

Lesson 5: Biotechnology in the Food Industry

In the food industry, biotechnology has likely made an impact on food you have consumed. This lesson will define biotechnology, examine its effect on food production, discuss examples of bioengineered foods, and look at biotechnology's future.

What is Biotechnology?

Biotechnology can be defined in many ways. The use of microorganisms, animal cells, plant cells, or components of cells such as enzymes to produce products or carry out processes for human benefit is the detailed definition. A more concise way of defining biotechnology may be the use of living organisms or their enzymes to make commercial products.

Biotechnology's Effects on Food Production

People using principles of biotechnology have made dramatic impacts on global food production. A greater variety of foods is the first result. A tangelo is a bioengineered hybrid between tangerine and grapefruit trees. Potatoes prefer cool climates, but may soon be produced in hot, humid climates. Soybeans are one of the brightest stars of current food biotechnology research.

A second result of biotechnology's effect on food production is the increased shelf life/safety of food. Food preservatives and fermentation are some of the areas in which food scientists have applied biotechnology toward food safety and shelf life enhancement. This area holds great promise in reducing the need for synthetic pesticides and food additives.

Another area of biotechnological advances has been harvested to benefit greater efficiency in food production. Crop production benefits from biotechnology produced fertilizers, pesticides, genetic-engineering, and hydroponics. Animal agriculture benefits from new vaccines, nutritional advances, embryo transplant programs, feed additives, and growth hormone research.

Bioengineered Foods

One only has to browse through a grocery store to find hundreds of food products that are a result, to some degree, of bioengineering. Enzymes, low-calorie foods, waste management, biological monitoring, casings, and insulin will be evaluated in this section.

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Rennet and lactase are enzymes used in the dairy fermentation industry. Naturally, the enzyme rennet is used to coagulate casein during cheese-making, and is consumed in each batch. Bioengineered, immobilized rennet improves its stability and allows easy separation from the cheese, thus it can be recycled and reused. Lactase cleaves lactose to glucose and galactose. It too can be immobilized and recycled.

Low-calorie foods may contain non-nutritive sweeteners like aspartame, thaumatin, or monellin. These compounds are taste active proteins. The genes that code for these compounds may be isolated and transferred to non-harmful bacteria. Since bacteria reproduce so quickly, bacteria with these sweetener genes can be added to food products in a fermentation process and transfer the taste. Low-calorie foods are also one of the goals of soybean and rapeseed research. By reducing the oil content of the seed, more protein would be produced per seed. Genetic engineering may soon produce extra-lean pork and beef carcasses, resulting in red meat that fits better into a healthy diet.

In waste management, the waste from food processing, particularly the whey from cheese making, can be consumed by a bioengineered yeast. This particular yeast produces a grape aroma and could be used as a flavor component in the wine and food industries.

Biological monitoring is another prospect for bioengineered foods. DNA fragments from disease-causing microbes can be coded, isolated, and hybridized to detect the presence of the same microbe in food.

Bioengineering is responsible for manufactured casings used as a substitute for natural casings. Cellulose casings are produced from cotton lint and paper pulp. Collagen casings are made from the inedible portions of the beef carcass.

Businesses Involved in Biotechnology Research

Anyone who has been involved in selective breeding programs has been involved in biotechnology. However, the new technologies that allow scientists to work at the cellular or chromosomal level require expensive equipment. Major advances in biotechnology have been the result of the cooperative efforts of many business enterprises.

The United States Department of Agriculture (USDA), universities, food processing companies, commodity organizations, the National Live Stock and Meat Board, and other food related companies are active in biotech research.

Future Influence

The Green Revolution, which is the widespread adoption of high-yielding grain varieties along with an expanded use of fertilizers and irrigation, started in the late 1960's. Will the Green Revolution continue? As long as there are hungry people to feed, science and agriculture will continue to strive to feed them. The need for better weed control, less insect damage, enhanced nutritional quality and safety, greater disease resistance, and improved genetics will fuel the machine to continue the biotechnology revolution. Look for a longer shelf life, new vaccines, less dependence on petroleum-based oil, further advances with soybean- and corn-based products, a greater dependence on biological control of insects, and new resistant varieties of fruits and vegetables. Herbicide-resistant corn, greater reliance on hydroponics, possibly grasses that fix their own nitrogen, soy-based coatings to keep food from dehydrating or oxidizing, and natural antifreeze sprays to prevent citrus trees from freezing are just a few samples of what the future may hold. Herbicide-Resistant Corn is a genetically engineered corn variety that is tolerant to previously lethal herbicides.

Factors Influencing New Developments

To name every factor that may influence new developments in food biotechnology would be similar to forecasting next year's weather. Some factors are known while several remain unknown.

Generally, the greatest need receives the most attention and effort. "Where there is a will, there is a way" is the old saying. If there is semi-drought growing conditions in the Midwest for five consecutive years, drought-resistant crops will be developed and planted. If a new strain of grasshopper invades the South, a new insecticide will likely be developed.

Finances always play a role. Research takes money, whether it is federal, state, or private funds. The need for talented, committed, educated researchers will need to be met. Biotechnology takes some specific facilities and equipment. The weather will play a part in research of plants, insects, animals, etc. Time is also a factor. New releases must be thoroughly tested before release. The Food and Drug Administration and Environmental Protection Agency require extensive testing.

Summary

The biotechnology revolution will continue to make major impacts on human lives. The use of microorganisms, animal cells, plant cells, or components of cells such as enzymes to produce products or carry out processes for human benefit will increase in the future. Whether it is protein derivatives; resistant varieties, or low-calorie foods, biotechnology will continue to impact a growing population.

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Credits

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