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## **MSU-patented pretreatment process aims to reduce the cost of cellulosic biofuels**

EAST LANSING, Mich. — Using a process patented by Michigan State University to pretreat corn stover (cobs, stalks and leaves) before it's converted into ethanol means extra nutrients don't have to be added, a finding that will significantly reduce the cost of making biofuels from cellulose according to Bruce Dale, MSU university distinguished professor.

The AFEX (ammonia fiber expansion) pretreatment process, invented by Dale, uses ammonia to make the breakdown of cellulose and hemicellulose in plants 75 percent more efficient than when enzymes alone are used. Cellulose in plants must be broken down into fermentable sugars before they can be turned into biofuel.

"Doctoral student Ming Lau and I have shown that it's possible to use AFEX to pretreat corn stover and then hydrolyze and ferment it to commercially relevant levels of ethanol without adding nutrients to the stover," Dale explained. "It's always been assumed that agricultural residues such as corn stover didn't have enough nutrients to support fermentation. We have shown this isn't so."

"The research also shows that the chemical compounds created when the stover goes through the AFEX process can improve the overall fermentation process," Lau added. "This is at odds with the general perception that these compounds are detrimental and should be removed."

The research is published in the current issue of the Proceedings of the National Academy of Sciences.

Currently, pretreating cellulose with acid is a common way to breakdown the material into fermentable sugars. But after acid pretreatment, the resulting material must be washed and detoxified to remove the acid and other compounds produced by the acid pretreatment.

Both washing and detoxifying remove nutrients from the treated cellulose, leading to the mistaken idea that agricultural crops lacked the necessary nutrients, according to Dale. Cellulosic material pretreated with the AFEX process doesn't have to be washed or detoxified, allowing ethanol to be created from cellulose without added nutrients or these other expensive steps.

"Washing, detoxifying and adding nutrients back into the pretreated cellulose are three separate steps," Dale explained. "Each step is expensive and adds to the cost of the biofuel. Breaking down cellulose into fermentable sugars cost effectively has been a major issue slowing cellulosic ethanol production. Using AFEX as the pretreatment process can dramatically reduce the cost of making biofuels from cellulose."

Using this research as a springboard, Dale said the next step could be a pilot plant facility, perhaps at MBI, a subsidiary of the MSU Foundation. MBI partners with universities and companies to bridge the gap between research innovations and commercial applications.

"There are several companies, including the Mascoma Corp., which plans to open one of the nation's first cellulosic ethanol plants here in Michigan, that may be interested in using this technology," Dale said. "We are working to make the AFEX technology fit these companies' needs."

Dale also serves as associate director of the MSU Office of Biobased Technologies and has a leadership role in the Great Lakes Bioenergy Research Center (GLBRC), a partnership between Michigan State and the University of Wisconsin-Madison funded by the U.S. Department of Energy (DOE) to conduct basic research aimed at solving some of the most complex problems in converting natural materials to energy.

This research is supported by the GLBRC and the MSU Research Foundation. Dale's research also is supported by the Michigan Agricultural Experiment Station.

"Cellulosic Ethanol Production from AFEX-treated Corn Stover Using *Saccharomyces cerevisiae* 424A(LNH-ST)" is available online.

For more information on Michigan State University's biofuel and bioenergy research, visit:  
**[www.bioeconomy.msu.edu](http://www.bioeconomy.msu.edu)**.

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