Genetically Engineered Foods

For centuries, gardeners, farmers and plant breeders have crossbred plants with the intention of creating a prettier Bower, a tastier fruit, or more attractive vegetable.

Since 1994, a growing number of foods have been developed using the tools of a new biotechnology based OD DNA discoveries. The new biotechnology differs in that it can involve the direct transfer of specific genes from one kind of organism, into any other kind of organism.

How does it work?
First, let's review some basic biology. All living things, plants, animals, including humans, are made up of cells. Within each cell is a nucleus that contains chromosomes. Chromosomes are strands of genes made of deoxyribonucleic acid, or DNA. The genes are blueprints that all living things use to transmit instructions to themselves and to the next generation of just how to be that particular plant or animal. For example, genes contain directions to our bodies to grow blond or brown hair and directions on exactly how to do it. They tell a tomato to become red or yellow and exactly how to do it. They tell people and tomatoes how to fight off infections. They tell bananas about how long they can live after being picked before they turn brown and what kinds of vitamins they will contain. What's amazing is that through the process of evolution, all living organisms share many of the same genes. For example, people share about 7000 genes with the worm, C.elegans. The main difference between organisms is the total number of genes they have, how they are arranged and which ones are turned on and off at different times. For example, some of the genes in plants are exactly the same as the ones in you. You've probably heard of the term antioxidant. Certain molecules in the tomato keep it from oxidizing, or turning brown, just like those same molecules prevent your cells from certain kinds of oxidizing damage, too. In fact, one of the reasons we eat tomatoes is to get extra amounts of those molecules, some of which we call vitamins.

Over the centuries, farmers have tried to get more nutritious, attractive or long-lived plants by a variety of methods. When farmers combine two closely related plants, it is called hybridization or cross-pollination because the pollen, or male part of one variety has been carried by wind or insects to the female part of another. The offspring, which is now a third variety, is called a hybrid. Food producers may do this in a laboratory.

Because one set of all the genes of one plant combine with one set of all the genes of another, plant breeders can't be sure what the new plant will be like. Also, because only plants that are already closely related can mate, the possibilities of new traits that the hybrid can have are limited.

Now, because scientists have learned how to identify the function of many genes, and have also learned how to transfer genes from one cell to another, there is a new way to get desired traits in plants. It is called genetic modification, genetic engineering, gene splicing or recombinant DNA.

How does it work?
Genetic engineering involves several steps. The first step is to identify the genes that encode the genetic information for the desirable trait. Then, selected genes are chemically cut out of their strand and are taken by one of several methods to the nucleus of the plant they want to modify. Once in the nucleus, these new genes find their way to a chromosome. Some of them find their way to a suitable place and produce new plants with the desired trait, and some don't. Plants that don't have the desired trait are thrown away. Plants that do have the desired trait are saved and allowed to multiply. These plants are then tested to make sure they are safe to eat, look right and taste right. Another advantage of genetic engineering is that because certain genes are essentially the same in all life forms, scientists will be able to pick and choose the best form of the gene to be the blueprint for certain tasks. The new technique will allow scientists to introduce genes from essentially any organism into a plant.

For example, scientists can DOW take a gene that helps Arctic flounder make antifreeze, put the gene into a strawberry plant and thus extend the growing season of strawberries in cold climates. Just in case you're worried, this does not give the strawberry a fishy taste or smell; it just extends its growing season. Researchers hope one day to develop crops that are drought tolerant, thus greatly increasing the amount of arable land in the world.

They hope to improve the nutritional content of food, such as adding vitamins, or decreasing sodium and cholesterol. In fact, in the year 2000, scientists found that by introducing certain genes from daffodils, along with promoter genes from a bacterium, they could get a rice plant to make beta-carotene, which it ordinarily doesn't make. The body would then convert it to vitamin A. This holds the promise of reducing malnutrition and blindness in millions of children every year. They hope one day to be able to make potatoes that will last without preservatives. So far, their results in these areas have been inconsistent, sometimes even producing food with less nutritional value, and sometimes leading to deformities or immune problems in the animals in whom they were tested. In fact, even the so-called golden rice might not work in all situations because people can't convert the beta carotene into vitamin A and use it properly unless they have enough fat, protein and zinc in their diets. Also, they must be free of certain parasites that give them diarrhea or the beta carotene will be flushed out of their intestines before it can be absorbed and converted. But scientists continue to work OD perfecting the seeds.

Most genetic modifications to date have made it easier and cheaper to grow crops. ID 1999, about half of the American soybean crop carried a gene that makes it resistant to an herbicide used to control weeds. About a quarter of U.S. corn and 60% of the cotton contained a gene that produces a protein harmless to us, but toxic to the caterpillars that attack corn and cotton, reducing the need for certain conventional pesticides.

One of the main sources of donor genes is a common bacterium that lives in the soil, Bacillus thurigiensis, usually referred to as BT. There are many species of BT, each containing genes that code for proteins that are toxic to a variety of common pests that attack crops. Some make a protein that is lethal to certain caterpillars, corn borers, that

destroy corn plants. By inserting these genes right into the genome of corn plants, the corn can make its own pesticide, making it unnecessary to use chemical pesticides.

Advocates of this technology point out this reduces the cost of growing corn and is doesn't add toxic chemicals to our soil and ground water. In addition, they say the corn is safe because this natural pesticide is enough to kill the caterpillar but is present in much too small amounts to harm animals or humans.

Before being allowed to introduce this product into the food supply, the chemical companies that make them do extensive testing to make sure they are safe to people, animals and the environment. They consult with federal regulatory agencies, such as the FDA to find out just what tests they should do.

Safety Issues However, not everyone who has studied genetic engineering is convinced it is safe. They are concerned about the safety of the food made from genetically engineered plants, particularly its potential to cause allergies, and they are concerned about the effect these methods might have on the environment, now and in the futures

Allergies So far, all the genetically modified foods approved for human consumption have been found to be safe, and none have yet been found to be allergenic. This is probably because these proteins are heat sensitive, rapidly digestible, and do not have the structural similarities of proteins known to cause allergies. On the other hand, some scientists say most of the genes introduced into food crops so far have come not from other plants, but from micro-organisms that up till now have not been part of the food supply. Current testing methods are inadequate to be sure the new food product is not allergenic. They also say it is nearly impossible to totally separate bioengineered plants from traditional ones.

They point out that in September, 2000 a variety of bio-engineered corn, Star Link, that was not approved for human consumption was found in taco shells and other processed food products. It wasn't approved because this particular protein is more resistant to digestive juices than are the other bioengineered proteins in use. This means because it is not so readily broken down, if it was allergenic, it could cause allergies. Producers of the seed and some scientists were surprised at the reaction to Star Link. They feel the concern about allergenicity is out of proportion to the risk, and ignores the benefit. They say that some traditional foods, such as shellfish, tomatoes, celery, peanuts and dairy products are highly allergenic. If allergy standards being recommended by some groups were applied to them, they would not be allowed in the marketplace. Genetic engineering techniques even offer the promise of making these foods DOD allergenic. However, because there were some probable cases of allergic reactions to the Star Link corn, Japan refused to import corn products from the United States, and the intensity of the efforts to regulate these foods increased.

Environmental Concerns

Also of concern are the potential effects these new products might have OD the environment.

For example, some environmentalists say the BT toxin meant for the corn borer could also kill non- harmful caterpillars, such as the one that becomes a Monarch butterfly. Organic farmers who, for many years, have been using the whole, live bacteria, BT as a spray, are concerned that using BT as a gene donor will promote the evolution of corn borers that are resistant to BT. They will then have to find new ways to control this pest. There other big concerns to environmentalists. For example, 60% of soybeans in the United States now make a protein that makes the soybean plant resistant to chemical herbicides. This allows farmers to treat a field heavily with the herbicide to kill the weeds, without harming the crop. But, because the soybean, called Ready Roundup, is now able to resist the herbicide, farmers who use it have tended to use more herbicide than they did before. This is harmful to the environment. There is some concern that weeds could develop resistance to the herbicide, although so far this has not happened.

The creation of resistant superweeds, could also arise from cross pollination between food crops that have been genetically engineered and their wild relatives. So far the United States Department of Agriculture has not found any evidence that these superweeds have been created, but they are alert to this danger. Up to now, their position is that the benefits are real while the dangers have not developed. ID fact, this viral interference process has been used in Hawaii to save the papaya crop from being devastated by the ring-spot virus. But still, field trials will have to be conducted over many years, to be sure.

These concerns have prompted US government regulatory agencies to take a greater look at current regulations to see if they are adequate. In the United States, there are three regulatory agencies involved: the Food and Drug Administration, or FDA, the Department of Agriculture, or USDA, and the Environmental Protection Agency, or EPA. Although no difference has been found between the safety of traditional breeding methods and recombinant-DNA technology, the regulations have gradually become stricter. ID 1997, the guidelines allowed companies to engage in voluntary consultation with the FDA, to decide what kinds of safety tests they should do. Today, these consultations are mandate

Labeling Controversy

The call for labeling all foods originating from genetically engineered seeds is a major demand of some scientists, consumer advocacy groups and organic food producers. Their argument is simple: consumers are entitled to this information so they can make an informed choice, and labeling might make it easier to track and study any problems, such as allergies, that might develop in the future. Others counter with the argument that because of crosspollination and the complexity of the food processing and distribution systems, it is Dearly impossible to totally separate genetically engineered from traditional food products. They say labeling might give consumers a false sense of security.

Labeling does Dot solve the problem of food safety. Only adequate testing before these seeds are introduced can do that.

Labeling all genetically engineered fruits and vegetables is not merely a matter of putting a sticker on a tomato or a banana. What happens when tomato paste made from genetically engineered tomatoes is used to make pizzas? Does the label have to follow along, all through the food processing chain? Corn and soy are ingredients in virtually all packaged food products. Changing every label on all of these foods will be expensive.

Some from the food industry also fear labeling will have another effect: the elimination of genetically modified food from the marketplace. Food producers are afraid that most consumers will interpret the label as a warning, not just information. This fear seems justified. Because many consumers let them know they would reject their foods if they found they contained any genetically modified products, Frito Lay and Gerbers have been refusing to use them.

An Uncertain Future

Scientific breakthroughs and the ambitious marketing plans of giant, multinational chemical companies such as Monsanto, Aventis and Novartis propelled the early dazzling triumphs of genetically engineered seeds and foods. However, they have encountered a storm of resistance that was almost totally unforeseen.

By 1999, a high percentage of American food products were grown with genetically engineered seeds, especially, corn and soybeans. It is no exaggeration to say that today nearly every processed food in the supermarket contains one or the other. This food revolution went largely unnoticed by the general public in the United States until the Star Link story appeared in the news. Since then, many public groups have been advocating for both increased labeling, tighter regulation and even outright banning of these food products.

ID Europe, possibly because of the problem of "mad cow disease," there has been more fear of genetically engineered food products. People have tended to lump the issues together. The European Union requires labeling on all foods containing 1% or more of GM ingredients. Restaurants and caterers must state if they used genetically modified ingredients in their dishes. Some countries have banned their use, even experimental planting, altogether. Bans OD imports are covered by international treaties and have become stricter as time has passed.

Resistance to genetically engineered foods is also present in the developing world. Earlier, we mentioned scientists have been able to produce a rice plant containing beta-carotene, the precursor to Vitamin A. Yet many countries, whose populations are Dearly entirely dependent OD rice, and might benefit from this "golden rice," are reluctant to import it.

Because no one wants to invest in research for which there is Do demand, the Dumber of Dew discoveries has dropped dramatically as the companies responsible for the research have cut back their efforts in this area.

For opposition to this technology to lessen, perhaps three steps need to be taken: 1) greater education about the science and promise of this technology, 2) encouragement of public discussion of the ethical and safety issues involved, and 3) efforts to make products with greater consumer appeal. Then, perhaps, this new technology can fulfill its promise and help feed the growing population of our world.