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Biomass Program

Sugars R&D

Biological Fractionation Fundamentals

Lignocellulosic materials, such as agricultural residues, trees, and grasses, are a low-cost bioenergy resource. Unlike starch-based biomass materials, lignocellulosic materials tend to be resistant to acid and enzymatic hydrolysis, which presents a challenge to converting them into usable sugars. Understanding how cellulases – the enzymes that break down cellulose – interact with the cellulosic substrates within lignocellulosic biomass is critical for developing a system that can efficiently convert biomass to sugars.

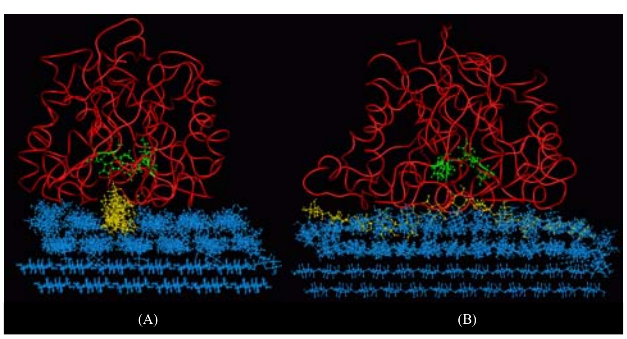
The goal of this project is to improve the conversion efficiency of cellulase and in doing so, lower the enzyme load required and reduce the overall cost of biomass sugar production. Three issues will be addressed by researchers: 1) lack of understanding of the preferred "substrate" for cellulase systems and component enzymes; 2) whether cellulase action can be improved with elevated operating temperatures; and 3) lack of understanding of the molecular details of the interaction of glycosyl hydrolase (GH) family 7A enzymes (one of the most important enzymes in the cellulase system) with the insoluble cellulosic substrate.

R&D Pathway

Advanced surface analysis tools and computer modeling of cellulose will be used to understand the interactions between cellulase systems and cellulose and selected substrates from advanced pretreatment technologies.

Researchers will use advanced computer modeling of cellulose, water, and enzymes to determine if cellulose is more accessible to the enzymes at higher temperatures, and whether the enzymes can be modified for increased activity at elevated temperatures. They will also describe the mechanisms through which the GH family 7A enzymes interact with the substrates at the thermodynamic and kinetic levels.

Two views of computer modeling of an endoglucanase (red) hydrolyzing a cellodextrin (yellow) from the surface of cellulose (blue). The green represents the active site of the endoglucanase. Such work provides new energetic insights into the action of cellulases not obtainable from traditional kinetics of x-ray crystallography.



Benefits

- **Enhance understanding of cellulase catalytic mechanisms and interaction mechanisms with insoluble lignocellulosic components**
- **Improve cellulase activity**
- **Enable a substantial reduction in sugar cost**

Applications

Coordinating studies that address pretreatment chemistries and cellulase mechanisms have the potential to substantially reduce sugar costs.

Project Participants

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Project Period

FY 2003 – FY 2005

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Visit the Web site for the Office of the Biomass Program (OBP) at
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