

## Is it Safe?

# Information on Genetically Engineered Foods for Consumers

**Londa Nwadike**

Ph.D., Kansas State University/ University of Missouri Extension  
Food Safety Specialist

Consumers are increasingly interested in where their food comes from and may be concerned about the health and safety implications of various food production methods. With many different terms such as “organic,” “natural,” and “GMO-free” being used in food marketing, it is confusing for consumers to know how to spend their food dollars wisely.

This fact sheet provides consumers with an introductory overview to genetically engineered (GE) foods (commonly referred to as GMOs — genetically modified organisms, also called transgenic crops or animals), as well as safety information on these products. Information on labeling of GE foods is also included. The term “genetically engineered (GE) foods” will be used throughout this fact sheet because the U.S. Food and Drug Administration (FDA) considers it scientifically accurate for these types of foods.

GE foods are controversial and misunderstood, with only 37 percent of U.S. adults saying that they think GE foods are safe, compared to 88 percent of scientists who are part of the American Association for the Advancement of Science (AAAS; Pew Research 2015). For many consumers, the safety issue of GE foods is tied together with many other issues, such as environmental concerns and sociopolitical concerns related to the industrialization of agriculture and privatization of the seed supply.

### What are GE foods?

Since the beginnings of domesticated agriculture, all food crops have been modified by man to improve taste, yield, disease resistance, and other traits. In the past, these genetics were modified through crossbreeding, selective breeding, or similar methods. This process takes many years. A GMO or GE food is typically defined as a plant or animal that



### Key definitions

**Biotechnology:** Using living organisms to make or modify a product. In this context, biotechnology means the process of intentionally transferring genetic material for a desired trait from one plant or organism into an unrelated plant or organism to attain the desired trait.

**Gene:** Unit of heredity to the next generation associated with particular identifiable traits.

**DNA:** Deoxyribonucleic acid. This is the hereditary genetic material for most living organisms.

**Genetic Engineering:** The name for certain methods used to introduce new traits or characteristics to an organism typically using recombinant DNA methods. While these techniques are sometimes referred to as “genetic modification,” “genetic engineering” is considered a more precise term. Humans have been genetically modifying crops and animals for thousands of years through cross-breeding or other methods.

**Genetically Modified Organisms (GMOs):** typically used to describe a transgenic organism resulting from intentionally transferring genetic material for a desired trait from one plant or organism into another plant or animal to attain the desired trait (genetic engineering).

has had its DNA (genes) altered in a lab through genetic engineering to enhance desirable traits. Unlike crossbreeding, which takes longer and other undesirable traits may come along, genetic engineering allows for more precise gene transfer of only the desired gene(s).

### What are the benefits of GE foods?

The world population is growing, so scientists use tools such as genetic engineering of plants and animals and other technology to help increase food production. Genetic engineering can help produce more food and/or enhance food quality to sustainably feed a growing number of people.

GE foods are developed for various purposes. Many of the GE crops are developed to increase yields by reducing damage from weeds, diseases, insects, and drought. For example, “Bt” corn has had a gene from the naturally occurring soil bacteria *Bacillus thuringiensis* added to make a protein that is toxic to corn borers. These borers can cause severe damage to corn plants, thus reducing yields and quality, which results in a lower supply of food and feed. The *Bacillus thuringiensis* protein produced is NOT toxic to other insects, animals, or humans. Since the 1960s, Bt has been applied as an insecticide to corn plants. Today, the plant can make this protein itself rather than being applied as a spray. Other genetically engineered crops more recently released or currently under development include varieties with improved nutrition (vitamin A enhanced rice — golden rice), taste, quality (non-browning potatoes), or shelf life (non-browning apples).

In November 2015, the FDA approved a GE salmon, which grows twice as fast as conventional farmed salmon. It was determined to be as safe and nutritious to eat as any non-GE salmon, but it is not currently available to consumers.

### What foods in the U.S. food supply are currently NOT GE foods?

Tomatoes, wheat, sorghum, sunflowers, and any other crop or animal not included in the table below.

### How are GE products regulated?

Before approval, the FDA rigorously reviews all plants and animals developed through genetic engineering. They are evaluated for any unintended effects, toxicity, and allergenicity (e.g. a nut gene inserted into another crop). Nutritional composition is evaluated for differences with their conventional counterparts. However, human trials are not conducted as the study of composition is a better indicator of safety than animal/human studies, and human studies are even more difficult and time-consuming to do than animal studies (Food and Agriculture Organization of the United Nations and the World Health Organization, 2001).

The U.S. Department of Agriculture (USDA) and the U.S. Environmental Protection Agency (EPA) also regulate GE products for their safety to other plants and animals and in the environment.

On average, it takes about 13 years from the time a GE product is developed until it reaches the marketplace because of the evaluation process by various agencies. Plants and animals developed

### What GE foods are currently in the U.S. food supply?

Plant/animal	Genetic trait expressed
Corn (field and sweet corn)	insect resistance, herbicide tolerance, drought tolerance
Soybeans	insect resistance and herbicide tolerance
Cotton	insect resistance and herbicide tolerance (may be used as animal feed)
Canola	herbicide tolerance
Alfalfa	herbicide tolerance (used as animal feed)
Sugar beets	herbicide tolerance
Rainbow papaya	disease resistance
Summer squash – some varieties	disease resistance
Potatoes – some varieties	reduced bruising and black spot; non-browning; low acrylamide

Note that a variety of genetically engineered non-browning apples have been approved and will be coming to market soon.



using other breeding techniques such as mutagenesis or crossbreeding do not go through any formal regulatory assessment.

### How are GE products digested by the human body?

All food from plants and animals (conventional, organic, and GE) are composed of DNA and include proteins. The human body breaks down any food with stomach acid and enzymes and digests it into its basic units: DNA is broken down to nucleotides and proteins to amino acids. These basic units (nucleotides and amino acids) are absorbed into the human body to make human DNA and proteins. Intact DNA or protein from food is NOT absorbed directly into our bodies. Therefore, the protein and DNA in GE foods are digested in the very same way as all other foods.

### Are GE foods safe?

There has been no documented instance of harm to human or animal health from consumption of genetically modified food since 1994 when the first GM seeds were available for planting. An important review of the past 10 years of GE crop safety research was conducted by faculty members from the University of Perugia in Italy and published in a peer-reviewed scientific journal in 2013. They found that the “scientific research conducted so far has not detected any significant hazard directly connected with the use of GM crops.” (Nicolia et al., 2013)

### What concerns do people have with GE foods?

Many consumers have multiple concerns with GE foods. A very brief description of a few of these concerns is listed below:

- » Environmental effects, including that the use of GE seeds may lead to pesticide resistance (such as with Bt corn or herbicide resistant weeds). This is primarily due to improper farming practices that may be associated with the overuse of these varieties. Farmers need to ensure they use crop rotation, alternate varieties, and follow good farming practices when using GE or any seed variety.
- » Concern with corporate control of the food supply, as large corporations may seem to be generating high profits from GE foods.
- » There is uncertainty of the long-term effects of GE foods on human health and if future research will show that GE foods are not safe. GE foods have only been in the U.S. food supply for 20 years, so the data only reflects the safety of 20 years of consumption. There is no indication, however, that long-term consumption will cause any health problems.
- » The fear of the unknown. A small number of studies are always present that show that GE foods do cause harm. These need careful evaluation for scientific validity and must be understood in the larger context of numerous larger scientific studies that have shown the product safety.
- » Labeling of GE foods is not a U.S. federal regulatory requirement, but rather voluntary. More information on labeling is included in the next section.

### Labeling of GE foods

Many vocal consumer groups feel that they have the right to know what is in their foods, including GMOs. However, at the time this fact sheet was written (January 2016), the U.S. FDA states that there is no reason to require labeling of GE foods since there is no documentation of harm from GE foods, the foods are not made “different” by GE, and there have been no allergies or specific health risks due to GE food consumption. The FDA has stated that companies can voluntarily label their products as long as it’s truthful and not misleading. In November 2015, FDA released guidance for food companies on such voluntary labeling.

If consumers would like to purchase GE-free products, options currently include USDA-certified organic foods, which are not allowed to have GE ingredients. Also, products may be voluntarily labeled as “GMO free” by manufacturers or third-party auditors, such as the Non-GMO Project.

Labeling GE foods could raise food prices due to the increased costs associated with label changes. If GE labeling were required, a number of things would need to occur, requiring time and money:

- » The FDA would need to define levels of GMOs, set industry regulations, and determine means of GMO and non-GMO ingredient tracking.



Further, all GMOs are not the same and have different ingredients that would have to be identified.

- » The food industry would need to have extensive tracking methods for ingredients and production methods to keep track of GE and non-GE components and would need to keep processing separate. This would add to food costs due to increased labor costs by the food industry.
- » More sensitive methods to detect GMOs in foods would need to be developed and purchased by FDA and the food industry, which would again add costs.
- » More FDA inspectors would be needed to educate and monitor the food industry, which would again increase costs.

### References:

- » Funk, Cary and Rainie, Lee. January 2015. *Public and Scientists' Views on Science and Society*. [www.pewinternet.org/2015/01/29/public-and-scientists-views-on-science-and-society/](http://www.pewinternet.org/2015/01/29/public-and-scientists-views-on-science-and-society/)
- » Nicolia, A, A. Manzo, F. Veronesi, D. Rosellini. 2013. *An overview of the last 10 years of genetically engineered crop safety research*. *Critical Reviews in Biotechnology*. ISSN: 1549-7801.

- » GMO Answers — [www.gmoanswers.com](http://www.gmoanswers.com)
- » FDA. *AquaAdvantage Salmon*: Accessed December 23, 2015. [www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/GeneticEngineering/GeneticallyEngineeredAnimals/ucm280853.htm](http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/GeneticEngineering/GeneticallyEngineeredAnimals/ucm280853.htm)
- » FDA. *FDA takes several actions involving genetically engineered plants and animals for food*. [www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm473249.htm](http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm473249.htm)
- » Food and Agriculture Organization of the United Nations and the World Health Organization. 2001. *Safety Assessment of Foods Derived from Genetically Modified Microorganisms*. Geneva, Switzerland. Available at [fao.org/fileadmin/templates/agns/pdf/topics/ec\\_sept2001.pdf](http://fao.org/fileadmin/templates/agns/pdf/topics/ec_sept2001.pdf)

### Sources for Further Information:

- » IFIC, [www.foodinsight.org](http://www.foodinsight.org)
- » GMO Answers, [www.gmoanswers.com](http://www.gmoanswers.com)
- » Genetic Literacy Project, [www.geneticliteracyproject.org](http://www.geneticliteracyproject.org)
- » Colorado State University — GMO labeling, [www.ext.colostate.edu/pubs/foodnut/09371.html](http://www.ext.colostate.edu/pubs/foodnut/09371.html)

Prepared by Londa Nwadike, Ph.D., Kansas State University/ University of Missouri Extension  
Food Safety Specialist

Reviewed by:

*Karen Blakeslee, M.S., K-State Research and Extension Rapid Response Center Coordinator*

*Crystal Futrell, Johnson County Family and Consumer Sciences Agent*

*Cary Rivard, Ph.D., State Extension Vegetable and Fruit Crop Specialist*

*Curtis Thompson, Ph.D., State Extension Leader for Agronomy*

*Sandy Procter, Ph.D., State Extension Nutrition Specialist*

---

Publications from Kansas State University are available at:  
[www.ksre.ksu.edu](http://www.ksre.ksu.edu)

Publications are reviewed or revised annually by appropriate faculty to reflect current research and practice. Date shown is that of publication or last revision. Contents of this publication may be freely reproduced for educational purposes. All other rights reserved. In each case, credit Londa Nwadike, *Is it safe? Information on Genetically Engineered Foods for Consumers, Fact Sheet*, Kansas State University, July 2016.

**Kansas State University Agricultural Experiment Station and  
Cooperative Extension Service**

K-State Research and Extension is an equal opportunity provider and employer. Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, Extension Districts, and United States Department of Agriculture Cooperating, John D. Floros, Director.