

Tampa Tribune

UF Research Mines Waste For Ethanol Production

By LINDSAY PETERSON
lpeterson@tampatrib.com
Published: November 16, 2008

GAINESVILLE - Inside his bright, new laboratory at the University of Florida, researcher Lonnie Ingram is trying to build a better bug.

That's what scientists and others call the [microscopic organisms](#) they are counting on to create a new U.S.-based [fuel industry](#) free of ties to foreign oil producers.

More than 20 years ago, Ingram and other [UF researchers](#) genetically engineered a bacterium that could turn common grasses, [agricultural waste](#) and [wood chips](#) into ethanol for our cars. Called cellulosic ethanol, it is an alternative to ethanol made from corn, which has lost favor because it uses land also needed for food crops.

Ingram, a microbiology and [cell science](#) professor, has devoted the better part of his career to the cellulosic cause. In 1991, he and the university received a U.S. patent on his first ethanol-making organism. Since then, his work has received 19 more patents and has attracted investors who bought the rights to use two of the microbial creations.

Success has always been just around the corner, with its promise of releasing the country from its [dependence on fossil fuels](#) - and of bringing millions to Ingram, 60, and the university. UF is hoping for the same success that followed the creation of the sports drink Gatorade in the mid-1960s.

But still Ingram waits, with no assurance his life's work will bring the transformation he envisions.

"We need to get off foreign oil, but this could do more than that. It could start a new industry, especially in Florida where we can grow so much of this material," he said.

"I would never have thought that we'd be working on this for so long."

Trial And Error

It's only partly a science problem. Ingram also faces the confounding rules of economics. His discoveries have earned him a place in the [prestigious National Academy](#) of Sciences, but he has been humbled, he said, by the difficulty of creating commercial success and the many things outside his control - gas prices, the mood of investors, competition from other energy alternatives.

He's at the center of UF's plans to build Florida's first ethanol plant on land owned by Florida Crystals sugar company near Lake Okeechobee. The state pledged \$20 million for construction.

But it's a small demonstration project, Ingram said. No one has put up enough money to build a full-scale commercial operation anywhere in the country.

One problem is the investors with hundreds of millions to spend don't know where to place their bets because they don't know which ethanol-making effort will pay off in the long run. They don't know what kind of plant would work best or how much it should cost.

Ingram and his UF colleagues are among hundreds of researchers worldwide working on a dozen ways to make cellulosic ethanol. They're racing to find the least expensive, most efficient "bugs"

and other techniques to break down the tough plant materials and turn the sugars locked inside into fuel.

Ingram is working with a company called Verenium (the name is a combination of the Spanish word for green, verde, and millennium), which has licensed two of his patents for use in a small demonstration plant in Louisiana. Verenium, based in Cambridge, Mass., will also operate the

Florida plant, expected to be running by the end of next year.

Others, such as DuPont, are using organisms such as Ingram's engineered by other scientists.

"Including the bugs, there are a whole host of processes," said Mike Hartwig of the Renewable Fuels Association. One uses acid to convert the cellulose in the plant material to starch or sugar.

Another uses heat and combustion to break down the plant material.

"It's going to be a matter of trial and error to determine which ones work," he said.

The Tequila Gene

More than one process will emerge at the top because the raw materials being used are so varied, said Brent Erikson of the Biotechnology Industry Organization. In the Southwest, researchers are working with switch grass. In the Northeast, it's wood chips.

Ingram's method is one of the most promising, he said. And with Florida's potential to grow grasses of all kinds year-round, it "could become the biggest ethanol producer in the country."

That's what Florida Crystals is counting on. Cellulosic is ideal for the sugar company because it can remain in the sugar business, but also use its waste, the bagasse, to make ethanol, said spokesman Gaston Cantens.

The plant that UF is building on its land will produce about 1.5 million gallons of ethanol a year; Floridians used more than 9 billion gallons of gasoline last year. But it will put Florida Crystals at the center of the research and development effort, he said.

The company already uses its bagasse and yard waste from surrounding counties to fuel a power plant that runs the company's sugar-making operations, with enough left over to power 60,000 homes in Palm Beach County.

"Energy is part of our future," Cantens said. "We see liquid fuels as the next generation of where we want to go."

In addition to hosting UF's project, the company has been working in its labs with Florida International University to refine an early stage of the ethanol-making process - breaking down the plant material to get it ready for fermentation.

Florida Crystals' interest in Ingram's work goes back to the beginning, more than 20 years ago, when Ingram visited the sugar operation to ask whether he could use its bagasse for his experiments.

At the time, the country was in the midst of an oil supply scare and entrepreneurs elsewhere were making ethanol from corn, a simple process that's a lot like making whiskey. But Ingram was intrigued with the idea of using less expensive, more abundant grasses and agricultural waste, such as sugar cane bagasse. These materials hold sugar, like corn, but it's hard to ferment because it's locked tightly in the plants' molecular structure.

"Cellulosic material is tough. It's what makes trees stand up," said Stephen Clarke, Florida Crystals' director of industrial research.

Ingram and his colleagues found their key in the genes of a bacterium used for centuries in Mexico to ferment the agave plant into a mild drink similar to tequila. The bacterium wasn't hardy enough to withstand the ethanol-making process, so the researchers isolated the genes responsible for fermentation and moved them into a stronger bug, a harmless strain of E. coli.

Ingram and the university received a patent on the process in 1991, and in 1995 a private company that would eventually become Verenium licensed the patent from UF. Energy worries had eased by the early '90s, and interest in cellulosic ethanol evaporated. But Ingram kept at it, with support from the university and grants from the U.S. Department of Energy.

Although groundbreaking, his first organism was expensive to make - the ethanol it produced would have cost about \$20 a gallon. So the researchers kept looking for different genes and new ways to increase the bacterium's yield of alcohol and speed the process. The bacterium cost is now down to a few cents per gallon, Ingram said.

Need For Commitment

In the past 20 years, Ingram and his colleagues have brought tens of millions in grant money to UF and trained hundreds of students working around the country. Last month, the university opened a 2,250-square-foot laboratory and pilot plant devoted to finding better bacterium and simplifying the ethanol-making process even more.

Verenium's licenses have brought UF only one royalty check, for \$66,000. The money came from a Japanese company that sublicensed the process from Verenium to make ethanol from wood construction waste. But there will be more, said Florida Agriculture Secretary Charles Bronson at the presentation ceremony in July 2007.

"I am confident this is only the beginning of Florida's front-and-center role in the development of environmentally friendly alternative fuels," he said.

Ingram would feel better about that prediction if he saw more government leadership, he said. The state has given out about \$50 million in grants to companies and researchers trying to produce ethanol across the state, including the \$20 million for the UF plant on Florida Crystals land. The federal government has spent more than \$1 billion nationwide.

The state also has taken steps to increase demand, requiring that by 2010 ethanol make up at least 10 percent of all vehicle fuel statewide. That would be about 900 million gallons a year. But that demand could be met also with corn ethanol shipped in from the Midwest and sugar cane ethanol from Brazil.

The federal government has set a goal of increasing cellulosic ethanol use to 16 billion gallons a year by 2022.

Will the country get there?

It will take a greater commitment than what exists now, Ingram said.

He recalled his frustration watching the recent hearings on the \$750 billion bank bailout.

"That's enough capital for enough alternative fuels to totally eliminate our need for imported fuels," he said. "But if we asked Congress to do that, we'd be laughed out of Washington."

Reporter Lindsay Peterson can be reached at (813) 259-7834.

<http://www2.tbo.com/content/2008/nov/16/na-uf-research-mines-waste-for-ethanol-production/news-breaking/>