

Food firms test fry Pioneer's trans fat-free soybean oil

The US Department of Agriculture (USDA) has approved for environmental release one of the first biotech crops aimed at the food industry. The new crop, a genetically modified soybean with an altered fatty acid profile, yields oil that is more stable at high frying temperatures and has a longer shelf life than commodity soybean oil. It was developed by Pioneer Hi-Bred in Johnston, Iowa, a Dupont company. The company received marketing approval for the biotech soybean in June and aims to commercialize it by 2012. St. Louis-based Monsanto is following close behind, with two soybean products with modified oil profiles in its pipeline.

The new soybean traits may help the biotech industry deliver on a two-decade-long promise: to develop crops with improved nutritional value. Until now, most commercialized biotech crops have been engineered with such traits as pest resistance and herbicide tolerance—traits that mostly benefit farmers rather than the food industry or consumers. “Heat stability and longer shelf life: these are the things that can light up the food industry, not reduced pesticides,” says Tom Hoban, a professor of food science at North Carolina State University in Raleigh.

Pioneer is marketing its new soybean oil as an alternative to partially hydrogenated vegetable oils. For decades, food producers have relied on partially hydrogenated soybean oil because it retains its flavor at high cooking temperatures and for extended periods on the grocery store shelf. But the process of partial hydrogenation produces *trans* fatty acids, or trans fats, which are known to increase ‘bad’ low-density lipoprotein (LDL) cholesterol and increase risk of coronary heart disease.

In 2006, the US Food and Drug Administration began requiring food manufacturers to label food with trans fats, and measures to alert the public of the health risks of trans fats ensued. Food producers turned to alternatives, such as palm oil and certain kinds of canola oil, that have more stable frying and shelf life characteristics than those of unhydrogenated soybean oil. As a result, soybean oil's share of the edible fats and oils

market has gone from 76% in 2005 to 64% today, according to the US Census Bureau. “We hope to recapture that space [for soybeans],” says Pioneer's Russ Sanders, director of enhanced oils.

Pioneer's new soybean oil has an oleic fatty acid content of >75%, a property that gives it frying and shelf stability comparable to that of palm, high oleic acid canola and hydrogenated soybean oils. It also contains 20% less saturated fat than commodity soybean oil. Pioneer dubbed the crop “Plenish high-oleic soybeans.” Overproduction of oleic acid and decreased levels of linoleic and linolenic acids



John Leer/Stockphoto

The success of Pioneer's recently approved soybean, which has been engineered to cut down on trans fats, will depend on how well it is received by the food industry.

in Plenish arise from transgenic expression of a fragment of the soybean microsomal omega-6 desaturase gene (*FAD2-1*) under the control of soybean Kunitz trypsin inhibitor gene promoter, which silences endogenous omega-6 desaturase. The transgenic soybean also carries the *S*-adenosyl-L-methionine synthetase as a marker to enable initial selection in the laboratory by acetolactate synthase (ALS)-inhibiting herbicide.

The success of the Plenish soybean will depend on how well it is received by the food industry. Pioneer has already set up testing agreements with a dozen undisclosed food companies, says Sanders. The companies will run consumer taste tests, frying tests and shelf life tests—just about anything a food company would normally do with a new ingredient.

Food companies can already choose from an array of oils with modified fatty acid contents developed with conventional breeding. “The hard reality will be how producers of liquid vegetable oils compete,” says Terry Etherton, professor of animal nutrition at Penn State in University Park, Pennsylvania.

Food industry representatives say they welcome the new oil option, but see it as a “trial situation,” says Jeffrey Barach, vice president of science policy at Grocery Manufacturers Association in Washington, DC. “Each company has to try it out and do some experimental work,” he says.

Although Pioneer received the full go-ahead from regulators, the company doesn't plan to

IN brief

Anti-CD20 patent battle ends

On June 1, a four-year dispute over a European patent for anti-CD20 drugs to treat rheumatoid arthritis came to an end, with Seattle-based Trubion winning the dispute. This result frees up the space for anyone with a CD20 program, says Jeff Pepe, associate general counsel at Trubion. Multiple oppositions had been filed against the patent (European Patent 1176981) held jointly by Genentech of S. San Francisco, California, and Biogen Idec of Cambridge, Massachusetts. Trubion was joined by MedImmune, GenMab, Centocor, the Glaxo Group and Merck Serono, all pursuing anti-CD-20 programs at one time. In 2008, the Opposition Division of the European Patent Office ruled that, as filed, the patent did not meet the necessary requirements, favoring Trubion. Genentech and Biogen appealed in 2009. Finally, at an oral hearing this June, the original ruling was upheld, and no further appeals will be allowed. Ironically, around the time of the hearing, New York-based Pfizer, which acquired Trubion's CD20 programs when it bought Wyeth in 2009, announced they would drop Trubion's lead anti-CD20 compound (TRU-015) though retaining the biotech's second generation anti-CD20 monoclonal antibody also in rheumatoid arthritis. For Genentech/Roche “the decision does not impact our expectations with respect to protection against Rituxan [rituximab, anti-CD20 chimeric monoclonal antibody],” says company spokesperson Rubin Snyder.

Laura DeFrancesco

EU states free to ban GM crops

In July, the European Commission (EC) officially proposed to give member states the freedom to veto cultivation of genetically modified (GM) crops without having to back their decision with scientific evidence on new risks. The reform's goal is to hand back responsibility to individual states and speed up pending authorizations. Anti-GM countries can now choose to opt out whereas biotech-friendly countries can cultivate new GM varieties. However, there is no guarantee it will work. “We are not against freedom for member states, the problem is how the principle is articulated,” says Carel du Marchie Sarvaas, director for agricultural biotech at EuropaBio. The proposal stands on two legs: an amendment to directive 2001/18 that must gain the approval of the council of ministers and the European Parliament, and an EC recommendation on coexistence, already effective. The first legalizes national or local bans on growing, the second one achieves the same result by conceding that countries wanting to keep ‘contamination’ levels well below the labeling threshold can enforce wide isolation distances between GM and conventional or organic fields. “It's a Pandora's box. We are concerned it will create legal uncertainty and unpredictability for farmers and operators,” says du Marchie Sarvaas. The reform doesn't target imports of GM material for food or feed, whose approvals are also stalled.

Anna Meldolesi

IN brief

GM alfalfa—who wins?

Both sides are claiming victory following the Supreme Court's verdict issued June 21 in *Monsanto v. Geerston Seed Farms* over the future sale of Roundup Ready (RR) alfalfa seeds. The Supreme Court repealed a lower court injunction issued in 2007 banning the biotech seeds nationwide (*Nat. Biotechnol.* **28**, 184, 2010). Monsanto's business lead for the crop, Steve Welker, says the St. Louis-based company has plenty of RR alfalfa seeds "ready to deliver," although their release is subject to a pending environmental impact statement (EIS) by the US Department of Agriculture (USDA). "Our goal is to have everything in place for growers to plant in fall 2010," Welker adds. Not so fast, says lawsuit opponent Andrew Kimbrell of the Center for Food Safety in Washington. He points out that the Supreme Court "just took away the injunction, and USDA still has to comply with NEPA [the National Environmental Policy Act] and complete an EIS" before the crop can be deregulated. Although USDA appears poised to complete its EIS and fully deregulate RR alfalfa, the Center for Food Safety could renew its challenge of USDA's decision. This lingering uncertainty has agitated many members of Congress. Seven senators and 49 representatives have asked agriculture secretary Tom Vilsack to retain regulated status for RR alfalfa, whereas two other senators have urged Vilsack to "mount vigorous defenses against lawsuits that seek to upend science-based regulatory decisions." *Jeffrey L. Fox*

Biofuel 'Made in China'

Collaboration between the Danish enzyme producer Novozymes of Bagsvaerd, Beijing-based China Petroleum and Chemical and Cofco, the state-run agriculture company, will produce three million gallons of ethanol a year for local consumption, using corn stalks and leaves from northeastern China's corn belt. The demonstration plant will test novel technologies, including Novozymes' new Cellic CTec2 enzymes, with a view to launch a commercial facility by 2013. Cofco has been running a small pilot plant in Heilongjiang province for four years, but as a precondition for commercialization "we need more capacity to optimize our design and operation," says Guo Shunjie, general manager of Cofco's bio-energy and biochemical department. One remaining hurdle is the inability to break down five-carbon sugars abundant in lignocellulose, which make up 20–40% of the plant biomass. The new process could cut costs considerably, as it requires half the dose of enzymes needed by other treatments to break down plant waste. The partners' goal is to produce cellulosic ethanol at \$2.25 a gallon, a price further pushed down by government tax credits to be competitive with corn-based ethanol, currently at \$1.50–1.60 a gallon. "Since the trend to lower carbon emissions is here to stay, it won't be long before we break even," says Shunjie. *Daniel Grushkin*

Table 1 USDA-approved soybeans modified for improved trans fat content

Product	Company	Description
DP-305423	Pioneer Hi-Bred International	High oleic acid soybean produced by inserting extra copies of a portion of the gene encoding omega-6 desaturase, <i>gm-fad2-1</i> , resulting in silencing of the endogenous omega-6 desaturase gene (<i>FAD2-1</i>).
DD-026005-3	DuPont	High oleic acid soybean produced by inserting a second copy of a portion of the gene encoding omega-6 desaturase, <i>gm-fad2-1</i> , resulting in silencing of the endogenous omega-6 desaturase gene (<i>FAD2-1</i>).
OT96-15	Agriculture & Agri-Food Canada	Low linolenic acid soybean produced through traditional cross-breeding to incorporate the trait from a naturally occurring <i>fan1</i> gene mutant that was selected for low linolenic acid.

Source: AGBIOS

commercialize Plenish soybeans until the first quarter of 2012, after food players have had time to determine what food applications, if any, they want to pursue with Plenish soybeans. "We're being fairly conservative in our commercialization schedule," Sanders says.

The time to market also depends on Pioneer's ability to secure regulatory approval in key global markets, such as Europe, Japan, China, Taiwan and South Korea, Sanders says. The soybean is already approved in Canada and Mexico.

Global regulatory hurdles hampered Dupont's earlier development of a different high oleic acid soybean (Table 1). In 1997, the USDA approved, or deregulated, DD-026005-3—a Dupont soybean with an oleic acid content of 85%. This variety was modified with an extra copy of soybean Δ^{12} -fatty acid dehydrogenase under the control of the soybean β -conglycinin promoter, which triggered silencing of the transgene and its counterpart endogenous gene. But the product fizzled after the company encountered global regulatory complexities associated with the crop's marker technology, says Sanders. Markers are used by crop developers to test whether genetic material is successfully transferred to the host crop. In this case, DD-026005-3 contained the *Escherichia coli uidA* gene, encoding β -glucuronidase as a colorimetric marker, and the *bla* gene, encoding the enzyme β -lactamase as a selective marker that confers resistance to β -lactam antibiotics (such as penicillin and ampicillin).

Pioneer's new high oleic soybean targets the same oleic acid pathway as the 1997 version, but it is hoped that use of a different marker gene, one imparting tolerance to an ALS-inhibitor herbicide, will smooth the regulatory path. (The plant will not be tolerant to ALS-inhibitor herbicides at the levels used in the field.) Sanders says he is "optimistic" about the 2012 regulatory goals.

On Pioneer's regulatory heels are two Monsanto soybean products with modified oil profiles, one with omega-3 fatty acids for

nutrition and the other with enhanced texture and functionality, called high stearic acid soybeans. Monsanto has submitted to the USDA petitions for deregulation of both products. Still in the discovery phase, Dow AgroSciences in Indianapolis, Indiana is developing omega-9 canola and sunflower oils. With one nutritionally altered crop approved and a handful in the pipeline, the public may finally get what it has been promised for two decades. But whether high oleic acid soybeans directly benefit consumers enough to boost public opinion of biotech crops is doubtful, say agriculture experts. "Companies already have methods of removing trans fats" from food, says Jane Rissler, a senior scientist with the Union for Concerned Scientists in Washington, DC. Pioneer is "offering an alternative to those existing methods" without much added benefit to consumers, she says. Alan McHughen, a plant biotechnologist at the University of California, Riverside, notes that: "Those who already despise [genetic modification] will continue to do so, those who accept GM will continue to do so, and most others won't even notice it, as it's not a high-profile whole food with immediate consumer-recognized benefit."

In the US, food companies aren't required to label food derived from genetically engineered crops, and generally don't voluntarily do so.

An April 2010 survey of 750 US consumers asked this question: "All other things being equal, how likely would you be to buy a food product made with oils that had been modified by biotechnology to avoid trans fats?" Seventy-four percent said they were either very likely or somewhat likely to buy this kind of biotech food. However, in a separate question, only 32% of those respondents said they had a favorable impression of biotech food. The survey was conducted by the International Food Information Council Federation in Washington, DC.

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