetate and furfural tolerance are important for efficient conversion of pretreated cellulosic biomass, and ethanol tolerance is important for the production of ethanol as a biofuel.

Some important ways tolerance has been engineered include: relieving metabolic burden of inhibited biosynthetic pathways, reducing the intracellular concentration of the inhibitory compound, and thwarting entrance of toxic compounds into the cell. This technology offers bacterial strains capable of tolerating industrially-relevant concentrations of acetate, furfural, and ethanol, along with other inhibitors found in cellulosic hydrolysate.

Advantages

⇒ Hardier organisms with increased growth and production potential

⇒ Cost-efficient process for turning cellulosic biomass into useable biofuels and other bio-products like aldehydes and acetate.

⇒ Can be applied to any bacteria capable of producing biofuels and other bio-products

Key Documents

Methods, Compositions and Use for Enhancing Chemical Tolerance by Micro-organisms. US regular application filed April 30, 2010; related continuation-in-part filed Aug. 14, 2012.

Elucidating acetate tolerance in E. coli using a genome-wide approach. Metab Eng. 2011 Mar;13(2):214-24. *PDF available upon request.*