Looking for a cure in a kernel

Joy Powell, Star Tribune
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Corn has evolved beyond its use as a simple food and livestock feed to become the key ingredient in ethanol fuel and some plastics. And soon, the kernels could become far more valuable as grist for a new generation of medicines and health-promoting specialty foods.

A Golden Valley company called Biorefining Inc. is emerging as a leader in the industry's race to mine the golden kernels for certain components before their starchy remainder is turned to ethanol at corn-processing plants.

If it succeeds, the technology could turn ethanol plants into "chop shops" producing corn components for medicines and add millions of dollars a year in revenue to farmers and others who own the ethanol plants.

With some patents in hand and more pending, Biorefining says it intends to license the technology to two ethanol plants soon. It's close to signing a deal to supply at least one major pharmaceutical company with substances drawn from corn. And since 2000, the company has raised $2.4 million in private capital.

The question now is whether Biorefining can make its technology viable on a commercial scale.

The intellectual property firm is among those around the world that are racing to find a way to tap the golden potential of corn, which at its most refined levels holds a host of rare sugars.

"There are 80 or more different chemicals and ingredients in a kernel of corn that can be used for a variety of applications, if you take it apart carefully," said Bruce Cook, marketing director for Biorefining Inc. "If you just grind it up and cook it in the ethanol process, all you get out is ethanol, animal feed and carbon dioxide at the other end."

Company President Doug Van Thorre, a chemist and physicist, said the firm's new method uses far fewer chemicals, without a lot of heat, than now are used by other companies to take apart the basic components in corn: protein, oils and bran, which is the hull.

"It's cleaner, greener, faster, cheaper," Van Thorre said.

The three-step process begins with what the company calls "biomilling," which mechanically cracks the raw kernels to obtain oil, protein and carbohydrates. The starch goes into a fermenter to make ethanol.

The other extracted components can be further refined for possible use as building blocks in medicines and "functional" foods, also called nutraceuticals, that help prevent and treat a variety of ailments, from heart disease to arthritis.

The nation's leading ethanol plant builder, Ron Fagen of Fagen Inc. in Granite Falls, as well as the giant agribusiness Cargill Inc. are among those watching from an arm's length. Biorefining executives have discussed their potential with both Fagen and Cargill.

"We're just very cautious because we've got to have a real good confidence level before we suggest it to an ethanol plant," said Fagen, who has built more than 50 plants so far

and has 52 more on the drawing board. "We want to be on the leading edge -- not the bleeding edge."

Minnetonka-based Cargill, the nation's largest private company, said it does not comment on companies with which it has not signed agreements. Cargill's current strategy includes turning corn into a resin for plastics, clothing and blankets made by other companies.

Biorefining says its process makes ethanol plants not only more profitable but also more efficient as they send to the fermenter only the starch from the kernels.

An average plant that produces 40 million gallons of ethanol a year could triple its profits if it sells such co-products along with ethanol and livestock feed, Thom Menie, Biorefining's vice president of marketing and sales. That's three times as profitable as simply turning byproducts to livestock feed, he said.

Biorefining is negotiating with an engineering firm to put the technology into ethanol plants. Existing dry-grind ethanol plants -- the vast majority of plants in the country -- can be retrofitted at a cost of about $14.5 million, with a stand-alone facility nearby, Menie said. Or the technology can be built into new plants popping up around the country at a quickening clip.

Biorefining says its method can extract from corn certain substances used as building blocks in medicines to fight viral diseases such as AIDS and hepatitis, as well as to prevent and treat urinary tract infections and even stop tooth decay and plaque.

One of the rare sugars the company is after is called L-arabinose, which is being studied as a building block for pharmaceutical ingredients.

"We've been contacted by a major pharmaceutical company that is working on a hepatitis drug that is based on L-arabinose as a key building block," Menie said. "They're looking at it for a long-term, stable supply for their applications."

He said that particular drug is in the third phase of clinical trials, the last before the drug company seeks approval from the Food and Drug Administration.

"They've done enough testing to know that it works," said Menie, who declined to identify the company.

Beyond that pharmaceutical company, researchers are looking into using such carbohydrates, or "L" sugars, to disrupt communication signals between cells, such as those that form tumors.

Biorefining's corn-separation technology is aimed at replacing chemical-laden processes that companies now use, for example, to extract the carbohydrate xylose from birch trees as an ingredient for sugarless gum.

Such components from corn could find a market in the burgeoning "functional foods" industry. These foods can enhance performance and help treat conditions such as coronary heart disease, osteoporosis and neural tube defects, according to a new report by the Institute of Food Technologists in Chicago.

"There's a whole new world in agriculture," said U.S. Agriculture Secretary Mike Johanns, who visited Minnesota Friday. The firm's work brings one more opportunity to expand use of agricultural products, he said.

"The thought that a by-product of ethanol production might lead to a medicine to help cure something is just a remarkable phenomenon," Johanns said. "The science and

research and some of the things being done in Minnesota really are exciting. They're cutting edge. "

Picking corn apart

Near Philadelphia, chemist Kevin Hicks is a research leader for the U.S. Agriculture Department's eastern regional research center. He said that many in the industry are trying to achieve the separating process for corn, calling "fractionalization."

Hicks said he's waiting to see the details on Biorefining's process.

"It sounds encouraging, but we all know how difficult it is to do," he said. "If it works as well as they're saying, this might be the next evolution in dry-grind ethanol plants."

In Minnesota, the Agricultural Utilization Research Institute has provided the company with an $85,000 grant and technical assistance.

"Absolutely, this is feasible," said Max Norris, a chemist with the institute. 'They have taken their application to a one-tenth-scale pilot facility, and it's worked well for them. If you can scale it to one-tenth, you can take it on up to full-scale operation."

But it's one thing to develop technology and quite another to succeed in the marketplace, said Ralph Groschen, an ethanol industry expert at the Minnesota Agriculture Department.

"They seem to have the technology and the back-up to make it happen," Groschen said. "The big question is, how do you get into the market, how do you make it work on a large-scale basis?"

Last fall, the firm broke ground in a joint venture with Ace Technologies to build a bio-extraction plant in Stanley, Wis. The plant will extract from beets a gelling agent called pectin, which is used in hundreds of food products. The same method can be used on other crops. Corn holds greater promise than beets because it has many more components.

Two years from now, Biorefining intends to build a $6 million "bio-conversion" facility in the metro area to produce the rare sugars, the company said.

Corn provides not only carbohydrates but also proteins and lipids, which include fatty acids and oils such as glycerin. In the firm's final polishing step at the bio-conversion plant, chemists could add a lipid or a protein to a carbohydrate.

The firm could meet a food or drug makers' request for a specific combination, or "boutique" application, of the sugar molecules, Menie said.

Deconstructing the kernel

Imagine popping apart a kernel of corn. The brownish-gray material in the middle is the germ. Soak it a little and rub it with your finger and the skin called the pericarb, or corn bran, will flake off. That's used for feed. The tiny yellow and white pieces are the endosperm.

The firm's trademarked Biomilling process carefully takes apart the kernel, piece by piece.

Dry-mill plants could separate and extract molecules from corn within minutes, compared to a watery, chemical-laden process that wet-mill plants now use to make products that range from corn oil to Cargill's polymers for corn resin that go into plastic, clothing and blankets.

The process is for dry-mill ethanol plants, which represent most of the 84 plants now operating in the United States and at least 15 under construction. Their main products are ethanol, carbon dioxide for use in dry ice, and distillers' grain for livestock feed.

The industry also has 10 wet-mill plants, seven owned by Archer Daniels Midland and Cargill. The wet-mill plants soak the corn first and separate it into component parts to make high-fructose corn syrup, corn oil, livestock feed and ethanol.

Those expensive plants are losing ethanol market share, and no new ones have been built in the past five years as the high-fructose corn syrup market became saturated and health-conscious consumers increasingly have turned to bottled water rather than soft drinks containing the syrup.

Smaller operations, usually producing 100 million gallons of ethanol a year or less and often owned by farmer cooperatives, typically use the dry-milling process. These plants grind the corn into mash and cook it in a fermenter. That process destroys a lot of the potential components in the corn.

Biorefining said that besides harvesting these components, its process also dramatically cuts the volume of acids and other materials known as volatile organic compounds that are produced during the drying of ethanol byproducts that are made into animal feed.

"It's an environmentally friendly process," Menie said, "and we use little, if any, chemicals."