Researchers advance cellulosic ethanol production

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A team of researchers from Dartmouth's Thayer School of Engineering and Mascoma Corporation in Lebanon, N.H., have made a discovery that is important for producing large quantities of cellulosic ethanol, a leading candidate for a sustainable and secure alternative to petroleum-derived transportation fuel. For the first time, the group has genetically engineered a thermophilic bacterium, meaning it's able to grow at high temperatures, and this new microorganism makes ethanol as the only product of its fermentation.

The study was published online during the week of Sept. 8, 2008 in the journal *Proceedings of the National Academy of Science*.

"Our discovery is one potential avenue for research to facilitate turning inedible cellulosic biomass, including wood, grass, and various waste materials, into ethanol," says Lee Lynd, the Paul E. and Joan H. Queneau Distinguished Professor in Environmental Engineering Design at the Thayer School of Engineering at Dartmouth. "In the near term, the thermophilic bacterium we have developed is advantageous, because costly cellulase enzymes typically used for ethanol production can be augmented with the less expensive, genetically engineered new organism."

Lynd explains that this discovery is only the first step, a proof of concept, for future development of ethanol-producing microbes that can make ethanol from cellulosic biomass without adding enzymes. Lynd is the corresponding author on the study and the chief scientific officer and

co-founder of Mascoma Corporation, a company working to develop processes to make cellulosic ethanol.

All of the ethanol currently used in this country as an additive to gasoline comes from corn. However, it is widely recognized that cellulosic biomass has significant advantages over corn as a raw material for ethanol production, provided that a cost-effective technology for converting cellulosic materials can be developed.

There are several features that make cellulosic ethanol attractive. The raw material, cellulosic biomass, is available on a large scale, does not include food crops, and is cost-competitive with petroleum on both an energy and a mass basis. The technology to convert cellulosic biomass to ethanol is steadily improving, and it also has the potential to be cost-competitive with gasoline production. Environmental benefits include a sustainable carbon cycle with near-zero net greenhouse gas emissions, because the carbon dioxide captured growing the biomass roughly equals what is emitted while running an engine. In addition, ethanol has excellent performance and compatibility with existing internal combustion engines as well as fuel cell-powered vehicles of the future.

Innovative technology for ethanol production from cellulosic raw materials has been a central focus of Lynd's, who won the inaugural Lemelson-MIT Sustainability Award in 2007, a top honor for inventors.

"I'm not sure if it was a good or a bad sign that I knew alternative energy would be so important today when I started this work 30 years ago," says Lynd. "At that time, tools of molecular biology were in a nascent state of development. Now we can make much faster progress, and I anticipate more exciting advances soon."

Source: Dartmouth College

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