Researchers use fungus to improve corn-to-ethanol process

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Iowa State University researchers, left to right, Anthony L. Pometto III, Hans van Leeuwen and Mary Rasmussen display the 2008 Grand Prize for University Research recently presented to their research team by the American Academy of Environmental Engineers. Not pictured is Samir Khanal, a former Iowa State research assistant professor who's now at the University of Hawai'i at Manoa. Photo by Bob Elbert/Iowa State University

Growing a fungus in some of the leftovers from ethanol production can save energy, recycle more water and improve the livestock feed that's a co-product of fuel production, according to a team of researchers from Iowa State University and the University of Hawai'i.

"The process could change ethanol production in dry-grind plants so much that energy costs can be reduced by as much as one-third," said Hans van Leeuwen, an Iowa State professor of civil, construction and

environmental engineering and the leader of the research project.

Van Leeuwen and the other researchers developing the technology – Anthony L. Pometto III, a professor of food science and human nutrition; Mary Rasmussen, a graduate student in environmental engineering and biorenewable resources and technology; and Samir Khanal, a former Iowa State research assistant professor who's now an assistant professor of molecular biosciences and bioengineering at the University of Hawai'i at Mânoa – recently won the 2008 Grand Prize for University Research from the American Academy of Environmental Engineers for the project.

"Those chosen for prizes by an independent panel of distinguished experts address the broad range of modern challenges inherent in providing life-nurturing services for humans and protection of the environment," according to a statement from the academy. "… Their innovations and performance illustrate the essential role of environmental engineers in providing a healthy planet."

The Iowa State project is focused on using fungi to clean up and improve the dry-grind ethanol production process. That process grinds corn kernels and adds water and enzymes. The enzymes break the starches into sugars. The sugars are fermented with yeasts to produce ethanol.

The fuel is recovered by distillation, but there are about six gallons of leftovers for every gallon of fuel that's produced. Those leftovers, known as stillage, contain solids and other organic material. Most of the solids are removed by centrifugation and dried into distillers dried grains that are sold as livestock feed, primarily for cattle.

The remaining liquid, known as thin stillage, still contains some solids, a variety of organic compounds from corn and fermentation as well as

enzymes. Because the compounds and solids can interfere with ethanol production, only about 50 percent of thin stillage can be recycled back into ethanol production. The rest is evaporated and blended with distillers dried grains to produce distillers dried grains with solubles.

The researchers added a fungus, Rhizopus microsporus, to the thin stillage and found it would feed and grow. The fungus removes about 80 percent of the organic material and all of the solids in the thin stillage, allowing the water and enzymes in the thin stillage to be recycled back into production.

The fungus can also be harvested. It's a food-grade organism that's rich in protein, certain essential amino acids and other nutrients. It can be dried and sold as a livestock feed supplement. Or it can be blended with distillers dried grains to boost its value as a livestock feed and make it more suitable for feeding hogs and chickens.

Van Leeuwen said all of that can save United States ethanol producers a lot of energy and money at current production levels:

-- Eliminating the need to evaporate thin stillage would save ethanol plants up to $800 million a year in energy costs.

-- Allowing more water recycling would reduce the industry's water consumption by as much as 10 billion gallons per year. And it allows producers to recycle enzymes in the thin stillage, saving about $60 million per year.

-- Adding value and nutrients to the livestock feed produced by ethanol plants would grow the market for that feed by about $400 million per year.

-- And the researchers' fungal process would improve the energy balance

of ethanol production by reducing energy inputs so there is more of an energy gain.

Van Leeuwen estimated it would cost $11 million to start using the process in an ethanol plant that produces 100 million gallons of fuel per year. But, he said the cost savings at such a plant could pay off that investment in about six months.

The Iowa State research project is supported by grants of $78,806 from the Grow Iowa Values Fund, a state economic development program, and $80,000 from the U.S. Department of Agriculture through the Iowa Biotechnology Byproducts Consortium.

The researchers have filed for a patent on the technology and are looking for investors to commercialize the invention. And while the process needs to be proven at larger scales, there are high hopes it can do a lot to improve the efficiency of ethanol production.

“We will be saving ethanol producers money and energy,” Pometto said. “That’s the bottom line.”

Source: Iowa State University