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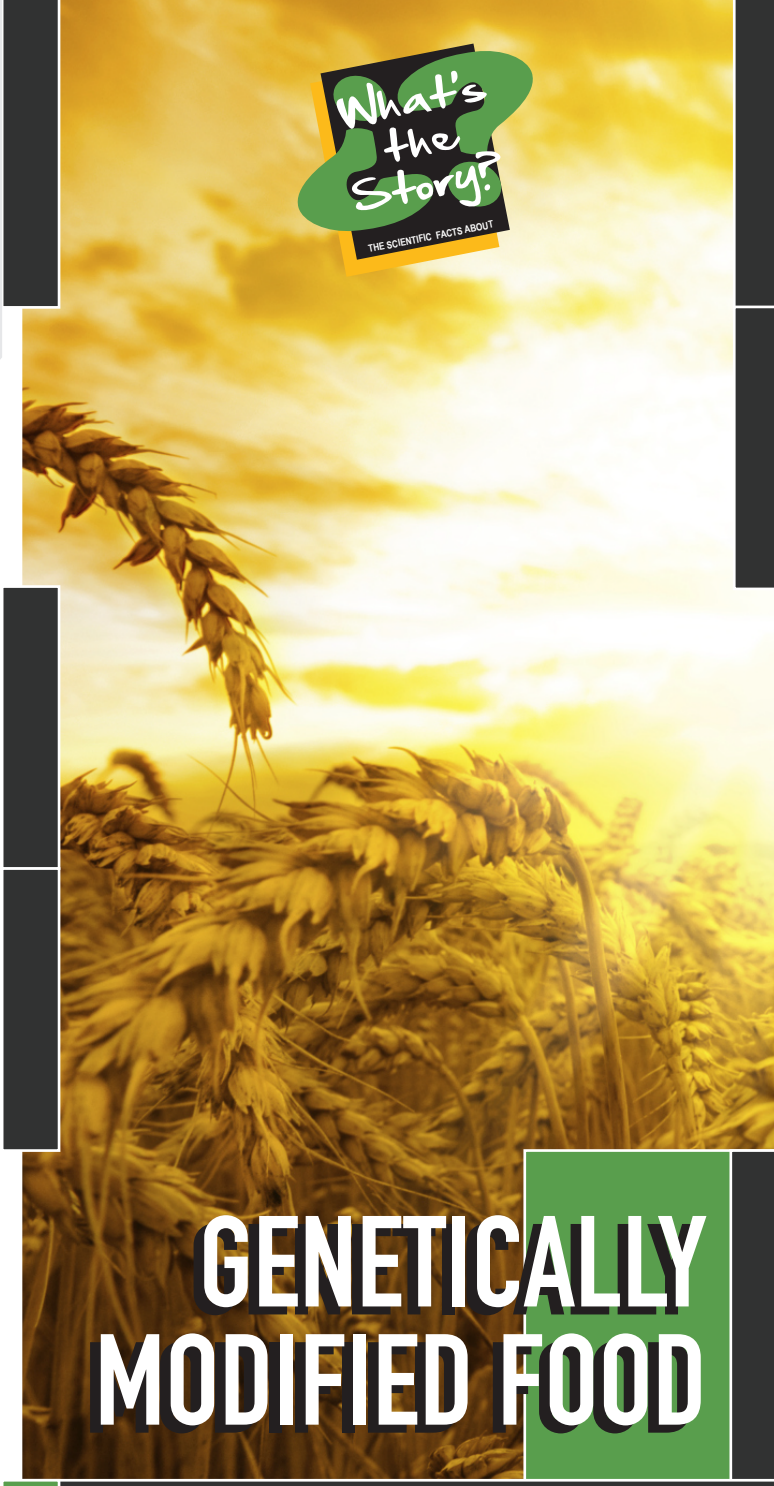


# GENETICALLY MODIFIED FOOD

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# GET THE STORY

## FROM THE AMERICAN COUNCIL ON SCIENCE AND HEALTH

### INTRODUCTION

In the latter half of the 20th century, major strides were made in agricultural productivity, helping to quadruple annual agricultural production worldwide. Among the factors contributing to the gains were the use of chemical fertilizers, pesticides, and herbicides, as well as selective breeding programs, including the use of gene splicing — the essence of biotechnology. Interestingly, the selective breeding of crop plants and farm animals is far from new. Farmers over the millennia have employed crossbreeding to modify various characteristics of plants and animals. Over the past 20 years, scientists simply discovered a way to do this faster and more precisely.

### WHAT IS BIOTECHNOLOGY?

Biotechnology is a set of techniques that permits the manipulation of the genetic material of living organisms to produce useful substances or allow adaptation to poor growing conditions. The ability to do this *with precision* is the hallmark of modern biotechnology. These techniques can be used in a variety of ways: 1) to enhance the ability of an organism to produce a particular chemical product (e.g., insulin from bacteria), 2) to prevent it from producing a product, or 3) to enable it to produce an entirely new product (e.g., a pesticide). Such modified plants are referred to as transgenic crops or "genetically modified organisms" (GMOs). Other terms commonly used include "gene-spliced," "genetically-improved," and "genetically engineered (GE)."

### HOW DOES BIOTECH DIFFER FROM TRADITIONAL BREEDING?

Historically, farmers selected improved crops by cross-pollination — the methodical genetic modification of plant-gene DNA, and thus traits (characteristics) arising from naturally occurring changes. This was done without prior knowledge of the nature of the molecular modifications that might occur in the genes — the DNA — or the resulting changes in the plant.

Almost 100 years ago, plant and animal breeders discovered other ways of facilitating genetic mutation (e.g., by the use of radiation and certain chemicals). A number of common foods resulted from these techniques, including seedless watermelon and bananas, different varieties of wheat, and red grapefruit.

All of these breeding methods involve some form of genetic manipulation — "biotechnology" in fact, whether natural or otherwise — since genetic mutation is the key to selecting the desired traits. Thus, from a scientific perspective, the term "genetically modified organism" need not apply solely to the products of modern biotechnology, as virtually all domesticated crops and animals have been subjected to varying degrees of genetic modification.

### A DISTINCTION WITHOUT A DIFFERENCE

In some quarters, it is believed that genetically modified (GM) crops should undergo special scrutiny because they express novel traits not normally associated with that crop. But does this make sense scientifically?

When a genuinely novel substance (e.g., a new protein or other plant-based chemical) is produced by a plant, testing the new product to ensure safety would reasonably seem to be warranted. But logically this should apply to *any* new species — not just those created using biotech methods. However, testing is not applied equally.

In fact, crops produced using modern biotechnology are all subject to special regulation, whereas those produced by classical methods are subject to neither safety testing nor regulation. This is a scientifically flawed approach, since only the products of gene manipulation — new traits — form the characteristics of the newly modified organisms, *not the method used to produce the new variety.*

To date, the many new GM crop varieties produced since 1996 have been without exception safe to plant, grow, harvest, and consume.

### SAFETY CONCERNS: IS THERE ANYTHING TO WORRY ABOUT?

As long ago as 1987, an analysis published by the U.S. National Academy of Sciences examined the available research and concluded that plants and other organisms produced using genetic engineering techniques posed no new or different risks to human health or the environment than those produced using other breeding methods.


This opinion has been echoed by regulatory agencies both in the US and in other countries, including the Food and Agriculture Organization of the United Nations, the World Health Organization, the Organization for Economic Cooperation and Development, the European Commission, the French Academy of Sciences, the U.S. National Research Council of the National Academy of Sciences, the Royal Society of London, and the Society of Toxicology.

Nonetheless, genetically modified crops produced using biotechnology are specifically regulated by governments and may not be marketed until they have successfully passed a rigorous pre-market safety evaluation. On a case-by-case basis, it is determined if the new trait introduced into a crop is cause for safety concerns. In principle, the focus of regulators should be the safety of the new trait — not the fact that genetic engineering has been used to introduce the new trait. Yet, paradoxically, crops developed using less precise and more disruptive methods of breeding may be released *without* any pre-market regulatory review.

This is not to suggest that classical breeding methods are inherently unsafe. What it does suggest is that the contrasting regulatory treatment of these two classes of plants is arbitrary, merely adding a needless, burdensome obstacle to innovation while tremendously increasing costs, and thereby chilling innovation.

*It is important to keep in mind that there is no evidence that the uncertainties associated with transgene insertion are any greater than those that occur with other forms of genetic modification, such as the random genetic changes that result from mutation breeding, and are, in fact, likely to be less uncertain.*

## HOW DOES BIOTECHNOLOGY HELP TO FEED THE WORLD?

The first biotechnology products commercialized in agriculture were crops with improved agronomic traits, primarily pest and disease resistance and herbicide tolerance. The benefits of these traits to agriculture are bound to grow in importance as the world's population expands from the current 7 billion to a forecasted 9 billion by 2050. According to some estimates, agricultural production over the next 25 years will have to double just to keep pace with rising demand.

Modifications of crop plants can be organized into two broad categories: those that benefit the producer through introduction of such properties as improved insect, weed, and disease management; and those that benefit the consumer more directly, with increased nutritional value, flavor, or other desirable product attributes.

The most important genetically modified crops are corn, cotton, soy, and canola. U.S. farmers grow significant quantities of each of these crops. Even though rice is the principal staple for much of the world, GM rice is not commercially marketed anywhere. However, some biotech rice has been cultivated in test fields, and China is known to have GM rice fields, although the crop is not available for public consumption.

Unfortunately, progress is sometimes not accepted, and there is no better example than the tragic story of "Golden Rice." This rice, which was developed by researchers in Switzerland and Germany in 2000, was gene-spliced to produce beta-carotene, which is converted in the body to vitamin A. According to the World Health Organization, "an estimated 250 million preschool children are vitamin A deficient and it is likely that in vitamin A deficient areas a substantial proportion of pregnant women is vitamin A deficient. An estimated 250,000 to 500,000 vitamin A-deficient children become blind every year, half of them dying within 12 months of losing their sight."

Yet, despite numerous risk assessments, the modified crop did not win governmental approval until February 2013. Worse still, anti-GMO activists and farmers, led by Greenpeace, recently stormed and destroyed a Golden Rice test field in the Philippines. By doing so, they contributed to the resistance to progress in supplying vitamin A to those in dire need, and this will certainly translate into loss of vision and life.

As illustrated by this needless, fear-based destruction, opposition to agricultural progress is not an abstract issue. It causes blindness and death worldwide. Critics of biotechnology may choose to ignore these facts, but in the real world their opposition to progress has real consequences.

## SHOULD GM FOOD BE LABELED?

The question of whether foods derived from organisms modified with recombinant DNA techniques should be specially labeled has received a great deal of attention. The U.S. Food and Drug Administration's approach to the labeling of foods is quite clear. Special labeling is required "if a food derived from a new plant variety differs from its traditional counterpart such that the common or usual name no longer applies, or if a safety or usage issue exists to which consumers must be alerted."

Examples include the potential introduction of a toxin or allergen into a food product in which consumers would not ordinarily expect to find it (e.g., an allergenic protein from nuts in corn), or a significant change in the level of dietary nutrients in a food (e.g., oranges with abnormally low levels of vitamin C).

Therefore, the FDA's position is that no pre-market review or approval is required unless characteristics of the biotech food explicitly raise safety issues. Indeed, the FDA does not currently require the labeling to make mention of the genetic method used in the development of a new plant variety.

Nonetheless, many of the novel nutritionally enhanced foods expected on the market in the next few years may well be labeled, voluntarily, as they will differ from their traditional counterparts, and in most instances marketers will want to proclaim the new product's enhanced nutritional value.

## WHAT ARE THE BARRIERS TO BIOTECHNOLOGY?

Biotech crop developers face a number of hurdles when introducing new varieties. Although GM crops are grown in 29 countries, the technology has been met with stiff resistance from some consumers, producers, and non-governmental organizations (NGOs), as well as regulators. Many countries ban both the cultivation of GM crops and the import of food or animal feeds derived from them. Yet, even in the countries where GM crops are grown, such as the United States and Canada, the vast majority of production is limited to cotton and commodity grains (e.g., corn, canola, and soy) that are primarily fed to livestock or consumed by humans only after processing into products such as sugar, which is identical in every way to sugar derived from sugar cane.

A bigger problem than consumer and regulatory resistance is the rejection of biotech foods by producers and retailers. A small but important segment of the public holds very passionate anti-biotechnology attitudes. In response, many packaged-food companies and food retailers have been reluctant to embrace GM products. With anti-biotechnology campaigners eager to protest against supermarket chains and food processing companies that use bioengineered ingredients, it is understandable that some firms are reluctant to put their hard-earned reputations at risk.

## WHAT'S THE BOTTOM LINE?

The United Nations' Food and Agriculture Organization (FAO) estimates that about one billion people worldwide suffer from under-nutrition, to which insufficient protein in the diet is a significant contributing factor. Protein-energy malnutrition is the most lethal form of malnutrition and affects every fourth child. Biotech crops could potentially do much to relieve the problem of under-nutrition, especially in some cultures where plant-based nutrition comprises almost 100 percent of the diet.

There are no alternative technologies available to plant breeders with which new improved varieties can be created to overcome the current limitations of global agriculture to produce sufficient food, feed, fuel, and fiber on available land.

Although the scientific hurdles to achieving these goals are not trivial, it is the non-technical factors that pose the most difficult challenges, especially excessive precaution leading to prohibitive biosafety rules, as well as public resistance.

The last two are the most insidious of the limitations on biotechnology as they have little basis in fact and thus are difficult to refute effectively. It is easier for foes of agricultural biotechnology to appeal to emotion and sell fear than it is for them to present a reasoned and judicious scientific rationale on which to base risk analysis. Looking forward, the actual commercialization of biotech products may have less to do with technical limitations and more to do with external constraints, primarily the process of regulatory approval.