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More than Meets the Eye

Getting More Attuned to the Distinctive Chemical Compositions and Unique Physical Properties of Distillers Grains

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Coproduct Breakdown

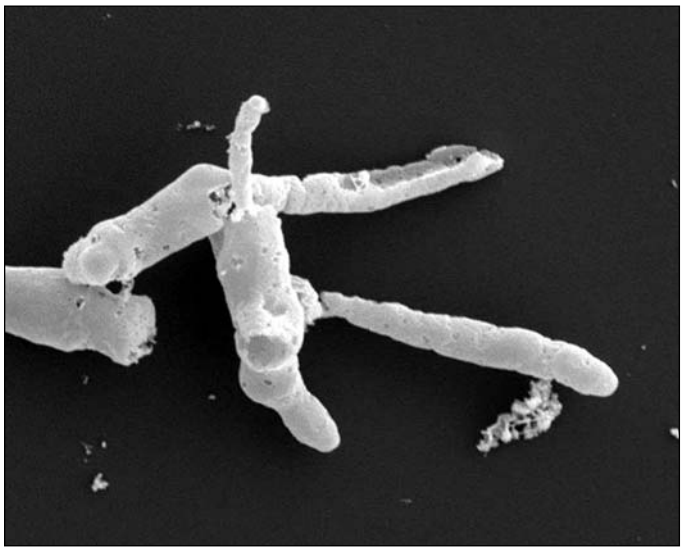
By Mark Emalfarb

As the ethanol industry's continuous drive toward greater efficiencies continues, so does the search for improved cellulosic conversion technologies—those that, according to many experts, will revolutionize the production of renewable transportation fuels as we know them today.

Although the commercialization of cellulose to ethanol seems always to be "five years off," there are novel methods being developed today that will potentially increase ethanol production from corn by utilizing enzymes that break down the lignocellulosic material that already exists in the production 0f distillers grains and other fibers. On its own for the past dozen years—and in conjunction with the Iowa Corn Promotion Board under a U.S. DOE-funded project over the past two years—Dyadic International has been working to this end. Dyadic is in the process of further optimizing proprietary and patented enzymes and technology to convert the cellulose and hemicellulose in distillers grains to fermentable sugars such as glucose, xylose and arabinose. Fermenting these sugars to ethanol has the potential to increase yields of ethanol by 10% to 20% without growing or importing a single additional stalk of corn.

Emalfarb

Dyadic's ethanol-yield-improving technology is rooted in its discovery of a fungus, nicknamed "C1," from the Far East of Russia. The company engineered its C1 host technology to develop better and cheaper enzymes, as well as to discover and improve existing enzymes from C1 and other proprietary fungi. Using natural and artificial mixtures of enzymes, Dyadic's scientists have discovered combinations of enzymes that efficiently hydrolyze distillers grains and other biomass substrates into fermentable sugars. Results of the company's research were recently presented at the World Congress on Industrial



An electron micrograph of a C1 fragment

Dr. Hans Visser of Dyadic Netherlands operating one of Dyadic's fermentors

Scientists working at one of Dyadic's labs

Dyadic's large-scale fermentation tanks

Biotechnology and Bioprocessing. The remaining challenge is to further optimize the enzyme mixtures and to commercialize enzymes that can be profitably produced and sold in large volumes to ethanol manufacturers at prices that are cost-efficient for the ethanol industry.

Dyadic has also recently sequenced the genome of its proprietary C1 fungus. In collaboration with the Scripps Research Institute, the company is annotating the genomic sequence in order to identify and catalog the genes present in the genome. To date, over 11,000 gene candidates have been identified. This information has already led to the discovery of a large number of potentially useful enzymes from

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C1, and it is anticipated to aid in further improvements of the C1 host technology.

It is estimated that U.S. ethanol producers manufactured more than 9 million metric tons of distillers grains in 2005. Dyadic scientists project that by unlocking the sugars from the current volume of distillers grains, ethanol producers could yield an additional 90 gallons of ethanol per ton of DDGS—a process that would produce an additional 810 MMgy industry-wide.

How Is It Possible?

For every bushel of corn made into ethanol, 18 pounds of DDGS are created. The corn kernel is 61% starch (by wet weight), with protein, fiber, corn oil, and water making up the remaining 39%. The dry-grind ethanol process uses most of the starch present in the corn kernel during ethanol fermentation, leaving protein, fat, minerals and vitamins behind in a concentrated form as distillers dried grains (DDG), corn-condensed distillers soluble (CDS), corn distillers dried grains with solubles (DDGS), distillers wet grains with solubles (DWGS) or some modified version of one of these.

With distillers grains in hand—and when its enzyme system is fully developed—Dyadic's enzyme hydrolysis process will break down most of the cellulose and hemicellulose in distillers grains into sugars that may then be converted to ethanol. The protein-rich residue from this process is a potential feed additive that could be sold to the animal feed market in a more concentrated form. The potential results are staggering: If 80% of the sugars in distillers grains can be unlocked and utilized by the ethanol manufactures (producing the aforementioned 810 MMgy industry-wide), for example, an ethanol market price of $2.50 per gallon would produce a windfall of $2 billion in additional ethanol revenues. This number will only increase as additional ethanol plants come on line in the future.

Beyond corn starch, there is the residual agricultural biomass that could be made available to be turned into fermentable sugars and hence ethanol. The U.S. DOE estimates that the United States has an annual capacity to produce 1.3 billion tons of biomass without significant infrastructure changes. With new developments in enzyme technology, this lignocellulosic biomass potentially may be turned into enough "next-generation" ethanol to replace 30% of our transportation fuel imports of petroleum.

The increased yield in ethanol production will go a long way in feeding the growing appetite for fuel ethanol. An increased ethanol yield from corn stock, combined with the production of ethanol from cellulosic biomass will enable America to meet its 2012 goal of producing 7.5 billion gallons, thereby weaning the country off foreign oil and securing the future security and prosperity of Americans well into the 21st Century. DGQ

AUTHOR Mark Emalfarb is founder and CEO of Dyadic International. Since founding Dyadic in 1979, he has spearheaded the company's evolution from its origin as a pioneer in stonewashing blue jeans to its current leadership in the discovery, development, manufacturing and commercialization of specialty enzymes and other proteins from DNA for energy, agricultural, industrial and biomedical applications. Reach Emalfarb at (561) 743-8333.