What is GM food?

Meat and edible plants radically modified through genetic engineering (GE). Although humans have genetically modified animals and plants since the beginning of civilization, they did it through selective breeding, possible only within the same specie through natural reproduction over decades or centuries. GE techniques, however, can transfer genetic material from any source to instantly create utterly different variants. Since alien genes are not welcomed by the existing genes, suppressive GE techniques must be used to force the animal or plant to accept them.

http://www.businessdictionary.com/definition/genetically-modified-GM-food.html, 23/08/08

The term GM foods or GMOs (genetically-modified organisms) is most commonly used to refer to crop plants created for human or animal consumption using the latest molecular biology techniques. These plants have been modified in the laboratory to enhance desired traits such as increased resistance to herbicides or improved nutritional content. The enhancement of desired traits has traditionally been undertaken through breeding, but conventional plant breeding methods can be very time consuming and are often not very accurate. Genetic engineering, on the other hand, can create plants with the exact desired trait very rapidly and with great accuracy.

http://www.csa.com/discoveryguides/gmfood/overview.php, 23/08/08

Genetically modified organisms (GMOs) can be defined as organisms in which the genetic material (DNA) has been altered in a way that does not occur naturally. The technology is often called “modern biotechnology” or “gene technology”, sometimes also “recombinant DNA technology” or “genetic engineering”. It allows selected individual genes to be transferred from one organism into another, also between non-related species. Such methods are used to create GM plants – which are then used to grow GM food crops.

http://www.who.int/foodsafety/publications/biotech/20questions/en/, 23/08/08

Why are GM foods produced?

GM foods are developed – and marketed – because there is some perceived advantage either to the producer or consumer of these foods. This is meant to translate into a product with a lower price, greater benefit (in terms of durability or nutritional value) or both. Initially GM seed developers wanted their products to be accepted by producers so have concentrated on innovations that farmers (and the food industry more generally) would appreciate.

The initial objective for developing plants based on GM organisms was to improve crop protection. The GM crops currently on the market are mainly aimed at an increased level of crop protection through the introduction of resistance against plant diseases caused by insects or viruses or through increased tolerance towards herbicides.

http://www.who.int/foodsafety/publications/biotech/20questions/en/, 23/08/08

In many parts of the world such as the European Union, Japan, Malaysia and Australia consumers demand labelling so they can exercise choice between foods that have genetically modified, conventional or more natural organic origins. This requires a labelling system as well as the reliable separation of GM and non-GM organisms at production level and throughout the whole processing chain.

http://en.wikipedia.org/wiki/Genetically_modified_food, 23/08/08

What plants are used for genetic engineering (examples)?

Food	Properties of the genetically modified variety	Trade name and the company which produced initial version	Specific genetic modification
Soybeans	Resistant to herbicides	Roundup Ready, Monsanto	Herbicide resistant gene taken from bacteria inserted into soy bean
Corn	Resistance to certain pesticides (tolerating crop spray - this way a farmer can use amounts of pesticides which would normally kill the plant, without harming it)	TBA	New gene added/transferred into plant genome
Cotton	Pest-resistant cotton	TBA	New gene added/transferred into plant genome
Tomatoes	Variety that does not rot (degrade) as fast - the genetically modified tomatoes do not produce a substance that normally causes tomatoes to rot.	e.g. FlavrSavr	First genetically modified tomatoes contained genes that made them resistant to antibiotics. After concern from doctors and the medical community, tomatoes are now genetically modified in an alternative way
Potatoes			
Rapeseed (Canola)	Resistance to certain pesticides (tolerating crop spray)	TBA	New gene added/transferred into plant genome
Sugar cane	Resistance to certain pesticides (tolerating crop spray)	TBA	New gene added/transferred into plant genome
Sweet corn	Produces its own insecticide (a toxin to insects, so insect attacks are less likely)	Bt corn	Insect-killing gene added to the plant. The gene comes from the bacteria Bacillus thuringiensis.
Rice	Genetically modified to contain high amounts of Vitamin A (beta-carotene)	"Golden rice"	Three new genes implanted: two from daffodils and the third from a bacterium

http://en.wikipedia.org/wiki/Genetically_modified_food, 23/08/08

How does genetic engineering work?

The first step in GM is identifying a gene for a particular characteristic, such as herbicide resistance. The gene, which may come from any other organism, is inserted into the DNA of a plant cell, giving it the same trait. This means, for example, that a field can be sprayed with weedkiller and the GM crops will be unaffected.

http://news.bbc.co.uk/2/hi/science/nature/5098468.stm, 23/08/08

Insect resistance is achieved by incorporating into the food plant the gene for toxin production from the bacterium *Bacillus thuringiensis* (BT). This toxin is currently used as a conventional insecticide in agriculture and is safe for human consumption. GM crops that permanently produce this toxin have been shown to require lower quantities of insecticides in specific situations, e.g. where pest pressure is high.

Virus resistance is achieved through the introduction of a gene from certain viruses which cause disease in plants. Virus resistance makes plants less susceptible to diseases caused by such viruses, resulting in higher crop yields.

Herbicide tolerance is achieved through the introduction of a gene from a bacterium conveying resistance to some herbicides. In situations where weed pressure is high, the use of such crops has resulted in a reduction in the quantity of the herbicides used.

http://www.who.int/foodsafety/publications/biotech/20questions/en/, 23/08/08

For example, plant geneticists can isolate a gene responsible for drought tolerance and insert that gene into a different plant. The new genetically-modified plant will gain drought tolerance as well.

Not only can genes be transferred from one plant to another, but genes from non-plant organisms also can be used. The best known example of this is the use of B.t. genes in corn and other crops. B.t., or *Bacillus thuringiensis*, is a naturally occurring bacterium that produces crystal proteins that are lethal to insect larvae. B.t. crystal protein genes have been transferred into corn, enabling the corn to produce its own pesticides against insects such as the European corn borer.

http://www.csa.com/discoveryguides/gmfood/overview.php, 23/08/08

The Development of Genetic Engineering

The first commercially grown genetically modified whole food crop was the tomato (called Flavr Savr), which was made more resistant to rotting by Californian company Calgene. Calgene was allowed to release the tomatoes into the market in 1994 without any special labeling. It was welcomed by consumers who purchased the fruit at two to five times the price of regular tomatoes.

However, production problems and competition from a conventionally bred, longer shelf-life variety prevented the product from becoming profitable. A variant of the Flavr Savr was used by Zeneca to produce tomato paste which was sold in Europe during the summer of 1996. The labeling and pricing were designed as a marketing experiment, which proved, at the time, that European consumers would accept genetically engineered foods.

The attitude towards GM foods would be drastically changed after outbreaks of Mad Cow Disease weakened consumer trust in government regulators, and protesters rallied against the introduction of Monsanto's "Roundup-Ready" soybeans. The next GM crops included insect-resistant cotton and herbicide-tolerant soybeans both of which were commercially released in 1996.

GM crops have been widely adopted in the United States. They have also been extensively planted in several other countries (Argentina, Brazil, South Africa, India, and China) where the agriculture is a major part of the total economy.

http://en.wikipedia.org/wiki/Genetically_modified_food, 23/08/08

Between 1995 and 2005, the total surface area of land cultivated with GMOs had increased by a factor of 50, from 17,000 km² […] to 900,000 km² […], of which 55 % were Brazil.

Although most GM crops are grown in North America, in recent years there has been rapid growth in the area sown in developing countries. For instance in 2005 the largest increase in crop area planted to GM crops (soybeans) was in Brazil (94,000 km² in 2005 versus 50,000 km² in 2004.) There has also been rapid and continuing expansion of GM cotton varieties in India since 2002. (Cotton is a major source of vegetable cooking oil and animal feed.)

In 2003, countries that grew 99 % of the global transgenic crops were the United States (63 %), Argentina (21 %), Canada (6 %), Brazil (4 %), China (4 %), and South Africa (1 %). The Grocery Manufacturers of America estimate that 75 % of all processed foods in the U.S. contain a GM ingredient.

http://en.wikipedia.org/wiki/Genetically_modified_food, 23/08/08