

Biotechnology: Designing More Nourishing Foods



Biotechnology has been used for more than 25 years. Today, there are more products with some form of connection to biotechnology available in the marketplace than most consumers realize. Many medicines, including insulin, are produced using the tools of biotechnology. Foods with improved nutritional composition, functional characteristics (such as a longer shelf life), or sensory properties (for instance, fruits that stay sweet tasting) have been designed with biotechnology. Biotechnology has been used to develop or alter many of the foods now on the market as single foods, or as ingredients in combination foods.

Definition Biotechnology may be defined as "the use of methods to modify the genetic material of living cells so they will produce new substances or perform new functions."

Examples of biotech foods

- In the mid-1970's, microorganisms were genetically altered to improve the efficiency of fermentations and to produce natural food ingredients.
- In the early 1990's, biotechnology was first applied commercially to foods from animals when a hormone that could be given to dairy cows to increase milk production was approved by the U.S. Food and Drug Administration (FDA).
- The first commercial whole food from a plant modified by biotechnology was the Flavr-Savr tomato, made available in the mid-1990's. Soon afterwards, several other "biotech" foods, including tomatoes, squash, potatoes and soybeans, were introduced in the marketplace. • FDA approved more than 40 biotech foods during the next five-year period. Examples include cotton (cottonseed oil), soybeans (soybean oil, soy protein, and other soy products), field and sweet corn (corn syrup and corn oil), potatoes (eaten as french fries, potato chips, and many other potato products, as well as potato starch), rapeseed (canola oil), regular and cherry tomatoes (and tomato products), zucchini and crook-necked squash, peppers, chicory, cow's milk (and milk products), papaya, sugar beets (sugar and sweetening agents) and flax (meal and flaxseed oil).
- Bacteria modified through the tools of biotechnology are used to make yogurt, cheese and vinegar. Genetically-altered chymosin (rennet) is used to make cheese, and replaces the more expensive enzyme rennin, which is obtained from animal sources.
- A biotechnology-derived enzyme can be added to milk to reduce lactose content for persons with lactose intolerance.
- Microbes have been altered to produce amino acids for the manufacture of aspartame, a common sugar substitute.

Some foods have been modified using biotechnology to provide better nutrition.

- A biotech vitamin-rich tomato that has about four times the normal level of beta-carotene and twice the level of lycopene has been developed in Europe. Beta-carotene is used by the body to make vitamin A, and lycopene reduces risk for some cancers.

- Golden rice has had beta-carotene and genes that help increase iron absorption added through the tools of biotechnology. Nutritionists hope that common health problems caused by nutrient deficiencies, such as night blindness and anemia, will be reduced in many parts of the world if the nutritional value of staple crops can be sufficiently improved.
- Another type of rice has been modified using biotechnology to remove proteins causing allergic responses in some people.
- Potatoes with higher starch content have been produced with biotechnology. More starch means less oil is absorbed during frying, so there are fewer fat calories in the french fries and potato chips. It also costs less to fry them compared to potatoes with lower starch content.
- Canola and soybean oils have been developed with improved, more nutritious types of fat.
- Food-based vaccines have been designed with biotechnology. A new variety of banana has been developed that carries a hepatitis B vaccine. Making it widely available could help improve the health of people who live where certain diseases cause up to 10 million deaths annually, particularly among children. The banana does not require refrigeration, so it is easier to store than traditional hepatitis B vaccines.

Possibilities Researchers are using the tools of biotechnology to extend storage life of foods, to make them more healthful, to improve their taste, and to eliminate allergenic factors and thereby reduce the likelihood of allergic reactions. The number and kinds of food projects in progress are expanding rapidly. A few examples are described below.

- Corn and soybeans with increased protein content are being developed to improve their nutritional value.
- People with a disease known as PKU have a problem metabolizing the protein phenylalanine. Using biotechnology, a new variety of wheat is being designed that does not contain this substance. With this factor eliminated, people with PKU will be able to eat food products made from this wheat without suffering severe health consequences.
- Foods with high levels of naturally occurring toxins are being modified so that the level of the unhealthy factor is reduced.
- Ways to modify milk to reduce allergic factors while improving its nutritional value and shelf life are being studied.
- Some microorganisms are being altered so that they produce human-compatible digestive enzymes. Correcting certain digestive enzyme problems in people who cannot naturally make enough of these enzymes may someday involve placing these organisms into the intestinal tract of such persons. Persons with immune disorders might be treated in the future with microorganisms developed through the tools of biotechnology. These new microbes would produce the needed antibodies.

Nutritional & Health Concerns about Biotech Foods

The FDA requires special labeling if the composition of a food developed through biotechnology differs significantly from its conventional counterpart. For instance, the changed food product might need to be called by a different or modified name. The nutritional composition -- proteins, fats, fiber, carbohydrates, and some minerals -- of biotech foods are compared with those of traditional-source foods before they are allowed on the market. If there is a significant change in nutritional content, the label on the new food needs to clearly reveal the difference. Proteins that have been placed into new foods that are on the market through the tools of biotechnology are rapidly digestible. Before FDA approval is given, scientists also examine whether naturally occurring toxins are present at higher levels in the modified foods. Biotech feeds developed for animals raised as food sources must meet the same safety standards as human food. No health hazards are known to have occurred with biotechnology-derived foods that have reached the marketplace.

Novel non-biotech foods introduced into the U.S. marketplace from other areas of the world are not labeled as to whether they cause allergies before being offered to consumers. For example, kiwi fruits were brought into the U.S., even though some people are allergic to them. When consumers try a completely unfamiliar new food, however, they might suspect they could be allergic to it. However, foods changed through the tools of biotechnology must be tested to see if they are likely to cause allergies. Because of concerns about allergies, food developers using biotechnology take steps to minimize the chances that a new food will cause an allergic reaction. They test the proteins in new biotech foods for similarities to the proteins that are known to cause most allergic reactions. For example, a company was using biotechnology to improve the protein quality of soybeans by inserting a gene from Brazil nuts. The group discontinued its work on this project because of the possible risk of allergic reactions in people who already had Brazil nut allergies, and the new soybean was never released to the market. Consumers would not have expected soybeans to cause Brazil nut allergic reactions. If there is a potential allergen in a new food developed with biotechnology, its food label must clearly reveal this so those allergic consumers can avoid the product.

Reactions to Biotechnology from Health Organizations

- The American Dietetic Association took the position that biotechnology techniques have the potential to be useful in enhancing the quality, nutritional value, and variety of food available for human consumption and in increasing the efficiency of food production, food processing, food distribution, and waste management. (December, 1994)
- "Biotechnology currently offers ways to grow more food on less land. Even more promising are the benefits from nutrient enriched foods that are being developed. In addition to vitamin and mineral enriched foods that will prevent disease and malnutrition in the third world, I see tremendous benefit to packing more complete proteins, micronutrients, etc. into fewer calories. As our activity levels go down, we will need to find ways to meet our nutritional needs with fewer calories. The use of precision tools to insert genes carrying only the trait that you want has significant human health and agronomic advantages that traditional cross breeding does not." Barbara Petersen, Ph.D. Nutrition Biochemist, Novigen Sciences, Member of World Health Organization Joint Expert Committee on Food Additives and Contaminants.

What's the Consumer to Do?

The application of biotechnology in foods remains a political and social issue. With any new technology, there are potential benefits as well as potential risks. According to surveys, consumers are interested in biotechnology and most favor its use in the food supply. But consumers are not well informed about biotechnology. Using biotechnology to change plants is considered much more acceptable than using it to change animals. Environmental concerns are important to most people. Some groups believe the FDA does not adequately provide for consumers' right-to-know. They want to know whether genetic engineering was used to produce a food, and want to be able to choose food on the basis of how it was produced. Others believe that labeling is not necessary if foods are similar (or "substantially equivalent") in composition. Many people today are enthusiastic about the potential for these new techniques to improve nourishing qualities of their food choices. Others are skeptical, and believe that humans may be exposed to new, unpredictable health problems because of biotechnology. Increased awareness and knowledge about current practices will allow consumers to more accurately evaluate biotechnology, and other new technologies that affect food.

Sources for more information:

KSU's agricultural biotechnology website

<http://www.ksre.ksu.edu/biotech/>

American Dietetic Association position paper on biotech foods

<http://www.eatright.org/abiotechnology.html>

International Food Information Council's food biotechnology site

http://ific.policy.net/proactive/newsroom/release.vtml?id=18327&PROACTIVE_ID=cecfcec9cfdc8c7c8c5cecfcfcc5cecececdc6cac7cfc6c7c5cf

FDA's policy for foods developed by biotechnology

<http://vm.cfsan.fda.gov/~lrd/bioeme.html>

U.S. regulatory oversight in biotechnology

<http://www.aphis.usda.gov/biotech/OECD/usregs.htm>

Mary L. Meck Higgins, Ph.D., RD, LD.
Extension Specialist, Nutrition Education

K-State Research and Extension is a short name for the Kansas State University Agricultural Experiment Station and Cooperative Extension Service, a program designed to generate and distribute useful knowledge for the well-being of Kansans. Supported by county, state, federal and private funds, the program has county Extension offices, experiment fields, area Extension offices and regional research centers statewide. Its headquarters is on the K-State campus, Manhattan.