

Genetically Modified Foods - A Public Health Hazard?

The introduction of transgenic (genetically modified or GM) crops and foods into the existing food production system has generated a number of questions about possible negative consequences, some of which may be of public health relevance.

A GM crop plant contains a gene or genes that were artificially inserted instead of the plant acquiring them via pollination or selective breeding. The inserted gene sequence (known as the transgene) may come from another unrelated plant, or from a completely different species. Bt corn, for example, which produces its own insecticide, contains a gene from the bacterium, *Bacillus thuringiensis*.

Depending on where and for what purpose the plant is grown, desirable genes may provide features such as higher yield or improved quality, pest or disease resistance, or tolerance to heat, cold and drought. Crops can be modified to produce substances that would improve human health, including edible vaccines. Thus, transgenic technology enables plant breeders to bring together in one plant useful genes from a wide range of living sources, not just from within the crop species or closely related plants.

The International Service for the Acquisition of Agri-biotech Applications estimated 6 million farmers in 16 poor countries planted GM crops on 145 million acres (Associated Press, 1/16/03). And, in 2002, the US Department of Agriculture (USDA) estimated that worldwide GM crops grew on more than 225 million acres. Further both organizations reported that farmers were planting more GM crops than in previous years, partially in response to the Environmental Protection Agency (EPA) registration of controversial varieties of Bt corn, and India lifting its ban on a Bt cotton seed. The USDA estimated that in the US during 2002, 32% of corn, 71% of cotton, and 74% of soybeans would be GM. Opponents of GM technology have claimed that most of the GM crops in the US have gone into animal feed and that farmers are

rejecting GM food crops. This is disputed by the Monsanto Corporation, St Louis which claims that 70% of processed foods in the US include GM crops.

GM crops and foods have strong proponents as well as opponents. The opponents have raised concerns about damage to human health, damage to the natural environment, disruption of current practices of farming and food production in developed countries, and disruption of traditional practices and economies in less developed countries. The latter three concerns will be not be discussed here, but that does not discount their legitimacy.

These concerns have prompted countries such as Zimbabwe and Zambia to reject GM foods as part of international aid packages to help relieve the famine affecting 14 million people in several southern African countries. Several of the affected countries, such as Malawi, Mozambique and Lesotho, have agreed to receive GM food aid provided that it is milled so that it cannot be planted and contaminate indigenous crops. Meanwhile, the United Nations admitted in September 2002 that it had been delivering GM food as emergency aid for the past 7 years, but without telling the countries concerned. Furthermore, the international aid issues have led to allegations that the US is exploiting southern Africa's drought to establish markets for its large unsold stocks of GM maize and soya.

Objections to GM foods are not limited to developing countries. In the US, for example, the Food and Drug Administration (FDA) has not received information from biotechnology companies for at least half of the GM crops currently in production and has no post-market survey to detect any adverse health effects from these foods. As to be expected, opponents to GM foods have exploited this deficiency in their campaigns. Further, the PEW Initiative on Food and Technology issued its report, *Future Fish: Issues in Science and Regulation of Transgenic Fish*, in December 2002, pointed out that while the FDA has asserted its authority and expertise for pre-



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market approval of GM foods and animals, its legal authority to consider environmental risks beyond harm to the modified animal itself is uncertain. For example, the FDA evaluation of human food safety assumes that "the drug in question will be manufactured consistently from one batch to the next to the same standards of purity, strength and identity as the product used to generate the human food safety data." When applied to GM foods and animals this assumption can prove problematic. Exactly what does a "batch" consist of, a single plant or animal or a GM line? Can the FDA guarantee the "consistent" manufacture of the drug (gene product), given it has little control of the genetic evolution that may or may not occur at reproduction of the plant or animal.

Meanwhile, US consumers, most of whom probably do not realize they have been consuming GM foods for several years, are evenly divided over whether the benefits of GM crops outweigh environmental risks, according to, a survey, conducted in January 2002 by Zogby International.

In Europe, however, GM food issues are volatile, with the Church of England and Prince Charles weighing in on the side of opponents. And, the British Medical Association has requested that GM crop trials in Scotland immediately be halted as a precautionary measure to safeguard public health (BBC News 11/20/02). The heightened concern in Europe may stem from its experience with bovine spongiform encephalopathy (mad cow disease), which, although not a GM food issue, continues to threaten the farm economies of European Union (EU) countries as well as the lives of the residents. Therefore, the agriculture ministers drafted, in November 2002, a law that would force the labeling of foods (human and animal) that are derived from GM crops but do not contain any measurable GM protein or DNA. If enacted, this labeling law would allow consumers to make personal choices with regard to consumption of GM food products. Critics, on the other hand, claim that such a law would be unenforceable since enforcement agencies would have no way of detecting whether the derived products come from GM or non-GM crops. Paradoxically, the draft law would not require labeling of any food with <0.9% of detectable GM ingredients and would permit accidental contamination up to 0.5% with GM ingredients not approved in Europe, again without labeling. And, the Bush administration has objected to the EU proposal and warned that a trade war could flare up unless the EU lifts its unofficial 4 year block on GM imports. It is estimated that US farmers lost nearly \$300 million in corn exports last year due to the EU ban.

Given the emotional and political divide on the issue divide over GM foods, is there truly any public health concern, especially since GM foods in the US have not been linked to major health problems since those foods have entered the food supply? The issues surrounding objections to GM foods can be broadly grouped into concerns about allergenicity, horizontal transfer and antibiotic resistance, eating foreign DNA, cauliflower mosaic virus promoter, and changed nutrient levels.

The possibility that there may be an increase in the number of allergic reactions to food as a result of genetic engineering has a powerful emotional appeal because many persons experienced food allergies before the advent of GM crops. To date, there is no evidence that GM foods are more likely to cause allergic reactions than are conventional foods. While some people in the future may develop allergies to GM foods, there is no evidence that GM foods pose more of a risk than conventional foods. Meanwhile, a GM strain of soybeans that has been engineered to delete a protein known as P34, which is responsible for more than half of allergic reactions to soya, is being grown in Hawaii.

At several stages of the laboratory process, developers of GM crops use DNA that codes for resistance to certain antibiotics, and this DNA becomes a permanent feature of the final product although it serves no purpose outside of the laboratory. Therefore, the use of antibiotic resistance markers in the development of GM crops has raised concerns about whether GM foods will play a part in the loss of ability to treat illnesses with antibiotics.

One concern is the risk of horizontal gene transfer — transfer of DNA from one organism to another other than offspring. Transfer of a resistance gene from a GM food to intestinal microorganisms, for example, could help those organisms survive therapeutic levels of certain antibiotics. It is known that, in humans, DNA from GM soya can be horizontally transferred to intestinal bacteria although the level of uptake by the bacteria was low (New Scientist 7/18/02).

Another concern is that the enzyme product of the DNA might be produced at low levels in GM plant cells. While high processing temperatures would inactivate the enzyme in processed foods, ingestion of raw GM foods could result in intestinal levels of the enzyme that would inactivate orally administered doses of the antibiotic. This issue was raised during the approval process for Calgene's FlavrSavr tomato and Ciba-Geigy's BT corn 176. In both cases, tests showed that orally administered antibiotics would remain effective. Thus, the risks from antibiotic resistance genes in GM foods appears to be low and the industry is moving to phase out their use.

Some people have been concerned that when consuming GM foods they would be eating "foreign DNA" which could then lead to adverse health effects. What these individuals forget is that every time meat, fruit, vegetables, nuts, etc, are consumed, they are eating "foreign DNA". To date, there is no evidence that DNA from GM crops is any more dangerous than DNA from conventional crops, animals, and their attendant microorganisms.

When transgenic technology is used to insert a new gene into a plant, additional pieces of DNA known as promoters are added to direct the activity of the gene. The most widely used promoter is the cauliflower mosaic virus 35S promoter. This promoter comes from a virus that causes disease in several vegetables, such as cauliflower, broccoli, cabbage,

and canola. While there are concerns that cauliflower mosaic virus promoter might be harmful were it to invade human cells and turn on its genes, experiments in mice indicate that normal body defenses would eliminate stray fragments of foreign DNA that might enter the blood stream from the intestinal tract. People have been consuming small quantities of this virus for centuries as they ate virus infected vegetables. Although vegetables heavily infected with the virus are unappetizing, there have been no documented negative effects on health from eating either the virus or its promoter.

An important issue is how GM foods compare with conventional foods in nutritional quality. This will remain a critical question as crops that engineered specifically for improved nutritional quality are marketed. Unfortunately,

Smallpox Vaccination

President Bush has elected to embark on a phased-in smallpox vaccination program for the nation. The 1st phase calls for vaccination of the military, public health response teams, and a restricted number of medical care providers. The 2nd phase will expand the pool of medical care providers who can be vaccinated as well as including emergency responders. And, the final stage would be making the vaccine available to the general public. The 1st stage already is in progress. Vaccinations of military personnel began in December. Vaccination of public health response teams and medical care providers had to wait until the 24th of January, when the liability protection of the smallpox vaccination section of the Homeland Security Act of 2002 became effective. The civilian portion of the 1st phase should be completed by the end of February. With no definitive dates announced, the 2nd phase is scheduled to be completed by late summer and the 3rd phase to occur in 2004.

In Missouri, the goal of the 1st phase efforts was to vaccinate 350 public health workers and 6,000 to 8,000 hospital emergency department staff. However, according to an article in the *Kansas City Star* (1/23/03, B1), the state ordered 4,000 doses of vaccine from the Centers for Disease Control and Prevention (CDC) because only about 2,300 health care workers statewide, to date, had volunteered to be vaccinated. There are 5 vaccination centers in the state, one each in St Louis County, Butler County, Springfield/Greene County, Columbia/Boone County, and Kansas City. The Kansas City Health Department will cover

there have been few studies to date. For example, the level of isoflavones — thought to play a role in preventing various cancers — has been evaluated for RoundupReady soybeans. Various studies have found the levels of isoflavones in the GM soybeans to be equivalent to the variances found for conventional soybeans. Industry studies submitted in support of applications to sell GM crops indicate that nutritional components that are commonly tested are similar in GM foods and conventional foods.

Issues surrounding GM foods will continue to be debated in the future. Besides health issues, concerns over damage to the environment, disruption of farming practices and food production in developed countries, and disruption of traditional practices and economies in less developed countries, will continue to engender emotional debate.

28 counties and 42 hospitals as part of this initiative.

The nation's experience with the 1st phase initiative obviously will impact the 2nd and 3rd phases of the smallpox vaccination program. One of the major issues raised against the 1st phase is the lack of compensation for persons injured or killed by the vaccine. Federal liability protection established in the Homeland Security Act of 2002, protects the vaccine manufacturers and those who administer the vaccine against suit, and requires injured persons to file a tort case against the US government, provided they can establish negligence by the vaccine manufacturer or the person administering the vaccine. Thus, legal experts believe it will be extremely difficult for anyone to collect damages under this system. The Bush administration, meanwhile, has taken the position that injured persons should be covered under workmen's compensation laws and their personal health care insurance, although it is not clear if this assumption will be valid in all cases. Various organizations have petitioned Congress for a remedy to the compensation issue. And, the compensation issue has played a part in the decisions by many major hospitals across the country not to participate in the 1st phase of the smallpox program (*USA Today*, 1/21/03, 1A).

Further, there are still clarifications as to who might be vaccinated. For example, in January, CDC's Advisory Committee on Immunizations Practices (ACIP) recommended that healthcare workers with babies <1 y old in the household be vaccinated, while indicating that some states may wish to defer such individuals because of the potential for contact transmission of vaccinia from the healthcare worker to their child.

The Kansas City Health Department will be offering its 4-day *Principles of Epidemiology* course on the 28th of April to the 1st of May 2003. The course will be held at the Health Department and is free. Enrollment is limited to 15 individuals. If you are interested in attending, please contact:

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Influenza

Nearly twice as many people have been dying of influenza in the US as previously thought — 36,000 instead of 20,000 year (JAMA 289:179, 2003). And, that is for a normal influenza season. In bad years for influenza, the number of deaths is more likely in the range of 50-70,000. The revised estimates of death are not due to more dangerous strains of influenza viruses, but rather because the population is getting steadily older. At least 90% of influenza-related

deaths occur in the elderly.

In addition, another 11,000 Americans die each year from respiratory syncytial virus (RSV) infections, which is associated with respiratory disease in young children and older adults. RSV was estimated to account for 25% of all pneumonia/influenza mortality and 23% of respiratory and circulatory disease mortality.

Meanwhile, Wyeth announced that it ceasing production of its FluShield (an injectable influenza vaccine) and Pnu-Immune (an injectable polysaccharide pneumococcal vaccine for adults).



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