

2003

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Recommended Citation

Kathleen Hart, *An Introduction To Genetically Modified Foods*, 10 Rich. J.L. & Tech 6 (2003).

Available at: <http://scholarship.richmond.edu/jolt/vol10/iss2/1>

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AN INTRODUCTION TO GENETICALLY MODIFIED FOODS

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Cite as: Kathleen Hart, *Symposium: An Introduction to Genetically Modified Foods*, 10 RICH. J.L. & TECH. 6 (2003), at <http://law.richmond.edu/jolt/v10i2/article6.pdf>.

{1} Thank you. I have been visiting a lot of bookstores since *Eating in the Dark* came out last year, including a wonderful bookstore, I should mention, which is right here in Richmond called the Fountain Bookstore. People often ask me if I've changed my diet as a result of what I learned while researching the book. Mainly, have I stopped eating genetically engineered foods? I always answer that I'm an American, so of course I eat genetically engineered foods because we have no choice in the matter. GM foods are ubiquitous in the processed foods, and they're not labeled. But I noticed your organizers did a wonderful thing today – they decided to have a GM buffet and a non-GM food buffet. The organizers gave people here a choice that Americans never generally have, so my kudos.

{2} Around the world, including here in the U.S., GM foods are in many ways on trial – in laboratories where researchers are cloning farm animals and creating mega-salmon, in the channels of trade, and in the court of public opinion. The jury is still out on whether genetically engineered foods will prove safe for human health and the environment in the long term and whether today's GM crops will have lasting benefits for farmers or help to feed the world's poor. For two decades biotech companies have been promising consumers terrific new products: peanuts that won't cause allergies, crops that will thrive in poor soils and have higher yields, and vegetables that will fight cancer. The list of dreams is long, but the list of foods that have made it to the marketplace, at least so far, is very short.

{3} Nearly all of the GM crops grown today are engineered either to produce or withstand heavy doses of pesticides, which are traits designed to benefit farmers. So I want to first give you some background on how GM foods were introduced into our diet because I think that's had a lot to do with how they've been received in society. I will then touch a little on unresolved questions and share with you some of the emerging problems with pharm crops, that's p-h-a-r-m, not f-a-r-m, which are food plants that scientists have engineered to produce drugs and vaccines.

{4} I first learned about genetically modified foods in May 1997 when I had taken a reporting job with *Food Chemical News* – not exactly a *People Magazine* publication, but it was along the lines of the reporting I've done in science, technology, and the environment. I was covering a story on a threatened European boycott of U.S. soybeans, so I called one of my EU sources that told me grocery store owners didn't want U.S. soybeans to be mixed with genetically modified soybeans.

{5} When I asked "What's that?," he said, "GMO's of course, don't you know?" as if I'd been living under a cabbage leaf. I had to admit that I did not. Like most Americans in 1997, I had never heard of the term GMO, which incidentally means genetically modified organism. As I learned from scientists, these new patented soybeans were engineered in the laboratories of the chemical company Monsanto to tolerate dousing by the company's top selling weed killer called RoundUp. The RoundUp Ready



soybeans contained genes from bacteria, viruses, and petunias, and these genes helped the plant to change its metabolism so that it could withstand the application of RoundUp.

{6} Throughout Europe customers were apprehensive about eating these strange new foods and wanted them labeled. In Austria, 1.2 million citizens, about one-fifth of the nation's adults, had signed a petition in April calling on the government to stop releasing GMO's into the food chain. Fifteen grocery store chains in the United Kingdom, France, Denmark, Sweden, Germany, and Switzerland had just signed an open letter to U.S. Commodity Agri-Business pleading with growers here and shippers to separate genetically modified corn from regular corn and genetically modified soybeans from regular soybeans. So when I called Monsanto, a spokesman there told me that it would be impossible to segregate RoundUp Ready soybeans from regular soybeans because throughout the corn belt, the soybeans are harvested using the same combines, stored in the same grain elevators, moved on the same conveyor belts, and processed together for livestock feed and human food. So then I called USDA, and there an assistant to then Agriculture Secretary Dan Glickman assured me that genetically engineered soybeans and corn are nutritionally the same as regular soybeans and corn. The Europeans were basing their objections not on science, he said, but on emotion.

{7} When I called the Food and Drug Administration, a spokesperson there told me that there's no substantial difference between genetically engineered foods and their conventional counterparts, so there was no reason to differentiate and label them. In the view of the FDA, a tomato is still a tomato, even if it contains genes from a virus and firefly, for instance. Now intuitively you might wonder how an ear of corn, to take another example of a common GM food, which contains foreign genes that allow the corn to kill European corn borers, is the same as a regular ear of corn that side by side in the field, without those genes inserted, does not kill insects. You would be in good company, because regulators and millions of consumers around the world have questioned the FDA's premise that the process of shooting foreign genes into food plants neither changes them substantively nor raises any inherent safety questions. Indeed, strangely, the U.S. patent office deems genetically engineered varieties different enough from conventional plants produced by conventional plant breeders to the extent that the growers are awarded patents for the genetically engineered plants.

{8} Under a policy issued in 1992 by the first Bush administration, companies were not required to perform special safety testing or to conduct any human feeding studies on new genetically engineered foods. By contrast, the FDA requires extensive safety testing and clinical trials before approving biotech drugs. Whenever I traveled to Europe to cover science meetings, I encountered an impassioned debate with the ecologists, doctors and ordinary citizens wondering aloud "Why do we need these GM foods?" and "What if some problems are found with these crops in the future?" An Irishman reminded me that thalidomide had seemed safe enough when it was first prescribed, and that scientists had no inkling how harmful DDT would be to humans and wildlife when it was first used. By 1962 though, when Rachel Carson warned in *Silent Spring* that DDT and other pesticides were unleashing an epidemic of cancer across America, the bald eagle was already on the brink of extinction, and that was in about two decades.

{9} The Europeans I talked to did not sound irrational or emotional, as U.S. regulators claimed. Rather, they seemed cautious about the wisdom of letting genetic engineers and a handful of chemical companies tinker with their basic foods. Also, British consumers, as I'm sure you're aware, had recently witnessed their own regulators backpedaling mightily from their initial position on the safety of eating beef from cows infected with Mad Cow disease, so there was not a lot of confidence in scientists and regulators in Europe at that time.

{10} When I would return from trips to Europe in 1997, 1998, and right through 1999, no one I talked to here, teachers, journalists, or even lawyers, had heard of GM foods. In fact a national poll in February 1999 found that two-thirds of Americans did not know that supermarkets were selling genetically modified foods. Only three percent (3%) of Americans knew they were eating food made with gene altered soybeans, and only six percent (6%) knew they were eating GM corn. Yet at that time one-quarter of our corn crop was being engineered to produce pesticides and about half our soybeans were modified to withstand applications of the herbicide RoundUp. By contrast, at that time, the European Commission Ministers had already proposed mandatory labeling of GM foods. What finally brought GM foods to the attention of the U.S. media was an experiment conducted by John Losey, an entomologist at Cornell University. He decided to find if pollen from genetically engineered Bt corn would affect monarch butterflies. Bt is short for *Bacillus thuringiensis*, which is a naturally occurring soil bacterium that kills insects, and a lot of organic gardeners use it in its natural form.

{11} As you may remember from biology class, monarch caterpillars feed exclusively on milkweed leaves, and Losey, while tromping around fields in upstate New York near Cornell, had noticed a lot of milkweed plants growing around the edges of corn fields. So, in a lab, he fed milkweed leaves to three groups of monarch caterpillars. The first group ate leaves dusted with genetically engineered Bt corn pollen, a second group ate leaves coated with regular corn pollen, and a third group ate leaves with no pollen. Well, at the end of four days, forty-four percent (44%) of the caterpillars eating leaves dusted with Bt corn pollen were dead. None of the caterpillars eating either plain milkweed leaves or leaves dusted with regular corn pollen were dead. Losey did not know at the time of his experiment what effects Bt corn would have on monarchs in natural settings; this was just a laboratory experiment. In fact, later studies performed by scientists in the two subsequent years ultimately found that only one variety of Bt corn sold in the U.S., which had luckily been planted on only a small percentage of U.S. acreage, produced toxins at high enough levels to kill butterflies in the wild, so that seems to have been not the problem that many thought initially.

{12} But on May 20, 1999, when Dr. Losey's study appeared in the journal *Nature*, no ecological investigations had yet been done on the effects of GM corn. There were none in the literature. Consumers and government officials from Tokyo to Toronto found the study unsettling. One Canadian environment official I talked to called it scary since he had assumed that the pollen from genetically engineered corn did not contain the active Bt toxin when, in fact, it does. EU officials promptly halted approvals of all pending applications for genetically engineered seed corn. In Japan, Korea, and Australia, the public started asking to see scientific evidence proving the long term safety, and ecological safety of biotech crops. Getting back to the FDA's regulatory scheme, that didn't require such safety testing, they learned that the government had not required such studies, and then consumers throughout the Asia Pacific region also demanded mandatory labels on GM foods. U.S. consumer groups also started looking into GM foods in the summer of 1999.

{13} In September of 1999 *Consumer Reports* published a list of foods that it had purchased in American grocery stores that tested positive for genetically modified ingredients. Three infant formulas tested positive, as did several popular foods, such as bacon bits, tortilla chips, and taco shells. At that time incidentally, I went to my niece's one-year birthday party, and while I was visiting, after I fed her, I was putting her formula away in the cupboard and I noticed that soybeans were one of the main ingredients in the formula. My sister had no idea it contained genetically engineered soybeans that so far had been tested only on cows, chickens, and quail and had never gone through human feeding studies. It was really at that point that I decided to undertake writing a book to at least inform Americans about genetically engineered food.





{14} I would try to tell both what the scientists who advocated the foods and those who opposed the foods believed. At least it will get the word out there because Americans still don't know about genetically engineered food. In fact, a lot of the people that you talk to when you mention genetically engineered food think you're talking about those big giant strawberries that we have that are about the size of tennis balls, but those are just really the results of conventional breeding, they're not anything to do with having had genes inserted. In fact, the Grocery Manufacturers of America estimates that two-thirds of the processed foods in the U.S. contain GM ingredients, mostly in the form of soybeans and corn. If you look on the labels of the foods in your cupboards and refrigerator, you can find soy oil and soy lectafine in such items as bread, mayonnaise, ice cream, and even dog food. A host of cereals and snack foods contain corn starch or high fructose corn syrup – even Coca-Cola, my personal favorite, contains high fructose corn syrup. Another GM food still on the market is canola oil. There's a lot of GM canola grown, particularly in Canada.

{15} In the late 1990's, genetically engineered Bt potatoes were also part of our diet, but Monsanto withdrew them from the market 2001 after McDonald's and Procter & Gamble decided not to use them because they were afraid of consumer sentiments about eating genetically engineered french fries and potato chips. There are also a few other genetically modified foods that we eat, but not too many. There's some GM squash and some GM papayas on the market that were engineered to resist plant diseases.

{16} Sales of organic foods have been surging, albeit it's a small segment of the food industry to begin with, but the sales have been increasing at about twenty percent (20%) a year, in large measure because the organic industry pledges not to use GM ingredients. Organic dairy products made from dairy herds that were not injected with the genetically engineered bovine growth hormone have also grown in popularity. This form of milk and other dairy products made from milk that has been injected with genetically engineered growth hormone are the other primary source of GM ingredients in our diet. I've been told about one-third of our dairy herd has been injected with this hormone, but most dairies pool cow's milk, so it's believed to be pretty widespread unless you buy organic.

{17} In May 2000 the FDA held nine focus groups across the country to gauge public opinion of GM foods in the U.S. When told that more than sixty percent (60%) of the processed foods contained genetically engineered ingredients, participants, many of whom are college educated, were outraged. I will read you just briefly from the FDA report on those focus group meetings. "Some participants remarked that bio-engineered food had been snuck into the food supply. They were mainly disturbed by the lack of public information and public input to a major development in the quality of their food supply. Some participants saw this as evidence of a conspiracy to keep consumer in the dark; that is, the rationale for not informing the public must that there is something to hide." So clearly consumers around the globe, and even some consumer here in the U.S., are skittish about GM foods. The question is: "Do they need to be?" Regulators at the Food and Drug Administration, the Environmental Protection Agency, and the USDA think not. As evidence of the safety of GM foods, U.S. regulators often point to the fact that 280 million Americans have been eating this food on a regular basis since 1997 when it was first harvested with no apparent harm.

{18} Some doctors are not so sure though. Martha Herbert, a pediatric neurologist at Massachusetts General Hospital and Harvard Medical School, said that "no long term studies of the impact of genetically modified foods on the health and development on babies, the sick, or the elderly have been done. The promoters of this uncontrolled experiment on people and nature have no scientific grounds for claiming the substances are safe." On the other side of the Atlantic, the British Medical

Association, with more than 115,000 members, has issued papers on two occasions saying that it's too soon to know "whether there are any serious risks to the environment or to human health involved in producing GM crops or consuming GM foods." Some European researchers have raised concerns that the antibiotic resistant bacteria genes used to make GM foods will increase resistance of infectious diseases to treatment by antibiotic drugs, and incidentally, the CDC has said that this is a serious emerging problem in America; people are dying in hospitals because of antibiotics not treating infections that they used to treat.

{19} I don't know of any studies though, directly linking the antibiotic resistance to GM foods, and people are looking more to overuse by physicians and perhaps the widespread use of antibiotics in animals in the U.S. more as the cause. Nonetheless, as with many aspects of this technology, it's so new that all of these lines have not been investigated and scientists tell me there isn't always funding to perform these kinds of investigations.

{20} Brian Ellis, a biochemist at the University of British Columbia, thinks that the chances of a negative impact from these new foods are very, very small. Nonetheless, he said, "The fact that very, very small chance never materialized so far you would have to just put down to luck." Dr. Ellis told me he believes that these foods may sail along relatively unscathed for some period of time but then sooner or later something will pop up that no one could have predicted. Even scientists I've talked to who promote GM foods acknowledge that our understanding of genetic engineering is in its infancy and that scientific uncertainties abound.

{21} You need only look at the human genome mapping projects that scientists developed. First, scientists thought we had 80,000 genes and then eight months later there was an announcement at the White House that maybe humans only have 30,000 genes, and six months later someone published a study saying that 30,000 might be too low, it might be 50,000. In other words, genetics is in its infancy. This isn't to say that one day we won't have a greater understanding, but there are uncertainties now. One of these uncertainties is that when foreign genes are inserted in to a food plant or a fish, or an animal, the genes direct the organism to make proteins that it never made before. Scientists have no way, with current knowledge, to predict with certainty whether these new proteins will cause serious allergic reactions in susceptible people.

{22} In the fall of 2000, there was a mishap with one such food; a genetically engineered corn that EPA had approved only for chicken and hog feed made its way into the food stream. The corn, called StarLink, contains a pesticide protein, actually called Cry9C, that the EPA convened on three occasions thorough panels of allergy experts from NIH and from around the world to try to determine whether the properties of this protein would be likely to cause allergies in humans. The panels decided that this protein in StarLink corn was similar to know allergens such as peanuts and shellfish, but the StarLink corn got into regular corn. You might have read about this, as it made a lot headlines. It led to a massive food recall of over 300 food items, particularly, taco shells at the time.

{23} In a totally different kind of food crisis last summer, Zambia refused to accept food aid offered in the form of GM corn from the U.S., even though the country was in the midst of a severe famine. Zambian officials worried about long term health problems from the food and lack of enough safety studies, but equally they worried about the future of their food exports to Europe, and they were worried that these exports would be jeopardized if native African corn stalks were to become contaminated with genetically modified corn. While the State Department accused the Europeans of fostering a humanitarian catastrophe on the African continent, in another international food dispute, U.S. growers have been pushing the Bush Administration to sue the Europeans in the World Trade



Organization for refusing for years now to approve new GMO's. The U.S. charges that there's no scientific evidence that bio-engineered foods are any less safe than regular foods. So, this is a barrier to trade, the U.S. contends. The administration decided last month though to hold off on a WTO suit while President Bush was trying gain support in Europe for the U.S. war against Iraq, but this issue is far from resolved and will be one you'll want to look for in the future.

{24} This fall a problem came to light with another kind of GM food and that's pharm crops, p-h-a-r-m. Corn is one of the primary food crops scientists have altered to produce drugs, including blood thinners, blood clotters, a hepatitis vaccine, a diabetes drugs, and even a male contraceptive protein. Since 1992 food crops containing these experimental drugs have been grown on farms in the open at more than 300 undisclosed locations across the U.S. The way the rules are written now, I as a journalist and you as a citizen cannot call the USDA to find what's in the crops and where the crops are grown because that's considered confidential business information. This trumps consumer desires to know what this stuff is and where it's growing, at least at the moment.

{25} These experimental crops should be destroyed at the end of each test growing season, but last fall some straggler corn stalks, called volunteers for when they pop up the following year after they've been planted, appeared. The next year the farmer who had been growing the test pharmaceutical crops, designed to make a vaccine that fights a pig virus, planted soybeans. Anyway, the stragglers were harvested in soybean field and sent to a grain elevator in Nebraska. The pharmaceutical corn was fortunately detected by the USDA inspectors, who quickly quarantined the silo. Nevertheless, it was a wake-up call for the U.S. food industry. Can you imagine the headlines if antibodies for herpes end up in kids' cereals, or if male contraceptive proteins find their way into your tortilla chips? There's a host of issues with genetically modified foods which I don't really have time to get to, but we'll get to these and a host of issues in today's program.

{26} One of these issues, which I talk about in my book, is liability. Who pays the damages when a GM food ends up on the dinner plate of an unsuspecting consumer and causes a life threatening allergic reaction? Who pays the damages when an organic farmer is surrounded by a field where genetically engineered corn is being grown and when wind carries the pollen onto his field, cross-contaminating his crops so he can no longer sell his organic corn chips to markets that demand GM-free corn? Who is responsible? I think some of you lawyers will find some interesting liability issues coming up in the future.

{27} GM wheat is also looming on the horizon. If the federal government gives biotech companies the go ahead to market genetically engineered wheat, all of our bread, pasta, bagels, noodles, cakes – our very staff of life – will become engineered. Yet isn't this something citizens should have a say about? Another upcoming issue in the U.S. is labeling. An ABC news poll found that ninety-three percent (93%) of Americans, that's nearly everyone, believe that the federal government should require labels on GM foods. So far the biotech and food industries have blocked labeling efforts, but ballot initiatives, like the one put to a test in Oregon in November 2002, will likely be seen in future elections.

{28} In conclusion I will say that the debate on GM foods is as polarized as the other highly charged moral and political issues of our day – from abortion, to global warming, to the U.S. invasion of Iraq. People who think that the controversies roiling around genetically engineered foods is a tempest in a teapot or will soon go away are kidding themselves. I think that the contentious issues behind us could very well be dwarfed by those that lie ahead, keeping GM foods on trial for decades to come. Thank you.

* Kathleen Hart is a journalist who has been writing about health and the environment for more than fifteen years. She has covered agriculture and biotechnology for *Food Chemical News*, published by CRC Press, and has written for McGraw-Hill's energy publications. Her book, *Eating in the Dark: America's Experiment with Genetically Engineered Food*, was published in 2002 by Pantheon. A graduate of the University of Massachusetts, Amherst, her articles have appeared in *The Boston Globe*, *Bulletin of the Atomic Scientists* and other newspapers and magazines. She has appeared as a guest on numerous television and radio stations throughout the United States and Canada, including interviews on National Public Radio and C-SPAN TV. She lives in Washington, D.C.

