

John Fagan, Ph.d. - Molecular biologist (Cornell University)

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A summary of presentations by Dr. John Fagan in Ottawa, Canada Nov. 12-13, 1996

John Fagan, Ph.d. (Cornell University), award winning molecular biologist and former research scientist with the National Institute of Health made a series of public presentations across Canada between November 11th and 17th, 1996. In 1994, Dr. Fagan renounced over \$1.5 million in grants from the NIH to protest genetic engineering. He has recently toured Europe, Asia and USA to alert the public to the dangers of genetically engineered food.

PROMOTERS OF BIOTECHNOLOGY CLAIM THAT IT IS A natural extension of traditional breeding practices. However, this is a gross misstatement of reality. Genetic engineering is not natural. Neither is it an extension of the traditional breeding practices that have been used for thousands of years to improve our foods.

Traditional breeding practices make use of natural reproductive mechanisms, such as cross pollination and insemination where egg meets sperm. In contrast to these natural processes, genetic engineering utilizes very artificial laboratory methods to cut and insert genes. Genes are isolated from one organism and then transferred in the laboratory into the cells of another organism using unnatural biochemical and genetic techniques.

Using traditional breeding practices, it is possible to cross one kind of tomato with another or to mate one kind of fish with another, but it is impossible to mate a tomato with a fish. However, using genetic engineering, these sorts of crosses are possible. Scientists have already taken genes from fish and put them into tomatoes. In addition, they have taken genes from a wide range of other organisms, including human beings, pigs, bacteria, viruses, insects and even scorpions and transferred those into the foods we eat.

In fact, it is now possible to take genes from any organism and transfer these genes into any other organism. There are only two limitations, which are the creativity of the scientists and their good judgment. Human creativity knows no bounds. We also know that we do not always have the best judgment. Out of the juxtaposition of these two limitations come many of the serious problems with genetic engineering.

These dangers will become even more apparent by considering what genetic engineering really is. If we look inside the nucleus of the cells of any plant or animal, we find chromosomes. Within these chromosomes, we find a strand of DNA, a DNA

molecule, which carries genetic information segmented into what we call genes. A gene is a genetic blueprint for a specific protein.

Virtually every component of our body is either a protein or is synthesized by enzymes, which are themselves a class of proteins. Thus either directly or indirectly, the blueprint for every part of our body and for the physiology of any plant or animal is found in the genes that encode the proteins of that organism.

The rationale of genetic engineering is this: Because every component of the physiology is encoded in the genes of that organism, one can change the structure and function of the organism by altering the genes found in the nuclei of its cells. Genetic engineers, therefore, carry out surgery – they cut and isolate a gene from one organism, and then insert that gene into the DNA of the recipient organism.

If this process was precise and controlled, it would give rise to reliable results. But in fact, it isn't. There is always some uncertainty where the inserted gene is going to land. This process of inserting DNA into the cells of an organism can actually damage the DNA of the host. This damage can lead to foods that contains allergens or toxins, or have reduced nutritional value.

The lack of precision during gene insertion can be illustrated by the gene gun. The gene gun shoots little golden pellets, which have been coated with genes taken from one organism, into the cell of another organism. Once in the new host, these genes dissolve off the pellet and mysteriously get incorporated into the DNA in the cell of that organism.

This process seems to happen randomly. No one can predict where the new gene is going to end up. The gene may attach to the site of any chromosome. It may attach in the middle of another gene, and interfere with the normal functioning of the cell. There is no way to predict the result, and this

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can lead to unknown effects.

Other problems stem just from the immense complexity of living organisms. Living organisms contain thousands of components, which interact in very complex and intricate ways. Because of this complexity, it is impossible for any human being, even someone who has studied biology for many years, to predict precisely the effects of inserting even a single gene into a new organism.

An inserted gene does not function in isolation, but interacts in countless ways with other components of the organism. We cannot predict the range of interactions, nor can we control it. Therefore, unexpected damaging side effects are inevitable.

This unpredictability is exacerbated since genetic engineers take genes from widely divergent species. These genes have never, in the history of life or nature, been combined together. For instance, when a scientist takes a gene from an insect that has never been part of the human food supply, and inserts it into one of our foods, there is no way to know whether the protein produced by that gene will be allergenic. If it is an enzyme, we cannot predict whether the resultant food might be toxic or irritating to the digestive system or problematic in some other way.

There are several cases so far of foods that have been made allergenic or toxic through genetic engineering. One case is soybeans developed by Pioneer Hybrid International. This company, which is the largest seed company in the world, genetically engineered soybeans to contain more complete protein. They inserted into the soybean a gene from Brazil nuts. This gene was the blueprint for a protein that contained amino acids that are deficient in natural soybeans.

The new soybeans therefore contained all of the amino acids that are needed for human nutrition, which seemed like a very beneficial outcome. However, the problem was that the same genetic manipulations that caused the soybean to contain balanced protein also caused the soybeans to be

allergenic. They caused allergic reactions in a significant portion of the population.

In this case, Pioneer Hybrid stumbled onto this problem before this product went on the market so that consumers were never made sick by these soybeans. Yet, the US Food and Drug Administration would have allowed them to put these allergenic soybeans on the market. Fortunately, Pioneer Hybrid took the more ethical course of action and actually decided to not commercialize this product.

The next story does not have quite such a happy ending. A company called Showa Denko from Japan had for many years been producing nutritional supplements through fermentation. Fermentation involves growing a large number of bacteria in a nutrient media, similar to making a yogurt culture.

Once the bacteria have increased in number, one can extract a nutrient or another compound of interest in the bacteria. In this case, they were isolating tryptophan, which is an amino acid that is sold as a nutritional supplement, as a relaxant to help people sleep or to help women cope with PMS, or for other problems.

Showa Denko realized that they could genetic engineer the bacteria to make tryptophan more rapidly. After spending several years genetically engineering bacteria to produce higher level of tryptophan, the company succeeded in making one bacterial strain that produced very large amounts of tryptophan.

Showa Denko then began to use these bacteria in production and put this genetically engineered tryptophan on the market in the USA and Europe, and to some degree in Canada. However, within the next three months, 5,000 people became sick, 1500 were permanently disabled, and of those, at least 37 were killed by this tryptophan, which turned out to be toxic.

This incident caused quite a big upset, congressional hearings, and a lot of research. Over 200 papers have been published on research having to do with this toxic syndrome. Over two billion dol-

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lars of litigation was instituted against Showa Denko. As there is quite a lot of controversy on this issue, some of the facts have been not made available. However, some of the scientists who were invited to speak at the congressional hearings said that the tryptophan disaster was the result of genetic engineering. They concluded that the same genetic manipulations that increased tryptophan production also caused the bacteria to produce a powerful toxin that actually killed people.

When the producers put this tryptophan on the market, they did not even know that this toxin was present. No tests had been done that would have been sufficient to assess the safety of this product. This case illustrates the lack of control and reliability with this technology, and also the possibility of unexpected and toxic side effects, completely unknown to the scientists.

The question I would like to leave you with on this point is this: If genetic engineering can't be used safely even with the simplest single cell organisms, such as the bacteria used in tryptophan production, how can we trust this technology with the plants and animals that provide our food? As these foods are far more complex than single cell organisms, the outcomes of the genetic manipulations are far less predictable. Thus the risks associated with manipulations of our foods through genetic engineering are very substantial and of a serious nature.

In light of these problems, we would expect the agencies that have been put in place to protect consumers, (such as Health Canada, Agriculture Canada, and the US Food and Drug Administration) would require very stringent tests capable of identifying and eliminating these dangerous foods. In fact, that has not happened. Continually industry has pressed the regulatory agencies to relax testing so that they can move products through the system more rapidly. As a result, the regulations in effect today are toothless. They simply do not provide the protection that

humanity needs from these products.

In conclusion, we call for three actions to be immediately implemented in order to ensure our safety.

First, all genetically engineered foods that have not been rigorously tested to prove their safety should be banned from the grocery shelves until their safety is proven.

Second, we call for safety testing that is significantly more rigorous and stringent than what is currently in effect.

Third, we call for the labelling of all genetically engineered foods as being genetically engineered. Labelling would allow consumers to decide for themselves whether to consume these foods and would also allow any problems associated with these foods to be more easily traced.

In addition to the basic hazards of genetic engineering and food production, as discussed above, there is another very large category of problems, involving the impact of genetic engineering on the environment. For instance, genetic engineering in agriculture can lead to massive disturbances of the environment, due to cross pollination between genetically engineered crops and wild species. Through this process, genetically altered genes are carried into the wild plant population.

Once these genes been released in the wild, there is no way to recall them. The resultant gene pollution can lead to very significant environmental problems. For instance, if the varieties that carry the genetically altered genes are hardier or possess a genetic advantage, they may spread wildly and displace other species, thereby reducing biodiversity and disrupting the entire ecosystem.

Because of lack of time, we cannot describe the numerous environmental implications in detail now. However, this is a great concern that we can discuss later. ■