

Food Biotechnology: What Is It Really All About?

Food biotechnology is the use of genetics to bring specific results. This includes modifying plants, animals, or even microorganisms to obtain a greater and better food supply. People have been doing this for centuries through selecting and growing food.

History

Farmers have been trying for years to improve crop yields from both plants and animals. This has been accomplished through cross-breeding in animals and grafting in plants. Through this selective mating the plant or animal receives the genes from another plant or animal that will improve a trait in that species. The problem with this is that along with this one good trait comes several traits that may not be so positive. This is because plants have more than 100,000 genes and with each gene comes a character trait. After cross-breeding two plants, the farmer must then go through back-breeding to keep the good traits and breed out the bad traits.

A time table for biotechnology would look like this:

500 B.C.—Selective breeding of goats, cattle, chickens, etc. replaces the need to hunt.

300 B.C.—Grafting techniques developed by the Greeks leads to the creation of orchards and groves.

1852 A.D.—The first international show to feature corn varieties is held. Varieties of corn

come from Syria, Portugal, Hungary, and Algeria, among other countries.

1862—The Organic Act created the U.S. Department of Agriculture (USDA). The USDA was directed to collect seeds to distribute to farmers.

1865—Gregor Mendel began the study of modern genetics, although it was not accepted at the time.

1900—The field of genetics is established.

1933—Only 1 percent of farmers are growing hybrid corn.

1940—Oswald Avery isolates DNA.

1941—A. Jost coins the term *genetic engineering*.

1943—More than 78 percent of farmers are growing hybrid corn.

1953—James Watson and Francis Crick win the Nobel Prize for describing the double helix of DNA.

1962—The green revolution begins with high-yield wheat varieties.

1964—The green revolution spreads to the Philippines to start new strains of rice that double the yields.

1973—The age of biotechnology begins with Dr. Stanley Cohen and Dr. Herbert Boyer recombining ends of bacterial DNA, thereby coining the phrase *recombinant DNA*.

1981—The Chinese clone a golden carp (fish).

1982—The first genetically engineered product, humulin insulin, was introduced to the market in the United States.

1990—The first genetically engineered food product modified by biotechnology, cheese, was introduced into the market place. The cheese contained an enzyme that was created through the biotechnology of removing the enzyme from the stomach of calves. New technology now allows the use of this enzyme without the slaughter of animals.

Through the centuries humans unknowingly moved and changed genes to improve food.

Effect On Nutrition And Health

The United States is one of the best fed nations, partly because of selective breeding. Today's corn, soybeans, and canola oil have all been the result of this technology. Researchers have reviewed the effect on the nutrient content of the foods being altered to make sure that there has been no reduction in the nutritional content of the food product.

The future might hold:

- Potatoes with more starch that would absorb less fat when fried.
- Vegetables with greater vitamin content.
- Meat with reduced fat.

- Strawberries with ellagic acid that will reduce cancer risk.
- Garlic with more allicin, which will reduce cholesterol.

Food Allergies

One of the greatest concerns with biotechnology is the possibility of creating a food allergy. Food allergy is an adverse reaction to an otherwise harmless food or food component (usually a protein) that involves the immune system. Any allergy that occurs as a result of the addition of these proteins should be reported to the U.S. Food and Drug Administration. FDA policy requires testing for safety before a company places a food product on the market.

On the other hand, a known allergin could be removed from a food. Through biotechnology, the riddle concerning the actual factor that causes food allergies could be solved.

Benefits Of Biotechnology

Biotechnology has many other benefits aside from that of feeding the masses of people in the world. One of the major benefits is increasing plant resistance to insects and disease. This would result in a reduction in the number of acres of crops lost to disease and spoilage, as well as the reduction in the amount of chemical sprays needed and currently used on crops.

Another possible benefit would be to increase feed stock efficiency. Some feeds are not metabolized or digested by animals, and that results in a loss of energy that could be available to the growing animal.

Plants have developed more than 10,000 natural compounds that protect them against threats of various kinds. These natural toxins are intended to guard against specific threats by predators or disease, such as hungry

insects or damaging fungi. Some of these toxins produced naturally by plants could cause illness in humans if they were concentrated at high levels and were consumed in large quantities. Examples include:

- Rhubarb, which can contain oxalates.
- Green potatoes, which contain chaconine and solanine.
- Wine, which contains tyramine and tannins.

Over the years, through breeding techniques, plant breeders have devised well-established methods to identify and eliminate strains of plants that express unacceptably high levels of toxicants. Through biotechnology, these toxins could be eliminated in a much shorter time span.

Labeling

Labeling is a big issue in biotechnology. It presents some problems but it could be accomplished. Many consumer advocate groups such as Public Voice, Center for Science in the Public Interest, and others want all foods altered by biotechnology to be labeled. Consumer demand will be the only driving force that will lead to labeling requirements. However, labeling will be required when a food product contains a known allergen. Also, a label will be required if the nutritional composition is altered. Some of the following are specific examples of labels that will be required:

- Peanuts contain a known allergen, and, if this gene were added to another plant, the product would have to be labeled.
- If genes were altered in oranges and this resulted in either a reduction or an increase in vitamin C, oranges would have to be labeled.

- If a gene was removed and the final food product would not taste or appear just as the original product, then the product would require labeling.

Federal Regulations

Besides FDA, many governmental agencies are involved in a product appearing on the market. The Animal and Plant Health Inspection Service (APHIS) deals with the enforcement of all USDA regulations related to biotechnology. They also approve field research projects which deal with the altering of plants or animals. The Environmental Protection Agency (EPA) has control over any microorganism or virus that would be introduced to control plant toxins or insects. Several laws currently give the control to EPA over these areas. These laws include the Federal Insecticide, Fungicide and Rodenticide Act and the Toxic Substances Control Act.

Food Products On The Market

Cheese made from the enzyme produced by biotechnology was the first engineered food product on the market. Soon to follow was a yeast that is used in bread making. The most recent food product to be placed on the market is the Flavr Savr tomato. The story of this tomato and how it got to the marketplace is shown in Figure 1.

Several other products are being tested but are not yet on the market. These include:

- Potatoes grown on vines that are resistant to insects.
- A crookneck squash being developed that will be resistant to a virus that destroys 80 percent of the annual crop of squash.

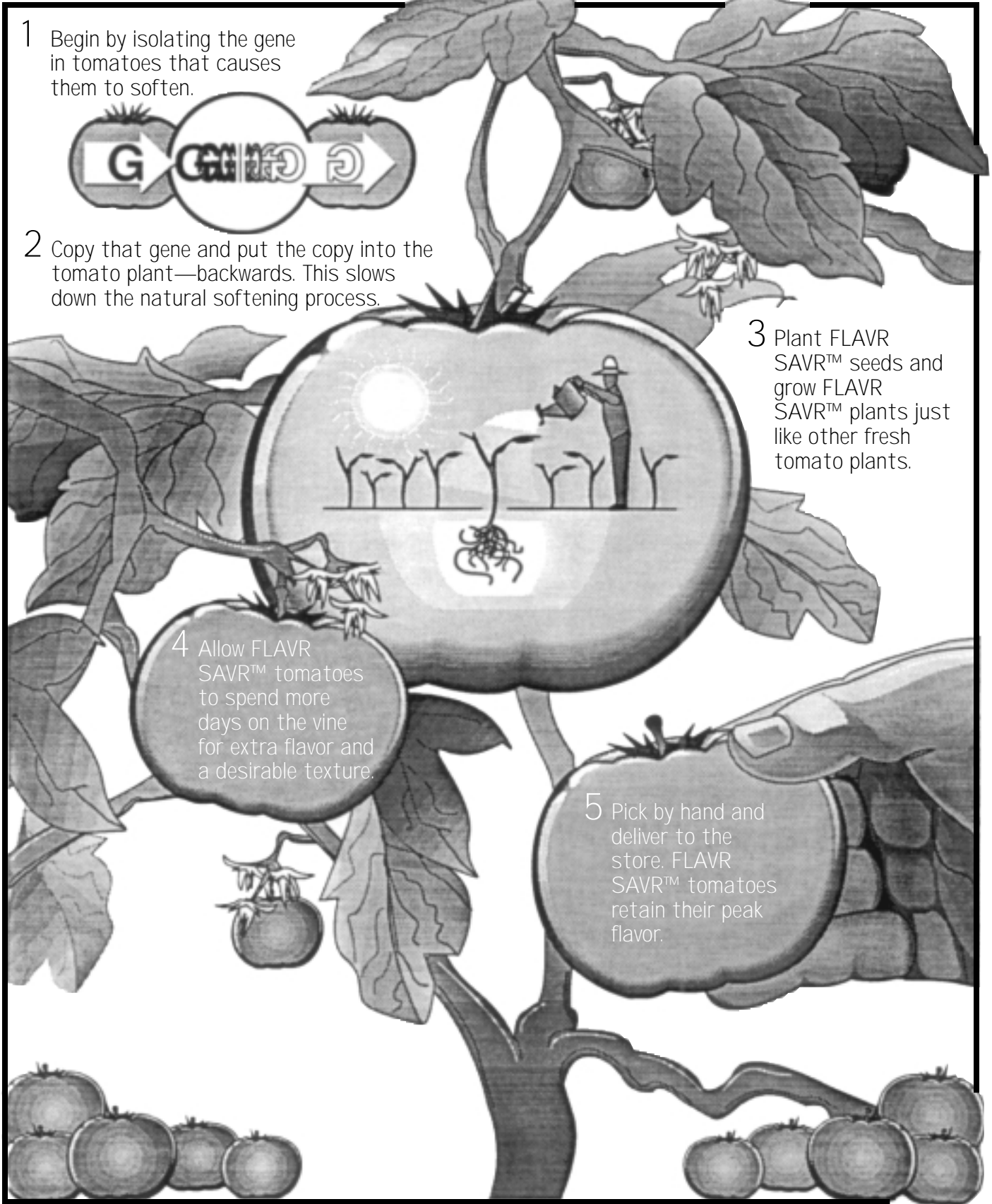


Figure 1. Bringing the FLAVR SAVR™ tomato to consumers (courtesy Calgene Inc.).

• A sweet potato variety that would not be destroyed by the feathery mottle virus (FMV). This virus results in an almost 60 percent loss of the sweet potato crop in Kenya, Africa. Through the biotechnology work of Dr. Florence Wambugu, this loss has already been reduced on a trial basis. This gives new hope for dwindling food supplies in Africa.

Summary

Bioengineering represents the future of our technology based society. As we gain knowledge on how to control diseases, the

next step in this control appears to be bioengineering, not only in food but in medicine. Imagine the day when we can identify the gene that results in some catastrophic disease. The gene could be removed or changed so that the disease would not occur. This step could save many lives.

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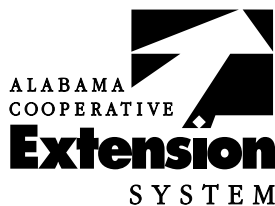
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