SAFETY ISSUES BASED ON SCIENCE

GMO safety issues based on science
Andre Leu
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Introduction

GMO's were prohibited by the organic sector due to the use of the precautionary principle. This concern about artificially transferring genes between, kingdoms and species in a way that has never occurred naturally is now being validated by a large body of science.

The Misconceptions

The GMO protagonists promote the image that they are only speeding up the natural crossbreeding processes used by farmers and breeders for millennia by inserting the new gene with the desired trait directly into the new organisms.

This distortion of the facts needs to be corrected.

The Natural Breeding Misconception

One critical issue is that multiple genes are being transferred across kingdoms and species such as bacteria, viruses, plants and animals in ways that do not occur by natural breeding methods.

All living things are classified according to a ranking system that starts with species. Closely related species are grouped together under a rank that is called a Genus. Closely related Genera (the plural of genus) are grouped together under the rank of Family. Closely related Families are grouped together under the rank of Order. There are seven ranks. Starting with the highest they are: kingdom, phylum or division, class, order, family, genus, species.

Plants, Animals, Fungi, Viruses and Bacteria belong to separate Kingdoms.

Natural breeding can take place between some species that belong to the same genus and very occasionally between species of different genera. However species that belong to different families do not breed and definitely species that belong to different Kingdoms such as plants, animals, fungi, bacteria and viruses do not breed in nature. Plants for example do not breed with animals, bacteria or viruses.

Genetic engineering allows for the transfer of genes between Kingdoms in a way that can never occur naturally. This is something that has never occurred before and it creates a new frontier with many uncertainties due to science's limited understanding about genetics.

The Single Gene Misconception
The other great misconception is that researchers are only inserting one new gene.

At this stage science is not sophisticated enough to insert a single gene and get it to work. To overcome this problem, scientists have to combine the gene with the desired trait (such as herbicide tolerance or pesticide production) with other genes that will make it work. Researchers also insert genes that help them to identify if the new gene is working within the chromosome.

This becomes a complex construction of transgenes that can come from bacterial, viral, fish, plant and other sources.

Inserting the Gene Sequence
Another misconception is that the gene is neatly inserted into the cell chromosome. Genes are grouped together inside the cell in long strands call chromosomes. Researchers use what can be best described as a shotgun approach when they push new genes into a chromosome. They either shoot the genetic material into the target cells, insert it after weakening the cell membrane with an electric shock/chemical, or use a modified microorganism such as a virus to infect the target cell with the new genes.

The problem with these approaches is that the researchers do not know if genes have been inserted into a chromosome and if they have been inserted they do not know where the new genes have landed in any of the chromosomes and if they will work.

Antibiotic Resistance Marker Genes
The most common method of discovering if the new gene will work involves using Antibiotic Resistance Marker Genes. These genes come from bacteria that are resistant to antibiotics. The marker genes are attached to the gene with the desired trait (herbicide resistance as an example) and they are shot into the target cells. These cells are then cultured and an antibiotic is added. The cells that live have adopted the new genes as they a resistant to the antibiotic.

These are then grown out as plants. The big problem with these plants is that every part of the plant has genes for antibiotic resistance. Many scientists and medical professionals have expressed concerns about these genes being horizontally transferred into the gut and mouth bacteria of humans and animals eating genetically modified food. They are worried that this could create bacteria that are resistant to the antibiotics needed to cure infections.

Horizontal gene transfer is where microorganisms take up genes directly through their cell walls rather than by the normal method of reproduction. It has been shown to occur with the antibiotic resistant super bugs that are now found in many hospitals.

When the potential danger of this was pointed out to the genetic scientists they dismissed it as impossible. Several studies have since shown that these antibiotic resistance genes can be transferred to bacteria in as little as two hours after eating genetically modified food.

New Scientist in July 2002 reported on a scientific experiment that showed that this can happen to bacteria in the human digestive system: For the first time, it has been proved that bacteria in the human gut can take up DNA from genetically modified food.

Currently every commercially released GMO plant has the antibiotic resistance genes in every cell. They should be banned for this reason alone.

Queensland researchers have developed a fluorescent marker gene that comes from a jellyfish. This gene can be used to select the cell with the desired trait as they fluoresce under an ultraviolet light. This will be a major improvement in the safety of GMOs over the current technology, however it does not address the multiplicity of more serious problems.

The Cauliflower Mosaic Virus Promoter (CaMV)
When foreign DNA is inserted into organisms, three things usually happen. The most common one is that the foreign DNA is digested to provide energy and building blocks for the cell. It can also be rejected. The other response is to close over the foreign DNA and deactivate it.

All of these responses are defence mechanisms to overcome attacks by pathogens (disease). The host organism defends itself by getting rid of the foreign material. This is the reason why transplant recipients have to take anti-rejection drugs. When organisms detect foreign DNA a whole range of responses, collectively known as the immune system, can be activated to repel or destroy the invaders.

When foreign genes are shot/infected into a cell, they tend to be digested, rejected or closed over. Either way this means that the target organism will not have the desired trait from the new gene.

To overcome this, genetic scientists build a construction with a section of the cauliflower mosaic virus (CaMV). The CaMV gives the signal that activates or promotes the new gene. It ensures that the gene is active so that its desired trait, like herbicide resistance, works in the new plant.

Problems with the CaMV
There are several problems with the CaMV. Every current GMO plant is part virus. Every cell of their bodies contains the active section of a virus. With billions of these plants now released into the environment, many scientists believe that there is a great risk of horizontal transfer of the viral genetic code from GMO plants into invading viruses, creating new virulent transgenic viruses.

The Union of Concerned Scientists states: Recombination can occur between the plant-produced viral genes and closely related genes of incoming viruses. Such recombination may produce viruses that can infect a wider range of hosts or that may be more virulent than the parent viruses.

According to Dr Mae-Wan Ho of the Institute of Science in Society, London: GM constructs are designed to cross species barriers and to invade genomes. In other words, GM constructs are more likely to transfer horizontally. Genetic engineering will accelerate the generation of new viruses and bacteria.

When GMO scientists and researchers are questioned on this the standard reply is that the cauliflower mosaic virus is harmless and doesn't affect humans. We know that many harmless viruses change into forms that can be serious. The various forms of the flu are the classic example. Seventy years ago AIDS was restricted to monkeys and didn't affect humans. SARS is a slightly modified common cold virus and is now a seriously fatal disease with the potential for massive epidemics.

According to Helen Pearson writing in the journal Nature, April 2003: "In a simple overnight experiment, researchers transformed a coronavirus that is lethal to cats into one that infects mouse cells by replacing a single gene. The result strengthens the idea that the SARS coronavirus might have arisen when an animal and human virus met and swapped genes, says the study's lead scientist"

The fact is no scientist can predict what would happen if transgenic viruses and bacteria emerged from GMO plants. It was only a short time ago these same scientists were saying pollen drift from GMOs would not affect nearby crops and that the horizontal transference of antibiotic resistant genes from GMOs into gut microorganisms was not possible. Dr. Mae-Wan Ho further states: This CaMV promoter is also known to work for genes all across the living world: in plants, bacteria, fungi, and, as we discovered recently in the literature more than 10 years old, also in frog eggs and human cells. It is able to substitute, in part or in whole, for the promoter of many other viruses. Viruses are not only everywhere in the environment, they also lie dormant in the genomes of all organisms, bacteria, plants and animals without exception. And there is evidence that such dormant viruses can be reactivated as a result of genetic recombination.

Unstable GM Constructs

A serious problem with the CaMV is that it has been proven to be unstable within the chromosomes of GMO plants. Researchers from the John Innes Center, UK one of the world's major biotechnology research centres, have found that during field trails of GM plants, that later generations became unstable and variable.

The CaMV moves from one part of a chromosome to another and activates the new gene next it. This means it randomly causes genes within the plant to work in ways that would not normally occur. It could lead to all sorts of future problems like making plants that have small amounts of beneficial phyto nutrients, express them in toxic amounts, cause hormones and other regulatory functions to be pushed out of balance and cause future chaos in the genetic make up plants and animals that we do not understand. It is the equivalent of Russian Roulette with DNA.

Dr. Mae-Wan Ho sums up the potential dangers of this technology: GM constructs are designed to cross species barriers and to invade genomes. In other words, GM constructs are more likely to transfer horizontally.

Horizontal gene transfer will increase the opportunity for genetic recombination. The GM constructs are already of mixed origins, with base sequences similar to the genetic material of many pathogenic bacteria and viruses. That, again, as every geneticist should know, will greatly increase the probability for genetic recombination, and with a wide assortment of bacteria and viruses.

What is most concerning with this is that this viral promoter gene and other GM constructs have escaped into the wild relatives of GMO plants and also contaminated a sizeable proportion of non GMO crops like corn, canola and soybeans.

The potential danger is being completely ignored by regulatory authorities, with no ongoing research looking at these potential pathogenic transgenic viruses and bacteria.

Dr. Mae-Wan Ho warns: The scientists set up guidelines, based largely on assumptions, all of which have fallen by the wayside as the result of new scientific findings. Instead of tightening the guidelines, our regulators have relaxed them as commercial pressures built up. It does not take a great feat of imagination to see why genetic engineering will accelerate the generation of new viruses and bacteria.

GMOs in our Food

GMOs are currently being pushed as the solution to feed the world's ever growing population. This logic has to be seriously questioned in the light of the scientific studies that show numerous serious health issues that are connected to the consumption of GMO food.

The most recent has just been published by Professor Gilles-Eric Séralini and colleagues in the peer reviewed scientific journal Environmental Sciences Europe.

The scientists reviewed 19 studies of animals fed with GMO soy and corn. The studies covered more that 80% of the GMO varieties that are widely cultivated around the world.

Their review found significant levels of negative effects to kidneys and livers in the animals that were fed GMOs. The scientists stated: '...the kidneys were particularly affected, concentrating 43.5% of all disrupted parameters in males, whereas the liver was more specifically disrupted in females (30.8% of all disrupted parameters).'

One of the key conclusions is that the current testing methodologies, length of feed trials and the parameters measured are insufficient to evaluate the health problems that are caused by diets of GMOs. The scientists clearly stated that this lack of proper testing protocols is socially unacceptable in terms of consumer health protection. (Seralini et al 2011)

GM Soy has Adverse Effect on the Offspring

One of the most concerning issues is the negative effects that occur in the offspring of rats and mice that are fed GM diets. These effects include increased infant mortality, reduced litter sizes and reduced body weights of the offspring.

In experimental trials male and female mice were fed GM soy and then mated. The early stage embryos (4-8 cells) showed a temporary decrease in gene expression. This was not found in embryos whose parents ate natural non-GM soy. (Oliveri 2006)

There is strong body of science that shows that subtle changes to gene expression in embryos can cause permanent negative effects in the development of offspring.

A Russian rat study conducted by Dr Irina Ermakova and colleagues found that offspring of rats fed in GM soy had higher levels of mortality than rates fed with non GMO soy. (Ermakova 2006)

The scientists noted that babies of the rats that were fed GMO diets developed at slower rate, had lower weights and looked markedly different than the babies of rates that were fed non GMO diets.

The photo on the upper right [see original at link above] is the offspring from mothers fed natural soy. In the lower left is the GM group.

The GMO group has a significant reduction in average weight.

Difficulties with Conception

Dr Ermakova and her colleagues found that when they mated the offspring from the GM group, that they did not conceive. This a serious concern that needs to fully investigated with more scientific research.

GM Soy Damages Testicles

One of the possible causes for the developmental differences and the lack of fertility in the offspring of mice that are fed GMOs is that several studies have found that GMO diets cause structural changes to the testicles.

A study published in the European Journal of Histochemistry found that testicles of mice fed GM soy had altered structures and function which influenced sperm development. (Vecchio 2004)

Effect on Mothers and Children

The greatest concern for humans is that the toxin from pesticide producing GMOs can be found in bloodstream of women and their unborn children. A Canadian study published in the scientific journal, Reproductive Toxicology, found the pesticide toxin from GMO crops in the blood samples of women and their unborn babies. The GMO toxin was found in 93 percent of maternal blood samples and of greater concern in 80 percent of fetal blood samples. These women were eating the typical Canadian diet. (Aris and Leblanc 2011)

Given the evidence of the changes to the offspring of animals fed a GMO diet, this Canadian study should be the

cause of great concern amongst health professionals and regulators to ensure that the GMO foods that are currently being consumed are not doing damage to our future generations.

GM potatoes damaged rats

Study published in highly respected medical journal The Lancet and in the peer reviewed Journal Nutrition and Health by Dr Arpad Pusztai showed multiple serious problems with rats that were fed GM potatoes.

The scientific studies found that the rats that were fed on the GMO developed smaller brains, livers and testicles, had partial atrophy of the liver and damage to immune system.

The studies showed that the rats developed potentially precancerous cell growth in the linings of their stomach and intestinal walls. (Pusztai 2002, Ewen and Pusztai 1999)

The picture on the left [see original at link above] is the intestinal wall of a rat that was fed on non GMO potato. Picture on right is from a rat that was fed on GMO potato. These types inflammatory growths are potentially precancerous and can lead to bowel cancer, which has become one of the forms of cancer that is increasing in humans

The picture on the left [see original at link above] is the stomach wall of a rat that was fed non-GMO potato. On the right is the stomach wall of a rat that was fed the GM-potato. These inflammatory growths are potentially precancerous

GMO Soybean Products

There are several animal studies that show range of adverse effects from consuming GMO soybean products.

Mice fed GMO soy for 8 months had a profound drop in the amount of digestive enzymes produced by their pancreas. (Malatesta 2002 a, Malatesta 2003). Researcher also found that the liver cells were damaged or misshapen and there was altered gene expression. They found that there was a higher rated metabolic activity that suggested that the liver was reacting to a toxic insult. (Malatesta 2002 b)

The above photos show [see original at link above] how the membrane surrounding the nuclei of liver cells was more irregular in the GM-fed mice.

The above photos [see original at link above] show that within the nuclei of the liver cells, the structure called the nucleoli was also misshapen in the GM-fed mice.

Rats fed GM soy also showed changes in their livers

BT Corn

In a study by Monsanto made public because of a lawsuit, rats fed Bt corn developed signs of liver and kidney toxicity. These included kidney inflammation and kidney lesions, and decreased kidney weight. The latter symptom is typically related to blood pressure problems. They also developed increased basophiles which are related to allergies. The study showed that they had increased lymphocytes or white blood cells which are part of the immune system indicating a reaction to infection or possibly disease. A 10% increase in blood sugar, and decreased immature red blood cells by 50%. This might indicate anaemia. (Burns 2002, Seralini 2007)

GM Corn

When Liberty Link corn was fed to chickens, twice the number of chickens died. But, the test conducted by the industry was designed so poorly, even a doubling of the death rate was not statistically significant. (Leeson 1996)

FlaverSavr Tomato

The first GM crop that was looked at by the US FDA was the FlavrSavr tomato, engineered to have a longer shelf-life. Calgene, its producers, were the only company to give the United States FDA raw feeding study data. They did a study with rats but the rats refused to eat the tomato.

They force fed rats the FlavrSavr tomato for 28 days. 7 of 20 rats developed stomach lesions. Another 7 of 40 died within 2 weeks. In the documents made public, scientists said that the study doesn't show "a reasonable certainty of no harm." The FDA did not block the introduction of the tomato.

The company had created two lines of the GM tomato, both with the same gene inserted. One was associated with these high rates of lesions and deaths, the other was not. The company voluntarily decided to market the one that was not associated with the rat problems.

This also provides an example of how the same crop inserted with identical genes, may have very different results. And it provides a good example of what can go wrong with GMOs. (FDA 1993, Pusztai 2002)

GM Pea

In Australia, CSIRO researchers took a gene from a kidney bean, which produced a pesticide, and inserted it into peas to kill the pea weevil. The researchers did an allergic-type test on mice that no other GMO food crop developer had done before.

When they exposed mice to the proteins from the kidney beans, it caused no reaction. They expected the same to happen when mice were exposed to the "same" protein produced by the transgene inside the peas. In fact, the amino acid sequence was identical in both proteins as the one produced by both the bean and the pea. But the mice developed an inflammatory response to the protein produced in the GMO peas. It was an immune type response that was very dangerous, suggesting that the peas might create a deadly anaphylactic shock or other types of immune or inflammatory reactions in humans.

To understand why the GMO pea caused the sever allergy problems, the researchers looked very carefully at the protein structure and found that the sugars that had attached to it had a slightly changed pattern. They said it was the slightly changed pattern of the sugars that made the peas harmful.

The problem is that the potentially deadly GM peas had already passed all the allergy tests that are normally used to get GM foods on the market. The only reason they were stopped was because the crop developer had chosen to use a mice study that had never been used on any other GM food crop. This shows that the regulatory system, as practiced, is a failure, and may be letting deadly allergens on the market.

To the credit of the CSIRO they discontinued bringing the GMO pea to the point where it would be grown commercially. (Prescott 2005)

LTrytophan

In the late 1980s an epidemic that killed about 100 Americans and caused another 5-10,000 to fall sick or become permanently disabled was traced to an amino acid health supplement called L-tryptophan. L-tryptophan is a common amino acid that is found in milk products. For many years it was extracted from milk and sold as health supplement to help people sleep.

A Japanese company Showa Denko started to produce L-tryptophan from genetically engineering the bacteria. The epidemic was traced back to the L-tryptophan that was produced from the genetically engineering the bacteria.

It took years to discover that the epidemic was underway. It required a series of coincidences, plus the fact that the disease had three concurrent characteristics. The disease:

*Was new with unique symptoms that stood out
*It was acute so people went to doctors or hospitals
*It came on quickly, so they went to doctors right after taking it

According to the Los Angeles Times , July 10, 1991: 'A Japanese chemical manufacturer was ordered to pay more than $2 million to four people who used L-tryptophan, a food supplement linked to a rare blood disorder that killed

at least 27 people.

The state arbitration panel's order late Monday was the nation's first damage award against manufacturer Showa Denko Co., said Turner Branch of Albuquerque, N.M., vice chairman of a steering committee for attorneys representing L-tryptophan victims.'

Lack of Research

Professor Seralini and his colleague have expressed great concern over the lack of scientific testing for the adverse health effects associated with GMOs. They stated: '...that it is unacceptable to submit 500 million Europeans and several billions of consumers worldwide to the new pesticide GM-derived foods or feed, this being done without more controls (if any) than the only 3-month-long toxicological tests and using only one mammalian species, especially since there is growing evidence of concern...' (Seralini et al 2011)

Conclusion

We are looking at a large scale uncontrolled experiment and we do not know the outcomes. Logic and common sense would state that we need a moratorium on the release of all GMOs until there is good quality, long term peer reviewed science that ensures that there are no risks. To do otherwise is to leave a massive problem for future generations.

Never forget that the scientist who invented DDT received a Noble Prize because of the immense benefits this discovery was supposed to bring to the world. We are still paying the hidden price of a lack of understanding of the long term consequences of this discovery.

Major Acknowledgement

The pictures and some of the text comes from a comprehensive GMO presentation by Jeffrey M. Smith, Executive Director, Institute for Responsible Technology. View the presentation.
http://www.responsibletechnology.org/resources/powerpoint-presentation-on-gmos

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