

# GMOs in foods

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## **The Basics:**

### **What's a GMO?**

A GMO (genetically modified organism) is the result of a laboratory process of taking genes from one species and inserting them into another in an attempt to obtain a desired trait or characteristic, hence they are also known as transgenic organisms. This process may be called either Genetic Engineering (GE) or Genetic Modification (GM); they are one and the same.

### **But haven't growers been grafting trees, breeding animals, and hybridizing seeds for years?**

Genetic engineering is completely different from traditional breeding and carries unique risks.

In traditional breeding it is possible to mate a pig with another pig to get a new variety, but is not possible to mate a pig with a potato or a mouse. Even when species that may seem to be closely related do succeed in breeding, the offspring are usually infertile—a horse, for example, can mate with a donkey, but the offspring (a mule) is sterile.

With genetic engineering, scientists can breach species barriers set up by nature. For

example, they have spliced fish genes into tomatoes. The results are plants (or animals) with traits that would be virtually impossible to obtain with natural processes, such as crossbreeding or grafting.

### **What combinations have been tried?**

It is now possible for plants to be engineered with genes taken from bacteria, viruses, insects, animals or even humans. Scientists have worked on some interesting combinations:

- Spider genes were inserted into goat DNA, in hopes that the goat milk would contain spider web protein for use in bulletproof vests.
- Cow genes turned pigskins into cowhides.
- Jellyfish genes lit up pigs' noses in the dark.
- Artic fish genes gave tomatoes and strawberries tolerance to frost.
- Potatoes that glowed in the dark when they needed watering.
- Human genes were inserted into corn to produce spermicide.

Current field trials include:

- Corn engineered with human genes (Dow)
- Sugarcane engineered with human genes (Hawaii Agriculture Research Center)
- Corn engineered with jellyfish genes (Stanford University)
- Tobacco engineered with lettuce genes (University of Hawaii)
- Rice engineered with human genes (Applied Phytologics)
- Corn engineered with hepatitis virus genes (Prodigene)

### **What is a gene?**

Every plant and animal is made of cells, each of which has a center called a nucleus. Inside every nucleus there are strings of DNA, half of which is normally inherited from the mother and half from the father. Short sequences of DNA are called genes. These genes operate in complex networks that are finely regulated to enable the processes of living organisms to happen in the right place and at the right time.

### **How is genetic engineering done?**

Because living organisms have natural barriers to protect themselves against the introduction of DNA from a different species, genetic engineers have to find ways to force the DNA from one organism into another. These methods include:

- Using viruses or bacteria to "infect" animal or plant cells with the new DNA.
- Coating DNA onto tiny metal pellets, and firing it with a special gun into the cells.
- Injecting the new DNA into fertilized eggs with a very fine needle.
- Using electric shocks to create holes in the membrane covering sperm, and then forcing the new DNA into the sperm through these holes.

### **Is genetic engineering precise?**

The technology of genetic engineering is currently very crude. It is not possible to insert a new gene with any accuracy, and the transfer of new genes can disrupt the finely controlled network of DNA in an organism.

Current understanding of the way in which DNA works is extremely limited, and any change to the DNA of an organism at any point can have [side effects](#) that are impossible to predict or control. The new gene could, for example, alter chemical reactions within the cell or disturb cell functions. This could lead to instability, the creation of new toxins or allergens, and changes in [nutritional value](#).

### **Does the biotech industry hold any promise?**

Genetic modification of plants is not the only biotechnology. The study of DNA does hold promise for many potential applications, including medicine. However, the current technology of GM foods is based on obsolete information and theory, and is prone to dangerous side effects. Economic interests have pushed it onto the market too soon.

Moreover, molecular marker technologies - so called Marker Assisted Selection (MAS) used with conventional breeding shows much promise for developing improved crop varieties, without the potentially dangerous side effects of direct genetic modification.

### **GMOs in Foods:**

#### **What kinds of traits have been added to food crops?**

Although there are attempts to increase nutritional benefits or productivity, the two main traits that have been added to date are herbicide tolerance and the ability of the plant to produce its own pesticide. These results have no health benefit, only economic benefit.

Herbicide tolerance lets the farmer spray weed-killer directly on the crop without killing it.

Crops such as Bt cotton produce pesticides inside the plant. This kills or deters insects,

saving the farmer from having to spray pesticides. The plants themselves are toxic, and not just to insects. Farmers in India, who let their sheep graze on Bt cotton plants after the harvest, saw thousands of sheep die!

### **Why do genetically engineered foods have antibiotic resistant genes in them?**

The techniques used to transfer genes have a very low success rate, so the genetic engineers attach "marker genes" that are resistant to antibiotics to help them to find out which cells have taken up the new DNA. These marker genes are resistant to antibiotics that are commonly used in human and veterinary medicine. Some scientists believe that eating GE food containing these marker genes could encourage gut bacteria to develop antibiotic resistance.

### **What are the problems created through genetic engineering of food and crops?**

Genetic engineers continually encounter unintended side effects – GM plants create toxins, react to weather differently, contain too much or too little nutrients, become diseased or malfunction and die. When foreign genes are inserted, dormant genes may be activated or the functioning of genes altered, creating new or unknown proteins, or increasing or decreasing the output of existing proteins inside the plant. The effects of consuming these new combinations of proteins are unknown.

### **What foods are GM?**

Currently commercialized GM crops in the U.S. include soy (91%), cotton (88%), canola (80-85%), corn (85%), Hawaiian papaya (more than 50%), zucchini and yellow squash (small amount), and tobacco (Quest® brand). About half of the sugar beets grown for sugar in 2008 were GM and current projections are that about 90% grown in 2009 will be GM.

### **What are other sources of GMOs?**

Products derived from the above, including oils from all four, soy protein, soy lecithin, cornstarch, corn syrup and high fructose corn syrup among others. Also:

- meat, eggs, and dairy products from animals that have eaten GM feed (and the majority of the GM corn and soy is used for feed);
- dairy products from cows injected with rbGH (a GM hormone);
- food additives, enzymes, flavorings, and processing agents, including the sweetener aspartame (NutraSweet®) and rennet used to make hard cheeses; and
- honey and bee pollen that may have GM sources of pollen.

## **The Health Dangers:**

### **What are the potential dangers of eating GM foods?**

There are a number of dangers that broadly fall into the categories of potential toxins, allergens, carcinogens, new diseases, antibiotic resistant diseases, and [nutritional](#) problems.

[View](#) all 65 health risks of GM foods, excerpted from Jeffrey Smith's comprehensive book Genetic Roulette: The Documented Health Risks of Genetically Engineered Foods. [Other References](#)

### **Hasn't research shown GM foods to be safe?**

No. The only feeding study done with humans showed that GMOs survived inside the stomach of the people eating GMO food. No follow-up studies were done.

Various feeding studies in animals have resulted in potentially pre-cancerous cell growth, damaged immune systems, smaller brains, [livers](#), and testicles, partial atrophy or increased density of the liver, odd shaped cell nuclei and other unexplained anomalies, false pregnancies and higher death rates.

### **But aren't the plants chemically the same, whether or not they are GM?**

Most tests can't determine the differences at the level of the DNA. And, even if they appear to be the same, eyewitness reports from all over North America describe how several types of animals, including cows, pigs, geese, elk, deer, squirrels, and rats, when given a choice, avoid eating GM foods.

### **Haven't people been eating GM foods without any ill effect?**

The biotech industry says that millions have been eating GM foods without ill effect. This is misleading. No one monitors human health impacts of GM foods. If the foods were creating health problems in the US population, it might take years or decades before we identified the cause.

### **What indications are there that GM foods are causing problems?**

Soon after GM soy was introduced to the UK, soy allergies skyrocketed by 50 percent.

In March 2001, the Center for Disease Control reported that food is responsible for twice the number of illnesses in the U.S. compared to estimates just seven years earlier. This increase roughly corresponds to the period when Americans have been eating GM food.

Without follow-up tests, which neither the industry or government are doing, we can't be absolutely sure if genetic engineering was the cause.

### **What about GM hormones in milk?**

Milk from rBGH-treated cows contains an increased amount of the hormone IGF-1, which is one of the highest risk factors associated with breast and prostate cancer, but no one is tracking this in relation to cancer rates.

### **Why do genetically engineered foods have antibiotic resistant genes in them?**

A. The techniques used to transfer genes have a very low success rate, so the genetic engineers attach "marker genes" that are resistant to antibiotics to help them to find out which cells have taken up the new DNA. That way scientist can then douse the experimental GMO in antibiotics and if it lives, they have successful altered the genes. The marker genes are resistant to antibiotics that are commonly used in human and veterinary medicine. Some scientists believe that eating GE food containing these marker genes could encourage gut bacteria to develop antibiotic resistance.

### **But is there any documented instance of adverse effects of GMOs on people?**

One epidemic was rare, serious, and fast acting, and therefore more easily discovered. Called EMS, it was traced to a GM brand of the food supplement L-tryptophan. In the 1980's, the contaminated brand killed about 100 Americans and caused sickness or disability in about 5,000-10,000 others.

### **Why are children particularly susceptible to the effects of GM foods?**

Children face the greatest risk from the potential dangers of GM foods for the same reasons that they also face the greatest risk from other hazards like pesticides and radiation, these include:

- Young, fast-developing bodies are influenced most.
- Children are more susceptible to allergies.
- Children are more susceptible to problems with milk.
- Children are more susceptible to nutritional problems.

- Children are in danger from antibiotic resistant diseases.

### **How dangerous, or potentially dangerous, are GM foods relative to other food dangers, e.g., pesticides, irradiation, additives, preservatives?**

Since so little research has been done on the safety of GM foods, it is not possible to rank its risks. Unlike the others, GM crops persist in the environment, and may continue to pose risks to health for centuries.

In addition, transfer of transgenes to gut bacteria may present long-term chronic exposure, since the foreign protein may continued to be produced inside of us after we no longer consume the GM food.

### **Dangers to the environment and traditional agriculture:**

#### **What is the effect of growing GM crops on the environment?**

Studies have shown that pesticide-producing crops contaminate nearby streams, possibly affecting aquatic life. They may harm beneficial insects too.

As weeds adapt to herbicides, they develop resistance and evolve into what are called "super weeds." When that happens, herbicide use increases and the benefits of herbicide resistant crops are diminished, if not lost.

#### **Can the growing of GM crops effect nearby crops?**

Pollen from GM crops can contaminate nearby crops of the same type, except for soy, which does not cross-pollinate. In fact, virtually all heritage varieties of corn in Mexico (the origin of all corn) have been found to have some contamination. Canola and cotton also cross-pollinate.

#### **Why is there an effort to create GM-free agricultural zones?**

Using identity preservation (IP), farmers keep crop varieties separate from others to meet purity requirements of their buyers. Contamination is a key challenge to IP growers. Unwanted varieties may cross-pollinate or get mixed up in the seed, harvest equipment, or during storage and transport.

Some farm regions create entire zones that exclude unwanted varieties, where all the farms, and if possible all collection and distribution points, only handle approved grain.

### **Have any local efforts in the US been successful?**

There are local efforts throughout the U.S. that are raising public awareness, changing laws, and creating commitments to non-GM ingredients. Most notably, voters in Mendocino and Marin Counties in California passed ballot initiative to ban GM crops.

Officials in Trinity County and Arcada California have passed ordinances banning the outdoor cultivation of GM crops as well. But since then, a California law was passed prohibiting this type of local initiatives.

In March 2008, voters at the Montville, Maine, annual town meeting overwhelmingly passed a binding ordinance banning the cultivation of GM crops in their community.

### **Is it possible that organically grown crops can be infected by GM genes?**

Yes. Organic standards do not allow the use of GM seeds and therefore steps are taken to try to prevent contamination. Tests are not required, although some vigilant organic companies require them. According to the organic standards, contamination by cross-pollination is not disallowed, but some companies reject contaminated product above some small amount such as 0.1%.

Organic canola farmers in Canada sued biotech companies, since cross-pollination has made it impossible for them to grow organic, non-GM canola.

### **Is the Natural Foods Industry doing something to insure the purity of its products?**

Right now there are efforts underway for an industry wide clean up of foods labeled organic and non-GMO. A handful of noble companies took it upon themselves to ensure that consumers could rest assured that their organic and non-GMO foods are truly free of modified genes. They established The Non-GMO Project, which has created an industry-wide consensus-based set of standards and a third-party verification process with testing for GMO content.

Companies began to enroll their products in the spring of 2008 and the first "non-GMO" seals for companies who fully comply with the protocols will be issued in 2009.

### **Government Regulation:**

#### **Q. Hasn't the FDA said that GM foods are safe?**

The biotech industry claims that the FDA has thoroughly evaluated GM foods and found them safe. This is untrue. The FDA does not require safety studies. Instead, if the makers of the GM foods claim that they are safe, the agency has no further questions.

**Q. Didn't the scientists at the FDA study GM foods themselves?**

No. The FDA relies solely on information supplied by the biotech companies.

**Q. What kind of information did the companies provide?**

Calgene, the makers of the first GM crop, the FlavrSavr tomato, was the only company to submit detailed raw data from animal feeding studies to the FDA. The rest provide only summaries and conclusions. Industry research can be rigged; data often is omitted or distorted.

In the FlavrSavr tests, lab rats refused to eat the tomatoes and had to be force-fed. Several developed stomach lesions, and seven of forty died within two weeks. Still, the tomato was approved, but has since been taken off the market.

**Q. Based on the information that was supplied, did the FDA scientist have concerns?**

Agency scientists did warn that GM foods might create toxins, allergies, nutritional problems, and new diseases that might be difficult to identify. Internal FDA memos reveal that the scientists urged their superiors to require long-term safety testing to catch these hard-to-detect side effects.

**Q. What did the FDA do about these concerns?**

Nothing was done that would protect consumers. In fact, in the case of genetically modified bovine growth hormone, some FDA scientists who expressed concerns were harassed, stripped of responsibilities, or fired. The remaining whistleblowers had to write an anonymous letter to Congress complaining of fraud and conflict of interest at the agency

**Q. How could the government approve dangerous foods?**

A close examination reveals that industry manipulation and political collusion – not sound science – was the driving force.

The FDA official in charge ignored all warnings of the FDA staff scientists. The official, a former outside attorney for Monsanto, was a political appointee specifically to a new FDA

post on GM policy, and left shortly after to become vice president at Monsanto.

### **Q. Why aren't foods with GMOs at least labeled here?**

The same political influence and money that got them past the FDA has prevented any labeling laws from being passed. However, President Obama had indicated support for labeling laws during his campaign.

### **Q. So do the biotech companies always get everything they want?**

No. The biotech companies have fallen far short of their goals due to consumer resistance. The GM potatoes and tomatoes were taken off the market, and other GM crops, although approved, were never commercialized.

Concerned consumers in Europe were able to get major companies to commit to eliminate GMOs within one week. This was done with only a small percentage of the overall population. Businesses do not want to lose even a portion of their customer base. Everyone can vote with his or her pocketbook!

In 1998 the industry tried to get the USDA to let GM products pass as organic. During the public comment period, the Department received over 275,000 irate letters of protest from citizens, a public response unprecedented in the USDA's history. Thanks to this public protest, GM products cannot be labeled organic in the USA.

## **Around the World**

### **Q. What about in neighboring countries?**

In Canada, government scientists also complained that they were being pressured to approve the GM hormone, which is injected into cows to increase milk supply. They were concerned about human health impacts. They testified that the drugs maker, Monsanto, offered them a bribe of \$1-2 million to approve it. They also reported that documents were stolen from a locked file cabinet in a government office.

Mexico has resisted GMOs, but contamination has still occurred.

Other stories of pressure, bribes, and threatened whistleblowers are reported through the history of GM foods and their approval, research, and promotion around the world.

### **Q. What is happening with GM foods in the rest of the world?**

A. All over the world, regions and even nations are demanding an end to GM crop cultivation. Twenty-two countries in Europe have regions wanting to be GM-free. States in Australia, regions in New Zealand and Brazil, the countries of Venezuela, Zambia, Sudan, Angola, and others, all want to be GM-free. Thus, world markets are shrinking.

In 2009 ,Germany joined France, Hungary, Italy, Greece, Austria, Poland and Romania in banning Monsanto's Mon 810 GM corn because of its documented hazards to biodiversity and human health. In 2007 over three million Italians signed a petition, declaring their opposition to GM crops in their country. In Europe over 175 regions and over 4,500 municipalities have declared themselves GM-free zones. In Spain alone this includes over 50 municipalities and regions like Asturias, the Canary Islands and the Basque country.

Europe has greater rejection of GMOs due to a more balanced reporting by their press on the health and environmental dangers. In Europe, at least 174 regions, more than 4,500 councils and local governments have declared themselves GM free.

### **Q. Have any GM foods been banned?**

The rules of the World Trade Organization (which the US and other 150 countries are members of) explicitly prohibit countries from banning GM products. Therefore, countries that ban them do so at great risk. If this weren't the case, no doubt many countries would already have done so.

Some countries have banned GM crops entirely or not approved certain GM crops that are approved elsewhere.

In the US, GM wheat was not approved when wheat farmers banded together because they were concerned that contamination would seriously hurt exports. So the reason was economic, not safety.

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