Negative Side Effects of Genetically Modified Foods

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1. Introduction

Genetically Modified Foods (GM foods) or Genetically modified organisms (GMOs) are defined as organisms (except for human beings) in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination. GMOs have widespread applications as they are used in biological and medical research, production of pharmaceutical drugs, experimental medicine, and agriculture. The use of gene technology in food production has become interesting due to increased needs of food as well as its improved quality. With the application of gene technology to plants and animals, goals can be achieved more quickly than by traditional selection. Consequently, ethical dilemmas are opened concerning the eventual negative effects of production of genetically modified food. It seems that supplementation of nutraceuticals and wild foods as well as wild lifestyle may be protective, whereas western diet and lifestyle may enhance the expression of genes related to chronic diseases.

The prevalence and mortality due to multifactorial polygenic diseases; hypertension, coronary artery disease (CAD), diabetes and cancer vary depending upon genetic susceptibility and environmental precursors because they have identifiable Mendelian subsets. Rapid changes in diet and lifestyle may influence heritability of the variant phenotypes that are dependent on the nutraceutical or functional food supplementation for their expression.

It is possible to recognize the interaction of specific nutraceuticals, with the genetic code possessed by all nucleated cells. There is evidence that South Asians have an increased susceptibility to CAD, diabetes mellitus, central obesity and insulin resistance at younger age, which may be due to interaction of gene and nutraceutical environment. The negative consequences can affect the human health and environment.

2. Effects of Genetically Modified Foods on Human Health

Recombinant DNA technology faces our society with problems unprecedented not only in the history of science, but of life on Earth. Potentially, it could breed new animal and plant diseases.

2.1. Cancer

Growth Hormone (GH) is a protein hormone which, when injected into cows stimulates the pituitary gland in a way that the produces more milk, thus making milk production more profitable for the large dairy corporations. In 1993, FDA approved Monsanto's genetically-modified rBGH, a genetically-altered growth hormone that could be then injected into dairy cows to enhance this feature, and even though scientists warned that this resulted in an

increase of IGF-1 (from (70%-1000%). IGF-1 is a very potent chemical hormone that has been linked to a 2 1/2 to 4 times higher risk of human colorectal and breast cancer. Prostate cancer risk is considered equally serious – in the 2,8.to 4 times range. According to Dr. Samuel Epstein of the University of Chicago and Chairman of the Cancer Prevention Coalition, this "induces the malignant transformation of human breast epithelial cells." Canadian studies confirmed such a suspicion and showed active IGF-1 absorption, thyroid cysts and internal organ damage in rats.

2.2. Super viruses

Viruses can mix with genes of other viruses and retroviruses such as HIV. This can give rise to more deadly viruses – and at rates higher than previously thought. One study showed that gene mixing occurred in viruses in just 8 weeks (Kleiner, 1997). This kind of scenario applies to the cauliflower mosaic virus CaMV, the most common virus used in genetic engineering – in Round Up ready soy of Monsanto, Bt-maise of Novaris, and GM cotton and canola. It is a kind of "pararetro virus" or what multiplies by making DNA from RNA. It is somewhat similar to Hepatitis B and HIV viruses and can pose immense dangers.

In a Canadian study, a plant was infected with a crippled cucumber mosaic virus that lacked a gene needed for movement between plant cells. Within less than two weeks, the crippled plant found what it needed from neighboring genes – as evidence of gene mixing or horizontal transfer. This is significant because genes that cause diseases are often crippled or engineered to be dormant in order to make the end product "safe." Results of this kind led the US Department of Agriculture to hold a meeting in October of 1997 to discuss the risks and dangers of gene mixing and super viruses, but no regulatory action was taken. A French study also showed the recombination of RNA of two Cucomo viruses, and under conditions of minimal selection and in supposedly virus resistant transgenic plants.

2.3. Antibiotic resistance

In recent years health professionals have become alarmed by the increasing number of bacterial strains that are showing resistance to antibiotics. Bacteria develop resistance to antibiotics by creating antibiotic resistance genes through natural mutation. Biotechnologists use antibiotic resistance genes as selectable markers when inserting new genes into plants. In the early stages of the process scientists do not know if the target plant will incorporate the new gene into its genome. By attaching the desired gene to an antibiotic resistance gene the new GM plant can be tested by growing it in a solution containing the corresponding antibiotic. If the plant survives scientists know that it has taken up the antibiotic resistance gene along with the desired gene. There is concern that bacteria living in the guts of humans and animals could pick up an antibiotic resistance gene from a GM plant before the DNA becomes completely digested.

It is not clear what sort of risk the possibility of conferring antibiotic resistance to bacteria presents. No one has ever observed bacteria incorporating new DNA from the digestive system under controlled laboratory conditions. The two types of antibiotic resistance genes used by biotechnologists are ones that already exist in bacteria in nature so the process would not introduce new antibiotic resistance to bacteria. Never the less it is a concern and the FDA is encouraging biotechnologists to phase out the practice of using antibiotic resistance genes.

2.4. Birth Defects and Shorter Life Spans

rBGh in cows causes a rapid increase in birth defects and shorter life spans and the number of calves born with birth defects to dairy cows has increased significantly. Canada and the European Union have taken precautions and banned the use of rBGH in their dairy cows.

In a very recent study by Cornucopia Institute Research the following information was reported: "…The experience of actual GM-fed experimental animals is scary. When GM soy was fed to female rats, most of their babies died within three weeks—compared to a 10% death rate among the control group fed natural soy. The GM-fed babies were also smaller, and later had problems getting pregnant. When male rats were fed GM soy, their testicles actually changed color—from the normal pink to dark blue. Mice fed GM soy had altered young sperm. Even the embryos of GM fed parent mice had significant changes in their DNA. Mice fed GM corn in an Austrian government study had fewer babies, which were also smaller than normal…"

The American Academy of Environmental Medicine (AAEM) called on 'Physicians to educate their patients, the medical community, and the public to avoid GM (genetically modified) foods when possible and provide educational materials concerning GM foods and health risks.' They called for a moratorium on GM foods, long-term independent studies, and labeling. AAEM's position paper stated, 'Several animal studies indicate serious health risks associated with GM food,' including infertility, immune problems, accelerated aging, insulin regulation, and changes in major organs and the gastrointestinal system. They conclude, 'There is more than a casual association between GM foods and adverse health effects. There is causation,' as defined by recognized scientific criteria. 'The strength of association and consistency between GM foods and disease is confirmed in several animal studies.

2.5. Interior Toxins

"Pesticidal foods" have genes that produce a toxic pesticide inside the food's cells. The food is engineered to produce their own built in pesticide in every cell which produces a poison that splits open a bug's stomach and kills them when the bug tries to eat the plant. This represents the first time "cell-interior toxicity" is being sold for human consumption. There is little knowledge of the potential long-term health impacts. However, while some biotech companies claim that the pesticide called Bt has been approved safe and used by farmers for natural insect control, the Bt-toxin in GM plants is thousands of times more concentrated than the natural bug spray, can not be washed off the plants, and has a properties of allergens. We are now ingesting this interior plant toxin from GM foods.

As individuals ingest more and more genetically modified foods and organisms into their body it has been shown that the bodies toxicity increases which leads to a ton of other potentially serious health problems. There is a definite link between Obesity, Cancer and Toxicity.

2.6. Lowered Nutrition

A study in the Journal of Medicinal Food showed that certain GM foods have lower levels of vital nutrients – especially phytoestrogen compounds thought to protect the body from heart disease and cancer. In another study of GM Vicia Faba, a bean in the same family

as soy, there was also an increase in estrogen levels, what raises health issues – especially in infant soy formulas. Milk from cows with rBGH contains substantially higher levels of pus, bacteria, and fat. Monsanto's analysis of glyphosate-resistant soya showed the GM-line contained 28% more Kunitz-trypsin inhibitor, a known anti-nutrient and allergen.

2.7. Food Allergy

Food Allergy affects approximately 5% of children and 2% of adults in the U.S. and is a significant public health threat. Allergic reactions in humans occur when a normally harmless protein enters the body and stimulates an immune response. If the novel protein in a GM food comes from a source that is known to cause allergies in humans or a source that has never been consumed as human food, the concern that the protein could elicit an immune response in human increases. Although no allergic reactions to GM food by consumers have been confirmed, in vitro evidence suggesting that some GM products could cause an allergic reaction has motivated biotechnology companies to discontinue their development.

3. Effects on Environment

Genetic Engineering is often justified as a human technology, one that feeds more people with better food. Nothing could be further from the truth. With very few exceptions, the whole point of genetic engineering is to increase sales of chemicals and bio-engineered products to dependent farmers.

3.1. Soil Sterility and Pollution

In Oregon, scientists found GM bacterium (klebsiella planticola) meant to break down wood chips, corn stalks and lumber wastes to produce ethanol – with the post-process waste to be used as compost – rendered the soil sterile. It killed essential soil nutrients, robbing the soil of nitrogen and killed nitrogen capturing fungi. A similar result was found in 1997 with the GM bacteria Rhizobium melitoli. Professor Guenther Stotzky of New York University conducted research showing the toxins that were lethal to Monarch butterfly are also released by the roots to produce soil pollution. The pollution was found to last up to 8 months with depressed microbial activity. An Oregon study showed that GM soil microbes in the lab killed wheat plants when added to the soil.

3.2. Super weeds

It has been shown that genetically modified Bt endotoxin remains in the soil at least 18 months (according to Marc Lappé and Britt Bailey) and can be transported to wild plants creating super weeds – resistant to butterfly, moth, and beetle pests – potentially disturbing the balance of nature. A study in Denmark and in the UK showed super weeds growing nearby in just one generation. A US study showed the super weed resistant to glufosinate (which differs from glyphosate) to be just as fertile as non-polluted weeds. Another study showed 20 times more genetic leakage with GM plants – or a dramatic increase in the flow of genes to outside species. Also in a UK study by the National Institute of Agricultural Botany, it was confirmed that super weeds could grow nearby in just one generation. Scientists suspect that Monsanto's wheat will hybridize with goat grass, creating an invulnerable super weed. The National Academy of Science's study stated that " concern surrounds the possibility of genes for resisting pests being passed from cultivated plants to their weedy

relatives, potentially making the weed problem worse. This could pose a high cost to farmers and threaten the ecosystem."

An experiment in France showed a GM canola plant could transfer genes to wild radishes, what persisted in four generations. Similarly, and according to New Scientists, an Alberta Canada farmer began planting three fields of different GM canola seeds in 1997 and by 1999 produced not one, but three different mutant weeds – respectively resistant to three common herbicides (Monsanto's Roundup, Cyanamid's Pursuit, and Aventis' Liberty). In effect genetic materials migrated to the weeds they were meant to control. Now the Alberta farmer is forced to use a potent 2,4-D what GM crops promised to avoid use of. Finally Stuart Laidlaw reported in the Toronto Star that the Ontario government study indicated herbicide use was on the rise primarily largely due to the introduction of GM crops.

3.3. Destruction of Forest Life

GM trees or "super trees" are being developed which can be sprayed from the air to kill literally all of surrounding life, except the GM trees. There is an attempt underway to transform international forestry by introducing multiple species of such trees. The trees themselves are often sterile and flowerless. This is in contrast to rainforests teaming with life, or where a single tree can host thousands of unique species of insects, fungi, mammals and birds in an interconnected ecosphere. This kind of development has been called "death-engineering" rather than "life-" or "bio-engineering." More ominously pollen from such trees, because of their height, has traveled as much as 400 miles or 600 kilometers – roughly 1/5 of the distance across the United States.

3.4. Terminator Trees

Monsanto has developed plans with the New Zealand Forest Research Agency to create still more lethal tree plantations. These super deadly trees are non-flowering, herbicide-resistant and with leaves exuding toxic chemicals to kill caterpillars and other surrounding insects – destroying the wholesale ecology of forest life. As George McGavin, curator of entomology Oxford University noted, "If you replace vast tracts of natural forest with flowerless trees, there will be a serious effect on the richness and abundance of insects…If you put insect resistance in the leaves as well you will end up with nothing but booklice and earwigs. We are talking about vast tracts of land covered with plants that do not support animal life as a sterile means to cultivate wood tissue. That is a pretty unattractive vision of the future and I for one want no part of it."

3.5. Super pests

Lab tests indicate that common plant pests such as cotton boll worms, will evolve into super pests immune from the Bt sprays used by organic farmers. The recent "stink bug" epidemic in North Carolina and Georgia seems linked to bioengineered plants that the bugs love. Monsanto, on their Farm source website, recommended spraying them with methyl parathion, one of the deadliest chemicals. So much for the notion of Bt cotton getting US farmers off the toxic treadmill. Pests the transgenic cotton was meant to kill – cotton bollworms, pink bollworms, and budworms – were once "secondary pests." Toxic chemicals killed off their predators, unbalanced nature, and thus made them "major pests."

3.6. Animal Bio-invasions

Fish and marine life are threatened by accidental release of GM fish currently under development in several countries – trout, carp, and salmon several times the normal size and growing up to 6x times as fast. One such accident has already occurred in the Philippines – threatening local fish supplies.

3.7. Killing Beneficial Insects

Studies have shown that GM products can kill beneficial insects – most notably the monarch butterfly larvae. Swiss government researchers found Bt crops killed lacewings that ate the cotton worms which the Bt targeted. A study reported in 1997 by New Scientist indicates honeybees may be harmed by feeding on proteins found in GM canola flowers. Other studies relate to the death of bees (40% died during a contained trial with Monsanto's Bt cotton), springtails and ladybird beetles.

3.8. Poisonous to Mammals

In a study with GM potatoes, spliced with DNA from the snowdrop plant and a viral promoter (CaMV), the resulting plant was poisonous to mammals (rats) – damaging vital organs, the stomach lining and immune system. CaMV is a pararetro virus. It can reactivate dormant viruses or create new viruses – as some presume have occurred with the AIDES epidemic. CaMV is promiscuous, why biologist Mae Wan-Ho concluded that "all transgenic crops containing CaMV 35S or similar promoters which are recombinogenic should be immediately withdrawn from commercial production or open field trials. All products derived from such crops containing transgenic DNA should also be immediately withdrawn from sale and from use for human consumption or animal feed."

3.9. Animal Abuse

Pig number 6706 was supposed to be a "super pig." It was implanted with a gene to become a technological wonder. But it eventually became a "super cripple" full of arthritis, cross-eyed, and could barely stand up with its mutated body. Some of these mutations seem to come right out of Greek mythology – such as a sheep-goat with faces and horns of a goat and the lower body of a sheep. Two US biotech companies are producing genetically modified birds as carriers for human drug delivery – without little concern for animal suffering. Gene Works of Ann Arbor, Michigan has up to 60 birds under "development." GM products, in general, allow companies to own the rights to create, direct, and orchestrate the evolution of animals.

3.10. Genetic Pollution

Carrying GM pollen by wind, rain, birds, bees, insects, fungus, bacteria – the entire chain of life becomes involved. Once released, unlike chemical pollution, there is no cleanup or recall possible. As mentioned, pollen from a single GM tree has been shown to travel 1/5th of the length of the United States. Thus there is no containing such genetic pollution. Experiments in Germany have shown that engineered oilseed rape can have its pollen move over 200 meters. As a result German farmers have sued to stop field trials in Berlin.

In Thailand, the government stopped field tests for Monsanto's Bt cotton when it was discovered by the Institute of Traditional Thai Medicine that 16 nearby plants of the cotton family, used by traditional healers, were being genetically polluted. US research showed that more than 50% of wild strawberries growing inside of 50 meters of a GM strawberry field assumed GM gene markers. Another showed that 25-38% of wild sunflowers growing near GM crops had GM gene markers.

A recent study in England showed that despite the tiny amount of GM plantings there (33,750 acres over two years compared to 70-80 million acres per year in the US) wild honey was found to be contaminated. This means that bees are likely to pollinate organic plants and trees with transgenic elements. Many other insects transport the by-products of GM plants throughout our environment, and even falling leaves can dramatically affect the genetic heritage of soil bacteria. The major difference between chemical pollution and genetic pollution is that the former eventually is dismantled or decays, while the later can reproduce itself forever in the wild.

As the National Academy of Science's report indicated – "the containment of crop genes is not considered to be feasible when seeds are distributed and grown on a commercial scale." Bioengineering firms are also developing fast growing salmon, trout, and catfish as part of the "blue revolution" in aquaculture. They often grow several times faster (6x faster for salmon) and larger in size (up to 39X) so as to potentially wipe out their competitors in the wild. There are no regulations for their safe containment to avoid ecological disasters. They frequently grow in "net pens," renown for being torn by waves, so that some will escape into the wild. If so, commercial wild fish could be devastated according to computer models in a study of the National Academy of Sciences by two Purdue University scientists (William Muir and Richard Howard). All of organic farming – and farming per se – may eventually be either threatened or polluted by this technology.

3.11. General Economic Harm to Small Family Farms

GM seeds sell at a premium, unless purchased in large quantities, which creates a financial burden for small farmers. Many GM products, such as rBGH, seem to offer a boom for dairy farmers – helping their cows produce considerably more milk. But the end result has been a lowering of prices, again putting the smaller farmers out of business. We can find similar trends with other GM techniques – as in pig and hen raising made more efficient. The University of Wisconsin's GM brooding hens lack the gene that produces prolactin proteins. The new hens no longer sit on their eggs as long, and produce more. Higher production leads to lower prices in the market place. The end result is that the average small farmer's income plummeted while a few large-scale, hyper-productive operations survived along with their "input providers" (companies selling seeds, soil amendments, and so on).

In an on-going trend, the self-sufficient family farmer is shoved to the very lowest rung of the economic ladder. In 1910 the labor portion of agriculture accounted for 41% of the value of the finally sold produce. Now the figure has been estimated at between 6-9% in North America. The balance gets channeled to agri-input and distribution firms – and more recently to biotech firms. Kristin Dawkins in Gene Wars: The Politics of Biotechnology, points out that between 1981 and 1987, food prices rose 36%, while the percentage of the pie earned by farmers continued to shrink dramatically.

3.12. Losing Natural Pesticides

Organic farmers have long used "Bt" (a naturally occurring pesticidal bacterium, Bacillus thuringiensis) as an invaluable farming aide. It is administered at only certain times, and then sparingly, in a diluted form. This harms only the target insects that bite the plant. Also in that diluted form, it quickly degrades in the soil. By contrast, genetically engineered Bt corn, potatoes and cotton – together making up roughly a third of US GM crops – all exude this natural pesticide. It is present in every single cell, and pervasively impacts entire fields over the entire life span of crops. This probably increases Bt use at least a million fold in US agriculture. According to a study conducted at NYU, BT residues remained in the soil for as much as 243 days. As an overall result, agricultural biologists predict this will lead to the destruction of one of organic farming's most important tools. It will make it essentially useless. A computer model developed at the University of Illinois predicted that if all US Farmers grew Bt resistant corn, resistance would occur within 12 months. Scientists at the University of North Carolina have already discovered Bt resistance among moth pests that feed on corn. The EPA now requires GM planting farmers to set aside 20-50% of acres with non-BT corn to attempt to control the risk and to help monarch butterflies survive.

3.13. Monopolization of Food Production

The rapid and radical change in the human diet was made possible by quick mergers and acquisitions that moved to control segments of the US farming industry. Although there are approximately 1500 seed companies worldwide, about two dozen control more than 50% of the commercial seed heritage of our planet. The consolidation has continued to grow, In 1998 the top five soy producers controlled 37% of the market (Murphy Family Foods; Carroll's Foods, Continental Grain, Smithfield Foods, and Seaboard). One year later, the top five controlled 51% (Smithfield, having acquired Murphy's and Carroll's, Continental, Seaboard, Prestige and Cargill). Cargill and Continental Grain later merged.

With corn seed production and sales, the top four seed companies controlled 87% of the market in 1996 (Pioneer Hi-Bred, Holden's Foundation Seeds, DeKalb Genetics, and Novaris). In 1999, the top three controlled 88% (Dupont having acquired Pioneer, Monsanto having acquired Holden's and DeKalb, and Novaris. In the cotton seed market, Delta and Land Pine Company now control about 75% of the market. The concentration is staggering. National farming associations see this dwindling of price competition and fewer distribution outlets as disfavoring and threatening the small family farm. Average annual income per farm has plummeted throughout the last decade. Almost a quarter of all farm operating families live below the poverty level, twice the national average – and most seek income from outside the farm to survive. A similar pattern is developing in Europe.

3.14. Impact on Long -Term Food Supply

If food production is monopolized, the future of that supply becomes dependent on the decisions of a few companies and the viability of their seed stocks. Like the example of Peru, there are only a few remaining pockets of diverse seed stocks to insure the long-term resilience of the world's staple foods. All of them are in the Third World. Food scientists indicate that if these indigenous territories are disturbed by biotech's advance, the long-term vitality of all of the world's food supply is endangered.

4. Conclusion

Genetically-modified foods have the potential to solve many of the world's hunger and malnutrition problems, and to help protect and preserve the environment by increasing yield and reducing reliance upon chemical pesticides and herbicides. Yet there are many challenges ahead for governments, especially in the areas of safety testing, regulation, international policy and food labeling. Many people feel that genetic engineering is the inevitable wave of the future and that we cannot afford to ignore a technology that has such enormous potential benefits.

What will happen if this technology is allowed to spread? Fifty years ago few predicted that chemical pollution would cause so much vast environmental harm. Now nearly 1/3rd of all species are threatened with extinction (and up to half of all plant species and half of all mammals). Few also knew that cancer rates would skyrocket during this same period. Nowadays approximately 41% on average of Americans can expect cancer in their lifetime. So we must proceed with caution to avoid causing unintended harm to human health and the environment as a result of our enthusiasm for this powerful technology. The use of genetically modified organisms in foods was recently banned in Europe,

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