

Lesson 1:
Challenges to Biotechnology

Some people view biotechnology as an answer to problems like world hunger, but others see it as a source of social, economic, environmental, and ethical concerns. Critics of modern biotechnology express a fear that biotechnology may be advancing too rapidly, without adequate safeguards. This lesson will examine several issues surrounding modern biotechnology.

The Issues

Although many issues have emerged from recent scientific research in biotechnology, most of them can be categorized into one of five groups. The first group deals with the safety of consuming genetically engineered foods. Are there any negative effects from eating these foods? Is it possible that modified foods will trigger allergies? What are the long-term effects of a diet containing genetically modified foods? The second set of issues concerns consumer choice and the labeling of genetically modified foods. Should genetically engineered food products be labeled so that consumers who prefer not to eat them will know which ones to avoid? What are the problems associated with mandated labeling of foods? The third group of issues involves the safety of releasing genetically modified organisms into the environment. What are the consequences of allowing modified plants or animals to mix with closely related organisms? Is the release of these organisms reversible? The fourth group of issues involves questions about whether using biotechnology on animals to produce more meat, milk, or other products or to yield human health products jeopardizes the welfare of the animals. The fifth set of issues includes moral questions about whether genetic engineering of plants and animals is ethical.

Food Safety

The Food and Drug Administration (FDA) is the federal government agency in charge of making sure that the food supply is safe. The FDA states that genetically engineered foods are as safe as or safer than foods already on store shelves. The basis of their claim is that genetically modified foods must meet the same standards as other foods. Most of the research done on the safety of genetically engineered foods confirms that they are as safe as nonengineered foods. Many scientific studies show that modified crops do not differ in chemical composition from foods that have not been modified. The government, most researchers, and many consumers accept genetically modified crops as safe.

Questions persist about the safety of modified foods for humans, however. Some consumers, including some restaurants and chefs, have stated that they will not use any food that has been genetically engineered. They claim that the government has done very little to ensure the safety of these foods. Some scientists caution that since no long-term studies have been done on the effects of genetically modified foods on human health, no hard evidence exists on which to base statements about their safety over a long period. Some people who are concerned about food safety are calling for long-term testing to determine the effects of genetically engineered foods on humans.

Other consumers have more specific concerns about food safety. They fear that genes that cause allergic reactions may be introduced into a food that was previously safe to consume. They are also concerned that antibiotic-resistant genes (which are used during the process of genetic engineering) in modified food products may reduce the effectiveness of antibiotics used by people who consume the products.

Labeling of Genetically Modified Foods

Some people argue that genetically engineered foods should be labeled because the public has the right to know if a food has been modified. Individuals can then make an informed decision about whether to buy the product. Some people view genetic modifications as unacceptable for religious reasons. Vegetarians may

Biotechnology: Applications in Agriculture

want to avoid modified foods because they may contain genes taken from animals. Other people may simply wish to avoid eating genetically engineered foods.

The FDA has stated that since genetically engineered foods are no different from other foods, no need exists for labeling foods as modified. The FDA has two exceptions to this policy. The first is that if a gene that has the potential to cause an allergic reaction is placed in a food, the label must identify the allergen. The second exception is that if a significant change is made in the food's composition, a label must identify this change. A significant change in composition includes any change in a food's nutrient or chemical content. The FDA states that it does not have the power to mandate that companies label foods to explain how they were developed.

Releasing Genetically Modified Organisms

Now that companies are marketing genetically modified crop seed such as insect-resistant cotton seed, the risk of releasing genetically modified organisms into the environment is again under debate. The governments of some countries, including the United States, Japan, and Australia, have stated that if nations follow voluntary precautionary policies, the environment is not at risk from modified plants and animals. The United States Department of Agriculture (USDA) had approved more than 25 genetically modified plants for commercial use by the end of 1996. Other governments, such as those in the Philippines and many European nations, have refused to allow genetically modified crops to be imported or grown in their countries. They fear the release of genetically modified plants and animals into the environment. Unless these countries can work out their differences, international trade may be affected.

Some scientists say that releasing genetically modified organisms into the environment is dangerous because they may introduce altered genes into native populations, giving them undesired traits. For some plants, the risk of modified genes entering a wild population is nearly nonexistent; for example, no plants with which cotton can cross pollinate grow in the wild. However, the yellow crooked-neck squash, which has been modified to resist disease, can cross pollinate with a closely related weed, the Texas gourd. The modified plant is now nearing the marketing phase. The squash could possibly pass on the DNA that allows it to resist disease to this noxious weed. Weeds that do obtain the advantage of genetically modified traits could potentially choke out other plants.

Another concern some environmentalists have about releasing genetically modified organisms into the environment is their effect on biodiversity, or diversity in the numbers of different species of plants and animals. They fear that unmodified organisms will not be able to compete, which will eventually reduce the biodiversity that exists in nature. If this happens, not only would species become extinct, but a potential source of products useful to human beings could be lost. Important sources of genetic information would also disappear with the plants and animals that become extinct.

Animal Welfare Issues

As advances in animal biotechnology continue, questions will be raised about whether the genetic engineering of animals is ethical from the standpoint of animal welfare. Some people question whether it is morally right to genetically engineer an animal to alter its natural ability to produce. One concern is that increasing an animal's production capacity may cause poorer animal health. When the FDA approved bovine somatotropin (BST) in 1994, controversy arose over whether the 10 to 20 percent increase in milk production was desirable, since a higher rate of mastitis and a change in the composition of milk might also occur. Studies of BST done in the United States have shown few effects on animal health. However, European countries, under the pressure of animal rights groups, still do not allow the use of BST.

Some people argue that genetically engineering livestock to produce pharmaceuticals and other health products for humans is inhumane. Some animals have already been genetically engineered to produce a desired pharmaceutical in their milk. Pigs that have been modified to produce human blood plasma must be killed to harvest the product. Opponents believe that such uses of animals are unethical.

The Morality of Genetic Engineering

Some groups have raised the basic question of the morality of genetic engineering as a whole. People who hold this viewpoint commonly express one of two main moral objections. The first is that humans are “playing God” by manipulating the basic elements of life. Doing so oversteps the bounds of what is appropriate for humans. Counter arguments generally state that human beings should use all the knowledge available to them to improve the human condition. The second moral objection is that genetic manipulation will permanently alter the balance of nature. This view states that human beings should not interfere with natural processes but should learn to live in harmony with their environment. The opposing argument is that humans have manipulated nature in many ways throughout history, and biotechnology is just another way to do so.

Summary

Many social and moral issues are associated with biotechnology. These issues include the safety and labeling of genetically modified foods, the safety of releasing genetically modified organisms into the environment, animal welfare issues, and the morality of genetic engineering itself. These issues are being debated in public forums. Coming up with acceptable answers for these tough questions will take time, but many people consider the debate to be healthy and important in shedding light on these issues.

Credits

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Biotechnology: Applications in Agriculture

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