Genetically modified food

From Wikipedia, the free encyclopedia.

A **genetically modified food** is a food product derived in whole or part from a genetically modified organism (GMO) such as a crop plant, animal or microbe such as yeast.

Some governments have a very strong disagreement over genetically modified organisms. For example, the European Union and Japan have enacted labelling and traceability requirements for GM food products, while the United States does not believe these requirements are necessary.

Contents

- 1 Background
  - 1.1 History
  - 1.2 Controversies over risks
  - 1.3 Public reaction
  - 1.4 Application
  - 1.5 Future applications
- 2 Policy around the world
  - 2.1 United States
  - 2.2 European Union
    - 2.2.1 EU regulation
  - 2.3 Japan
  - 2.4 Canada
  - 2.5 China and other developing countries
- 3 See also
- 4 References
- 5 External links
  - 5.1 News/commentary

Background

Although "biotechnology" and "genetic modification" commonly are used interchangeably, they should not be as the term biotechnology pertains to a much broader set of techniologies than genetic modification alone.

Genetic engineering or genetic modification GM refers to technologies that allow single genes to be inserted or altered in living organisms such as animals, plants, or bacteria. Biotechnology, a more general term, refers to using living organisms or their components, such as enzymes, to make products that include wine, cheese, beer, and yogurt. Combining genes from different organisms is known as recombinant DNA technology, and the resulting organism is said to be "genetically modified," "genetically engineered," or "transgenic." Genetic engineering may more correctly be termed genetic re-contextualisation where genes can be transferred to new contexts in order to generate new characteristics. GM products (current or in the pipeline) include medicines and vaccines (e.g. insulin, vaccines), foods and food ingredients, feeds, and fibers.

Locating genes for important traits—such as those conferring insect resistance or desired nutrients—has until recently been one of the most limiting steps for the use of genetic engineering for developing new or improved products for humankind. Genome sequencing and discovery programs for hundreds of different organisms are now generating detailed maps along with data-analyzing technologies to understand and use them.

History

The origins of genetic engineering represent a series of sequential scientific advances from the Nobel prize-winning discovery of the double helix to the production of the first recombinant E.coli bacteria.

The first commercially grown genetically modified food crop was a tomato created by Calgene called the FlavrSavr. Calgene submitted it to the U.S. Food and Drug Administration (FDA) for assessment in 1992; following the FDA's determination that the FlavrSavr was, in fact, a tomato, did not constitute a health hazard, and did not need to be labeled to indicate it was genetically modified, Calgene released it into the market in 1994, where it met with little public comment. Considered to have a poor flavor, it never sold well and was off the market by 1997. However, it had improved solids contents which made it an attractive new variety for canned tomatoes.

Controversies over risks

In August 1998 widespread concern, especially in Europe, was sparked by remarks by a leading nutrition researcher (with 270 published scientific papers to his name, albeit not in the area of genetics), Dr Arpad Pusztai, regarding some of his research into the safety of GM food. Pusztai claimed his experiments showed that rats fed on genetically modified potatoes had suffered serious damage to their immune systems and shown stunted growth. He was criticized by leading British politicians, the majority of scientific peers with expertise in the area and by the GM companies, not least because his remarks, in a television interview, preceded the scientific publication of his results. When his studies were finally published in The Lancet 1999 354:1353-1354 (http://www.thelancet.com/journals/lancet/article/PIIS0140673698058607/fulltext), no evidence of stunted growth or damage to immunue system was substantiated. The Royal Society's review of the Pusztai data had led to the damning verdict that the study "is flawed in many aspects of design, execution, and analysis and that no conclusion should be drawn from it" Royal Society Report (http://www.royalsoc.ac.uk/document.asp?id=1462).

As part of the EU regulatory process biotech company Monsanto supplied data on a 90-Day Rat Feeding Study on a strain of GM corn. In May 2005, critics of GM foods pointed to differences in kidney size and blood composition found in this study, suggesting that the observed differences called into question the regulatory doctrine of substantial equivalence - that GM food with similar proteins and toxins is deemed no different than conventional food, without further investigation of the effects of any other differences. Some argued that this study suggested human health might be affected by eating GM food. However, the EU regulatory authorities that examined the Monsanto data concluded that the observed small numerical decrease in rat kidney weights were not biologically meaningful, and the weights were well within the normal range of kidney weights for control animals. There were no corresponding microscopic findings in the relevant organ systems, and all blood chemistry and organ weight values fell within the "normal range of historical control values" for rats. Thus, the experts concluded that there were no effects on the functioning of kidneys in rats fed a diet of GM corn.

In 1993 Pioneer Hi-Bred International developed a soybean variety with an added gene from the Brazil nut.[1] (http://www.pioneer.com/biotech/brazil_nut/default.htm) This gene increased the levels of methionine, a nutrient commonly added to poultry feed, in the GM soybean. However, a preliminary Pioneer funded study by the University of Nebraska indicated that the added gene could cause allergic reactions in humans. The completed study, published in the New England Journal of Medicine (view the study abstract (http://www.pioneer.com/biotech/brazil_nut/default.htm)), later confirmed the preliminary results. Pioneer discontinued further development of the GM soybean and had all material related to the modified soybeans destroyed. While this study indicates the possible risks of GM foods, some point out it establishes the commitment the developmental community has toward consumer safety as well as the competence of current safeguards.

For some, fears of the safety of GM food for human consumption remain, despite 10 years of catastrophe free consumption of such foods in the USA. However, the main public concerns have been over the environmental impacts of crops grown for food or for animal feed. In March 2005 results of a farm-scale trial comparing the biodiversity impact of GM crops with equivalent conventional crops was published. Some claimed that the results showed that GM crops had a significant negative impact on wildlife.[2] (http://www.guardian.co.uk/life/science/story/0,12996,1443004,00.html) Others pointed out that the studies showed that using herbicide resistant GM crops allowed better weed control and that under such conditions there were fewer weeds and fewer weed seeds. This result was then extrapolated to suggest that GM crops would have significant impact on the wildlife that might rely on farm weeds.

In July 2005 it was reported in a town just out side of London, that those same trials had seen a possible transfer of a herbicide-resistance gene from GM oilseed rape to a wild cousin, charlock, a possibility previously discounted by scientists as virtually impossible. Two other weeds (both wild turnips) were also found to be herbicide-resistant datte.

Public reaction

Public outcry about the undue influence that the Terminator Technology (preventing plants from producing seeds) would give to Monsanto, particularly in less developed nations where seed saving is more common (in developed countries farmers usually tend to use the 1st generation seeds anyway), led to its withdrawal.

Awareness grew throughout the nineties and eventually produced a strong backlash against GM foods (discussed below), which were panned as "untested", "unlabeled" and "unsafe"; following this backlash, the International Rice Research Institute, with funding from the Rockefeller Foundation developed a strain of rice enriched with vitamin A through genetic modification, dubbed golden rice. Subsequently the biotech industry touted this as a boon to poor people suffering from Vitamin A deficiency, which can cause blindness. Because Golden Rice disproved many of the claims made by GM food opponents about GM food (eg GM crops can only help the rich, GM crops will force farmers to be dependant on multinational companies etc) the critics were forced to condemn this GM crop as a ploy and a public relations move. (See golden rice for more.)

The Sierra Club ran several advertising campaigns that dubbed the new technology "franken foods". A Sierra Club article in the New York Times in the late 1990s compared the use of plant retroviruses as transgenes in GMOs to HIV, also a retrovirus. No plant virus cross infects humans, nor are any plant viruses remotely related to HIV.

Many prominent environmental organizations, like Friends of the Earth and Greenpeace, currently consider the issue of the presence of GMOs in conventional food products to be a major issue - indeed Greenpeace has made it a centerpiece of their activism. In 2002, opponents placed a measure on the Oregon ballot that would have made that state the first to require labelling of GMO food. Greenpeace's activities are in spite of the views of founder Patrick Moore, who has championed the use of GMOs for food production in third world countries that are especially prone to drought and poor soil conditions.

Application

Transgenic crops are grown commercially or in field trials in over 40 countries and on 6 continents. In 2000, about 109.2 million acres (442,000 km²) were planted with transgenic crops, the principal ones being herbicide- and insecticide-resistant soybeans, corn, cotton, and canola. Other crops grown commercially or field-tested are a sweet potato resistant to a US strain of a virus that affects one out of the more than 89 different varieties of sweet potato grown in Africa, rice with increased iron and vitamins, and a variety of plants able to survive extreme weather.

Between 1996 and 2002, the total surface area of land cultivated with GMOs has increased by a factor of thirty. Land producing GMO crops grew from 17,000 km² (4.2 million acres) in 1996 to 520,000 km² (128 million acres) in 2001. The value for 2002 was 145 million acres (587,000 km²) and for 2003 was 167 million acres (676,000 km²). Soybean crop represented 63% of total surface in 2001, maize 19%, cotton 13% and canola 5%. In 2004, the value was about 200 million acres (809,000 km²) of which 2/3 were in the United States.

Four countries represent 99% of total GM surface in 2001: United States (68%), Argentina (22%), Canada (6%) and China (3%). It is estimated that 70% of products on U.S. grocery shelves include GM products. In particular, Bt corn is widely grown, as are soybeans genetically designed to tolerate glyphosate herbicides (e.g. Monsanto's Roundup herbicide).

The US Agriculture Department estimated that 38 percent of the 79 million acres (320,000 km²) of corn planted in 2003 will be genetically engineered varieties as well as 80% of the 73.2 million acres (296,000 km²) soybeans. The Grocery Manufacturers of America estimate that 75% of all processed foods in the U.S. contain a GM ingredient.

A recent study investigating the global impact of GM crops reported that they contributed to significantly reduced greenhouse gas emissions from agricultural practices. This reduction results from decreased fuel use, about 1.8 billion litres in the past nine years, and additional soil carbon sequestration because of reduced ploughing or improved conservation tillage associated with biotech crops. In 2004, this reduction was equivalent to eliminating more than 10 billion kg of carbon dioxide from the atmosphere, or removing 5 million cars — one-fifth of the cars registered in the United Kingdom — from the road for one year[[3] (http://www.pgeconomics.co.uk/GM_global_study.htm)].

Future applications

On the horizon are bananas that produce human vaccines against infectious diseases such as Hepatitis B; fish that mature more quickly; fruit and nut trees that yield years earlier, and plants that produce new plastics with unique properties. The next decade will see exponential progress in GM product development as researchers gain increasing and unprecedented access to genomic resources that are applicable to organisms beyond the scope of individual projects.

Technologies for genetically modifying (GM) foods offer dramatic promise for meeting some areas of greatest challenge for the 21st century. Like all new technologies, they also pose some risks, both known and unknown. Controversies surrounding GM foods and crops commonly focus on human and environmental safety, labeling and consumer choice, intellectual property rights, ethics, food security, poverty reduction, and environmental conservation (see below for a summary of "GM Foods: Benefits and Controversies").

Policy around the world

In 2000, countries that grew 99% of the global transgenic crops were the United States (68%), Argentina (23%), Canada (7%), and China (1%). Although growth is expected to plateau in industrialized countries, it is increasing in developing countries.

United States

In the United States, genetically modified food is widely available and accepted by consumers. The Food and Drug Administration assists companies in testing the safety of GM foods, but this process is voluntary. Labeling food as GM or non-GM is also voluntary. The USDA's office of the animal and plant health inspection service

(APHIS) also regulates GM crops. Some environmentalist groups believe the U.S. should regulate GM food more closely, and have called for mandatory labeling and testing requirements. Although agribusinesses are not required to test the safety of GM foods any more than non-GM foods, they have a legal duty to ensure that all their products are safe for human consumption.

Interestingly, some Amish people have adopted GM crops, because they are more productive, allow for less intensive farming (less pesticides, etc.), and do not conflict with the Amish lifestyle. [4] (http://www.whybiotech.com/index.asp?id=3947)

European Union

See also Trade war over genetically modified food

In Europe, a series of unrelated food crises during the 1990s (e.g. the BSE (or 'mad cow' disease) outbreaks and foot and mouth disease) have created consumer apprehension about food safety in general, and eroded the public trust in government oversight of the food industry. This has further fueled widespread public concern about GMOs, in terms of environmental protection (in particular biodiversity), health and safety of consumers and the right to make an informed choice. The apprehension might also be due to the perceived novelty of GM foods, as well as cultural factors relating to food. The mishandling of the BSE crisis has left some consumers unwilling to consider "science" to be a guarantee of quality.

European consumers are demanding that their "right to know" the content and origin of the food they consume be respected. In a context of local food surplus where current GM food has little added nutritional value, many European consumers are wondering why any risk should be taken. However, as a result of the high quantity of GMO crops, the presence of GM in imported food products (shipments of grain for food, feed and processing for example), is now thought inevitable and largely unavoidable, and usually not mentioned.

EU regulation

For these reasons, the marketing of GM food is regulated in a manner that helps to provide the necessary levels of safety, transparency and reassurance. At the beginning of the 2000's, European officials insisted that new regulations were needed to "restore consumer confidence" in the technology. These new regulations required strict labelling and traceability of all food and animal feed containing more than 0.5 % GM ingredients. Directives, such as directive 2001/18/EC, were designed to require authorisation for the placing on the market of GMO, in accordance with the precautionary principle. (see also Tax, tariff and trade).

One of the features of the European system is a comprehensive pre-market risk assessment, a system trying to provide means for products to be followed at each stage of their production and distribution, by both transmission of accurate information and labelling. This traceability is a means to implement post-market measures such as monitoring and withdrawals (recalls).
This system is not only limited to GMO products but should encompass any food product ultimately.

The original EU rules for labelling of GM products were limited to products where transformed DNA and/or transformed protein are detectable, not to products that have been produced from GMOs but no longer appears to contain modified DNA and/or proteins. New rules for tracebility and labelling which came into force in 2004 also require labelling of highly refined products made from GM indgredirents like oil and corn syrup, even though that the presence of recombinant DNA or protein cannot be proven. The labelling rules do not apply to products of microbial genetic engineering, so the cheese made with the help of GM-chymosin doesn't have to be labelled. Officials stress that while traceability facilitates the implementation of safety measures, where appropriate, it cannot and should not be considered as a safety measure.

In April 1998, a 5 year ban was pronounced on new genetically modified crops. At the end of 2002, European Union environment ministers agreed new controls on GMOs could eventually lead the 25-member bloc to reopen its markets to GM foods. European Union ministers agreed to new labelling controls for genetically modified goods which will have to carry a special harmless DNA sequence (a DNA code bar) identifying the origin of the crops, making it easier for regulators to spot contaminated crops, feed, or food, and enabling products to be withdrawn from the food chain should problems arise. A series of additional sequences of DNA with encrypted information about the company or what was done to the product could also be added to provide more data. (see Mandatory labelling).

See Trade war over genetically modified food for more details on disputes and more recent developments between the United States and the EU arising from EU position on genetically modified organisms.

Japan

Japan, like Europe, maintains labelling standards for GM food products. Japanese demand and assistance has led to a small effort to set up separate processing facility for non-GM soybeans in the U.S.

Canada

Labelling is currently not required for GM food products sold in Canada. In 2005, a standing committee began work in the province of Prince Edward Island to assess a proposal to ban the production of GM foods within the province.

China and other developing countries

China is currently a producer of GM cotton. Research published in Science shows that Chinese farmers growing GM cotton use significantly less pesticides, reducing costs and improving farmer health. The Chinese government has also released safety certificates following field and laboratory testing allowing the cultivation of GM tomato, pimiento and a species of morning glory. Development of new GM crops for food is an active field of research in Chinese institutions.

In March 2002, China introduced biosafety rules that demanded strict labelling, extensive documentation and government approval for food shipments. Under these new rules, all soybean shipments from the United States were briefly interrupted until interim safety certificates could be acquired.

In 2004 the Chinese Ministry of Agriculture announced its intention to assess the safety of GM rice lines developed by Chinese institutions for insect, disease and herbicide resistance. With government approval the crops may be planted as soon as spring 2006.

Agriculture officials from developing and other economically disadvantaged nations are receiving training courses on GMO at the American Agriculture Department, with instruction in the WTO rules on GM products and benefits of biotechnology. U.S. industry groups are also providing "technical assistance" to fund initiatives that promote "science-based and transparent biotechnology regulations" in countries such as China.

See also

- Biogenetic Revolution
- Biosafety Protocol
- Conventional food

- Food monitoring
- Food withdrawal
- Organic food
- Pre-market risk assessment
- Tax, tariff and trade
- Substantial equivalence

References

- Huang, J. et al. 2002. Plant Biotechnology in China. Science 295:674-677.
- Niu, 2003. Caution in China over GM Crops. Science 299: 1013
- Lei, W. 2004. China Could Be First Nation to Approve Sale of GM Rice. Science 306:1458-1459.
- Robert Ali Brac De La PerriFre and Franck Seuret (2001), *Brave New Seeds: The Threat of GM Crops to Farmers*, Zed Books
- Stephen Nottingham (2003), *Eat Your Genes: How Genetically Modified Food Is Entering Our Diet*, Zed Books

External links

- FAO Agriculture Department (http://www.fao.org/ag/) and its SOFA report on Agricultural Biotechnology (http://www.fao.org/docrep/006/y5160e/y5160e00.HTM) addressing GM food safety
- Genetically Modified Crops (http://www.greenfacts.org/gmo/index.htm) – A summary for non-specialists of the above FAO report by GreenFacts.
- http://homepages.picknowl.com.au/sagfin/
- http://biotech.foodpolicyinstitute.org/
- http://www.seedsofdeception.com/
- http://www.greenpeace.fr/campagnes/cdp/ogm/O991202.htm
- http://pewagbiotech.org/newsroom/releases/021303.php3
- http://www.taemag.com/issues/articleid.17889/article_detail.asp
- http://www.iiasa.ac.at/Research/LUC/ChinaFood/argu/trends/trend_80.htm
- http://www.grain.org/research/contamination.cfm
- Database of all GM crops approved for commercial release: http://www.agbios.com/
- http://www.checkbiotech.org/
- http://www.pbs.org/wgbh/harvest/

News/commentary

- Geoffrey Lean, The Independent, 22 May 2005, "Revealed: health fears over secret study into GM food" (http://news.independent.co.uk/world/science_technology/story.jsp?story=640430)
- Severin Carrell and Andy Rowell, The Independent, 22 May 2005, "When fed to rats it affected their kidneys and blood counts. So what might it do to humans? We think you should be told" (http://news.independent.co.uk/world/science_technology/story.jsp?story=640402)
- Paul Brown and David Gow, The Guardian, March 22, 2005, "Damning verdict on GM crop:Final report on world's most comprehensive field trials says oil seed rape varieties would harm wildlife and environment" (http://www.guardian.co.uk/life/science/story/0,12996,1443004,00.html)
- Zachary Makanya, Seedling, July 2004, "12 reasons for Africa to reject GM crops" (http://www.grain.org/seedling/?id=294)

GM Crops

Categories: NPOV disputes | Biotechnology | Food production and processing | Genetically modified organisms