Health

Biotech foods are still hard to swallow

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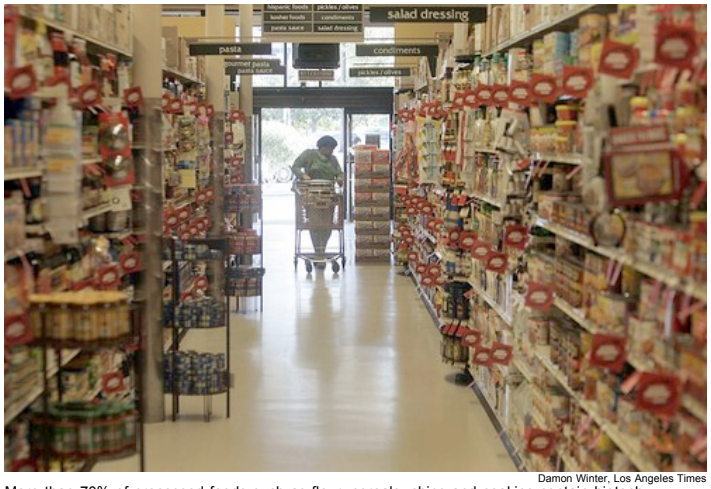

Damon Winter, Los Angeles Times

More than 70% of processed foods such as flour, cereals, chips and cookies contain biotech ingredients.

Hypoallergenic peanuts? Vitamin-rich rice? Calcium-filled potatoes? Biotech companies are working on the next wave of genetically engineered foods, but not without challenges.

By Elena Conis, Special to The Times
October 22, 2007

OPPONENTS call them Frankenfoods, man-made aberrations that should be banished from our grocery stores or at least clearly labeled so consumers know what they're eating.

Supporters have long cast genetically modified foods in a different light: as answers to human problems. They would, the dream went, make crops that didn't rot, spoil or succumb to frost. They would boost harvests, feed the hungry and fortify the malnourished.

Several decades later, very few of those goals have been realized. Yet today, largely unbeknownst to most consumers, more than 70% of processed foods on grocery store shelves contain genetically engineered or biotech ingredients.

For the most part (with the exception of a virus-resistant papaya from Hawaii) you won't find these genetically modified foods (or GMOs) in the produce aisle, but you will find them pretty much everywhere else -- in flours, cereals, margarines, oils, salad dressings, pies, chips, cookies, fried foods and candy coatings. The main sources: oil, flour, sweetener and lecithin. The ingredients come from just three crops -- corn, soy and canola -- and are engineered to do two things: withstand sprayings of herbicides and resist pests.

Biotech companies and public sector labs are working on the next wave of products, including hypoallergenic, heart-healthy, and vitamin-, nutrient- and even pharmaceutical-packed varieties of engineered crops. But this next wave faces significant challenges.

For one thing, biotech products have proven technically difficult and costly to develop. It takes about $100 million and an average of 10 years to bring a new biotech product to the market, says David Stark, vice president for consumer traits at the St. Louis-based agricultural biotechnology company Monsanto.

The foods also face obstacles from consumers. Compared with other parts of the world (notably Europe), GMO foods have met far less opposition in the U.S. But that ready acceptance may be changing.

Over the last few years a growing number of towns and counties (mostly in California) have voted to declare themselves GMO-free, concerned that the food isn't adequately tested and can't be proven safe for the environment and consumers. The towns of Arcata, Santa Cruz and Point Arena and the counties of Marin, Mendocino and Trinity have banned GMOs. You also can't grow GMOs

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in Montville, Maine, or on city land in Boulder, Colo.

Fueled by consumer demand, organic foods, which by law contain no genetically engineered ingredients, now make up the fastest growing segment of the food industry.

Such opposition may slow the introduction of new products with more consumer-focused goals. Peggy Lemaux, a professor of plant and microbial biology at UC Berkeley, spent six years developing a variety of wheat that could be safely eaten by people who have wheat allergies. But when she and a colleague took the engineered wheat to food manufacturers in 2001, "basically, nobody would touch it," she says.

"They were so nervous about what the public perception would be of something that was genetically engineered."

The modifying process

Farmers and scientists have been genetically modifying crops for centuries via conventional breeding -- for instance, mating insect-resistant or fast-growing individuals of a species together to create more resistant or fast-growing offspring.

But genetic engineering differs from conventional breeding in that it allows scientists (not farmers) to achieve results faster and take genes from one species and insert them into the genome of a completely unrelated species.

An oft-cited example: In 1991, scientists extracted a gene for cold-tolerance from a flounder and stuck it into the DNA of a tomato in an effort to make a frost-resistant vegetable. That effort failed, and the fish-gene tomato never made it to market.

This example illustrates the kind of cross-species combination that might occur, but it's not a good example of what's actually on the market.

Roughly 60% of the corn in the U.S. is engineered to contain a gene known as Bt that comes from a bacterium called *Bacillus thuringiensis*. Bt makes a toxin that kills certain insects, including the destructive European corn borer. When the Bt gene is inserted into the corn genome, the corn makes its own bug-killing Bt toxin -- pesticide is built right into the plant.

Nearly 90% of the U.S. soy crop is engineered with other genes taken from bacteria that allow the plant to withstand sprayings of specific weedkillers, or herbicides. Sometimes the chosen genes enable the soy to detoxify weed-killing chemicals; others block the response of the soy plant to the herbicide so it doesn't succumb.

Certain bacteria have the unique ability to infiltrate cells, and they are often used to escort new genes into plants. Alternatively, plants can be engineered using a tool called a "gene gun" in which bullets made of tungsten or gold are coated with the genetic material and then shot into plants' cells at a high speed in hopes that the gene will get incorporated into the plant's genome. In a third method, a shot of electricity makes the plant cell temporarily porous so that the new gene can get into the cell.

But all of these methods leave a fair amount of room for error, which means that genetic engineering can be, much like conventional breeding, a time-consuming, hit-or-miss process, says Michael Hansen, senior scientist with the consumer advocacy organization Consumers Union in Yonkers, N.Y. "You have no idea where you're inserting the material," he says.

In part, this explains why almost the only genetically engineered crops used in food products are engineered for pest- and herbicide-resistance. These "first generation" biotech crops were relative easy to engineer.

The second generation of biotech crops may look more like the harvest originally promised by its proponents several decades ago. Although most are still several years from hitting the market, crops are being engineered to contain things consumers are actually interested in, such as extra vitamins or minerals, healthful omega-3 fatty acids or hypoallergenic proteins.

Engineering such products doesn't always involve splicing genes from one species into another. To engineer a hypoallergenic peanut, scientists at Alabama A&M University inactivated a gene that produces an allergy-inducing protein in peanuts. They reported on the success of their research in the Plant Biotechnology Journal last month.

Scientists are also working on folate-rich tomatoes and calcium dense potatoes. Monsanto is developing a line of bioengineered soybean oils designed to be more healthful than their conventional counterpart. One oil -- made by inactivating genes naturally found in soybeans -- will be lower in saturated fats and have a reduced tendency to produce unhealthful trans fats during processing. Another will be made from soybeans altered to make stearidonic acid (SDA), which the body fairly easily converts into EPA, a beneficial omega-3 fat found in fish.

Undaunted by the hypoallergenic wheat sitting idle in her lab, Berkeley biologist Lemaux is now at

work on improving the nutritional characteristics of a different grain: sorghum. The crop isn't eaten in the U.S., but it's a common part of the African diet.

Supported by the Bill and Melinda Gates Foundation, Lemaux is attempting to increase the amino acids in the grain and make it more digestible. Others funded by the foundation are working to increase sorghum's vitamin and mineral content.

This time around, Lemaux is sure the final product will be well-received. "This is something that would actually mean something to a lot of people," she says.

That doesn't guarantee acceptance, however. In 2000, two European scientists announced that by inserting a daffodil gene (and a few other genes) into rice, they created a grain with 23 times the beta carotene as normal rice. The rice was unveiled as a solution to vitamin A deficiency, which causes blindness in developing countries.

But the rice has faced its share of opposition from critics who contend that the rice couldn't supply enough beta carotene to combat blindness and that if cultivated, it will supplant native rice varieties and erode biodiversity.

Seven years later, the rice (also being supported by the Gates Foundation) is still in development.

"Genetic engineering has some potential to bring benefits to consumers and farmers," says Greg Jaffe, director of the Biotechnology Project at the Washington, D.C.-based Center for Science in the Public Interest. "But it's a slow road to get there."

But will people eat it?

Technical challenges may be formidable, but consumer resistance may prove an even greater challenge for crop engineers to overcome.

In polls, genetically engineered ingredients consistently rank at the bottom of the list of things consumers try to avoid in foods (well below fat, salt and sugar). This is probably due in large part to the fact that most consumers think they've never eaten genetically engineered foods.

Yet at the same time, according to the Pew Initiative on Food and Biotechnology, about half of U.S. consumers say they're opposed to GMOs.

"Many people are hesitant," says Michael Fernandez, former executive director of the initiative, which surveyed consumers on the subject of agricultural biotechnology between 2001 and 2006. "They have questions of safety and ethical questions."

Is there evidence to back up these fears?

Many critics' concerns about genetically modified crops have centered around environmental issues. They argue that a newly engineered species could out-compete native species or that plants engineered to be resistant to weedkillers could inadvertently lead to the evolution of impossible-to-control "super-weeds."

Health concerns have also figured into the debate. Some scientists and food safety advocates have suggested that genetically engineered foods might result in new allergies, harm the immune system or lead to antibiotic resistance.

So far, the evidence for such claims is slim, but some examples do exist.

In the 1990s, Food and Drug Administration scientists warned that genetic engineering could result in new allergens because the introduction of new genes into a plant -- or even inserting a gene in a new place in the plant's genome -- could result in the plant making new or larger-than-normal amounts of proteins. (Allergic reactions, including itching and anaphylactic shock, are often triggered when the immune system encounters a foreign protein.)

In some cases, new allergens have, in fact, been created, although the end products of such tinkering haven't made it to market. In a widely cited example, scientists in 1996 inserted a Brazil nut gene into soybeans to make the bean more nutritious. The result was a soybean that triggered nut allergies, and the Brazil nut-soybean project came to a screeching halt.

In 2000, traces of a genetically modified corn called Starlink -- unapproved for human use because it contained a protein that hadn't been ruled out as an allergen -- inadvertently made its way into the food supply.

The unapproved corn ended up in, among other places, taco shells made by Kraft Foods. Dozens of consumers reported allergic reactions after they heard about the contamination. But when Centers for Disease Control and Prevention investigators attempted to correlate consumers' symptoms with consumption of Starlink, they couldn't find a link.

Today, researchers are highly vigilant about the possibility of introducing potential allergens into

the food supply, says Monsanto's Stark. One of the first things scientists do after identifying a gene with desirable characteristics, he says, is make sure it doesn't produce allergens. "If it even has the potential, it's dead. It doesn't go into the plant."

Risks are unclear

Another reason genetically engineered food is likely to be safe comes from the way it is used in our foods, says Jaffe of the Center for Science in the Public Interest. Most of the genetically engineered food consumed in this country is eaten processed -- in the form of high fructose corn syrup and vegetable oils, for example -- and not whole. Processing destroys much of the proteins and other products of genetic toying around that might otherwise have posed some health risk, Jaffe says.

Evidence from animal studies also suggests that genetically engineered crops could affect the immune system in unforeseen ways, but studies are few and far between (and limited to creatures with four legs).

In 2005, Australian scientists published findings that when a pea was engineered to include a gene from a bean to make it pest-resistant, the resulting pea caused immune reactions in mice. When mice ate, inhaled or were injected with meal made from the engineered peas, they suffered swelling and inflammation just about everywhere.

There's another, largely theoretical concern about genetically engineered foods: that they're toxic.

Many plants, such as potatoes, tomatoes and celery, manufacture their own toxic chemicals to ward off pests. In large amounts, these toxins can be harmful to humans too.

Critics argue that, in theory, at least, the inexact nature of gene insertion could cause mutations that could make a plant make an unexpected high level of toxins.

But conventional breeding can accomplish the same: Celery is sometimes selectively bred for high levels of psoralens, chemicals the plant makes to fight off disease, and that can cause rashes in farmers and produce aisle workers.

Also on the list of health concerns is the possibility that genetic engineering can exacerbate antibiotic resistance. To ensure that a desired gene (say, for making Bt toxin) has made it into the DNA of a target plant such as corn, scientists will sometimes insert the desired gene along with a gene for antibiotic resistance, too -- because resistance is easy to determine.

Today, the use of antibiotic-resistance genes is slowly (and at the urging of the FDA) being phased out.

Lemaux says biotech crops are extensively tested through multiple generations to ensure that they're stable and safe. And Michael Doane, director of public affairs for Monsanto, adds that genetically engineered crops have been grown and consumed around the world for more than a decade without incident.

The reason, he says: "There's a very, very comprehensive review process before a crop is commercialized."

That review process isn't comprehensive enough for many critics, particularly those who point to the environmental risks associated with GMOs.

Plant pollen and seeds scatter easily, carried by wind, bees and birds, which means that it's easy for engineered crops to cross-pollinate with, and possibly out-compete, wild species.

Earlier this year, federal Judge Charles Breyer issued a ruling that put a halt to the growing of genetically engineered alfalfa. Breyer ruled that the U.S. Department of Agriculture, which oversees field testing of genetically engineered crops, gave the green light to a variety of herbicide-resistant alfalfa prematurely saying it hadn't addressed the crop's potential to contaminate nonengineered and organic alfalfa and create super-weeds.

A call for oversight

Starlink aside, there's plenty of reason to think genetically engineered plants can turn up where they're not wanted. In 2004, scientists found that genetically engineered golf course grass in Oregon cross-pollinated with natural grass more than a dozen miles away.

In 2006, the USDA announced that an unapproved variety of genetically engineered long-grain rice had contaminated nonengineered rice fields in five Southern states.

Events such as these have led critics to say that far more government oversight of genetically engineered foods is needed.

Today, genetically engineered crops are regulated in part by the Environmental Protection Agency,

in part by the USDA and in part by the FDA. The EPA steps in when a crop is engineered to make a pesticide or herbicide. The USDA oversees the field testing that goes on before a biotech crop can be considered for the food supply. And the FDA takes over to make sure a new crop is safe for humans to eat.

The FDA accomplishes that through a voluntary consultation process in which companies developing new crops voluntarily submit the results of their safety testing to the agency. The agency reviews the company's data and then responds with questions or concerns.

On the whole, the FDA does not consider bioengineered foods to pose any risks beyond those posed by conventional foods, said FDA public affairs specialist Stephanie Kwisnek. In addition, "the agency believes that companies are cooperating with the voluntary system," Kwisnek stated via e-mail.

Some think this process is sufficient. Jaffe points out that it's similar to the type of regulation that applies to pharmaceuticals. His organization, Center for Science in the Public Interest, reviewed the safety data on genetically engineered soy, corn and canola submitted to the FDA. "We concluded that the current crops on the market aren't harmful to humans," he says.

In other words, even though the process is voluntary, it appears to be working, for now. Lemaux says that makes sense. Companies, she says, have an incentive to make sure their engineered products are safe. "In the end, who's going to get sued? It's not the FDA or the EPA."

But Hansen of the Consumers Union and others say that safety testing isn't adequate because it isn't standardized across the industry and isn't necessarily done well. French scientists this year published results of a reanalysis of the safety data collected by Monsanto on a variety of transgenic corn. Monsanto concluded the corn was safe, but when the French scientists looked at the data, they found evidence of decreased weight, liver toxicity and increased levels of blood lipids in rats.

Those kinds of discrepancies have led advocates to call for government-led, premarket testing of genetically engineered foods. "The public deserves an independent regulator," Jaffe says.

Others, meanwhile, such as Andrew Kimbrell, executive director of the Center for Food Safety, a consumer advocacy group, press for food labels so that consumers can have the choice whether to eat biotech foods or avoid them -- be it for health concerns, environmental reasons or both.

"Not a single American," Kimbrell says, "is getting up in the morning and saying 'Boy, I can't wait to go out and buy some genetically engineered food.' "

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