# BIOTECH-NOLOGY on your plate

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Is what we don't know hurting us?

We can all rest easier Not so. Their science turns out to knowing that Health Canada assumes genetically modified (GM) foods are safe—right?

Genetic engineering allows scientists

be flawed and these controversial gene-spliced crops are now linked to significant health problems. to take genes from one species and transfer them into the DNA of other species. Biotech companies had plans to genetically modify nearly all commercial food crops, but consumer concern about safety has restricted them to primarily four major types—soy, corn, cotton, and canola.

Despite biotech promises of designer traits, such as drought-resistance and improved nutrition, these crops today have just two traits. About 19 percent have added bacterial genes that produce a pesticide called Bt toxin. Another 68 percent are herbicide tolerant, which allows farmers to spray weed killer over the crops without killing them. Monsanto's Roundup Ready plants, for example, survive an otherwise deadly dose of the company's Roundup

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herbicide. The other 13 percent are engineered with both these traits.

GM crops entered our food supply in 1996 with little fanfare, no required labels, and dangerously few safety studies. Health Canada's approvals of these foods, according to a 2000 review by Professor Ann Clark, a University of Guelph plant physiologist, have been "largely an assumptions-based process." The agency's safety assessment of Roundup Ready cotton illustrates their over-reliance on wishful thinking.

# HEALTH RISKS? WHAT HEALTH RISKS?

GM cotton is not just for fabric. Its seeds are processed into pulp for animal feed and cooking oil for human consumption in snack products such as chips. According to their website, "Health Canada is of the opinion that refined oil from [Roundup Ready cotton] is as safe and nutritious as cottonseed oil from current commercial cotton" and  $\triangleright$ 



# Foods that may contain GM ingredients include:

- bread, candy, cereals, chips, chocolate, cookies, crackers, fried foods, frozen yogourt and ice cream, hamburgers and hot dogs
- infant formula, margarine, mayonnaise, meat substitutes and veggie burgers
- pasta, protein powder, salad dressing, soy cheese, soy sauce, tofu, and tomato sauce
- Go to responsibletechnology.org for a list of soy and corn derivatives and tips on how to avoid GMOs in restaurants.

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safety." Their assessments are narrowly focused on the protein produced from inserted genes. Proteins can trigger allergies, be toxic, or block nutrient absorption. Since Monsanto claims that oil from the cottonseed had no detectable protein, Health Canada assumed that it posed no risks and needed no testing. But sometimes oils do contain enough protein residues to be dangerous: in one study, for example, the residues of allergenic

does not "raise concerns related to

proteins were discovered in peanut oil. Even if the cottonseed oil were virtually protein-free, it doesn't mean that the GM version is safe. The process of creating a GM crop can create unpredicted damage in its DNA. The Royal Society of Canada stated in a 2001 report to Health Canada that "the default prediction" for GM crops includes "a range of collateral changes in expression of other genes, changes in the pattern of proteins produced and/or changes in metabolic activities." These unintended and incidental changes could produce dangerous toxins, allergens, or carcinogens, which, if fat soluble, could end up in the oil-and in our food.

In light of these unknown risks, health and science experts worldwide advocate using the better-safe-than-sorryapproach known as the "precautionary principle." They argue that we should not expose the public to genetically modified organisms (GMOs), even if we have not yet identified harmful substances and their effects. But biotech companies, like big tobacco before them, insist that we should assume their products are safe. Health Canada agreed.

# DNA DAMAGE

Genetic engineering damages plant DNA in several ways. The first is the gene insertion process, which is accomplished by either shooting genes from a gene gun into a plate of cells, or using bacteria to infect plant cells with foreign genes. Both create mutations in and around

the insertion site and elsewhere in the genome (the total genetic material of an organism).

The altered cell is then cloned into a plant. This process results in hundreds or thousands of additional mutations throughout the DNA. In the end, the GM plant's DNA can be 2 to 4 percent different from its natural parent. Native genes can be scrambled, deleted, or permanently turned on or off.

Inserting a gene triggers not only mutations, but an inexplicable genomewide response. One study revealed that about 5 percent of a plant's genes "were affected by the presence of the mutant gene." Some scientists and health experts are concerned that the mutations and altered gene expressions, therefore, might work to create new or higher levels of unknown and potentially harmful compounds.

### WHAT ARE THEY FEEDING COWS?

In 1997 Monsanto employee Kirk Azevedo was told by a Monsanto scientist that Roundup Ready cotton contained unexpected new proteins created as a side effect from the genetic engineering process. He was also told that the company had not conducted any safety studies on the proteins, which were part of the cottonseed pulp being fed to dairy cows near his home.

Azevedo, who was responsible for marketing that cotton, had been studying food safety issues on his own. He knew that certain proteins might not only harm cows, but the milk and meat from these animals could put consumers at risk. He alerted his fellow employees to the danger, but was ignored. "Anything that interfered with advancing the commercialization of this technology was going to be pushed aside," Azevedo concluded.

Health Canada's assessments of GM cotton overlooked the unpredicted and potentially harmful impacts of the >

# REPORTS OF REACTIONS TO GM FOODS

Evidence has emerged over the past decade suggesting that GM foods may be linked to health hazards. Here is a short sample of dangers attributed, anecdotally, to Bt crops:

- In 2003 people living in a Filipino village experienced mysterious skin, respiratory, and intestinal reactions when an adjacent Bt cornfield was pollinating. Blood samples from 39 individuals showed antibodies in response to Bt toxin, supporting-but not proving-a link. When the same corn was planted in four other villages the following year, the symptoms returned in each location—only during the time of pollination.
- Hundreds of agricultural workers in India developed allergic reactions when handling Bt cotton. Symptoms reported by a 2005 medical team report were identical to those described by people in Vancouver and Washington who were sprayed with Bt.
- In 2006 it was reported in India that sheep that had grazed on Bt cotton plants died within five to seven days. An estimated 10,000 sheep died in the region in 2006, with more deaths reported in 2007. Investigators said preliminary evidence "strongly suggests that the sheep mortality was due to a toxin...most probably Bt toxin."
- German farmers have reported that exposure to Bt corn caused the death of cows.

herbicide-resistant gene splice

# **How Genetic** cell division **Modification** Works

add leaf from plant to a culture of the bacterium



# GMOs are not labelled as such in North America, but here are four ways we can avoid them:

- 1. Buy organic foods, which are not allowed to use GM ingredients.
- 2. Choose from dozens of brands that display non-GMO labels.
- 3. Avoid products with at-risk ingredients, including soy, corn, cottonseed oils, and canola, and their derivatives. There is also GM papaya from Hawaii, and GM zucchini and crook neck squash from the US.
- 4. Consult a non-GMO shopping guide. (See the status of more than 3,000 products sold in Canada at *qmoquide.greenpeace.ca* or on our Web exclusive at *alive.com*) and at responsibletechnology.org.

proteins produced by inserted genes in animal feed derived from GM cotton and canola. In fact, they ignored virtually all the unexpected changes described in the Royal Society's report.

According to Ann Clark's review, "With two exceptions, no actual lab or feeding trial assessment of toxicity (or allergenicity) to livestock is referenced." Clark asks, "If such toxins or allergens exist, and are in fact present in the protein-rich residue left after refining the oils, why is toxicity assessment not more rigorous prior to feeding the protein-rich meal to livestock?" Clark found that "70 percent of the currently available GM crops, including all of the canola and cotton crops approved for commerce in Canada, have not been subjected to any actual lab or animal toxicity testing."

The studies that are done are not conducted by Health Canada but by the biotech companies themselves. These industry studies are notorious for using creative ways to avoid finding problems. They test feed on older animals instead of more sensitive young ones, keep sample sizes too low, dilute the GM component of the feed, overcook samples, compare results with irrelevant controls, choose obsolete, insensitive detection methods, limit the duration of feeding trials, and even ignore animal deaths and sickness.

# "Genetic engineering damages plant DNA in several ways."

# A FLAWED ASSESSMENT

In 1997 Health Canada approved Monsanto's MON 810 corn, which contains a pesticide-producing gene from a soil bacterium called Bacillus thuringiensis, or Bt. The fact that we consume that Bt toxin in our corn is hardly appetizing, but Health Canada assumes that MON 810 does not present a threat because of the "history of safe use of Bt."

They refer to the fact that for years farmers have sprayed crops with solutions containing natural Bt bacteria as a method of pest control. Health Canada states that Bt toxin is "highly selective for insects, with no activity against other organisms such as mammals."

Nevertheless, in several studies Bt toxin has triggered powerful immune responses in mice and damaged their small intestines. Moreover, when natural Bt was sprayed over areas around Vancouver and Washington State to fight gypsy moths, hundreds of people reported reactions-mostly allergy or flulike symptoms—to the spray.

There are no surefire tests to guarantee that a novel protein produced in a GM crop will not cause allergic reactions. To minimize the likelihood, the World Health Organization (WHO) recommends comparing the protein's amino acid sequence with those of known allergens. Health Canada declared that the Bt "protein did not show meaningful amino acid sequence [similarity] to known allergens." A year after they finished their approval, however, US researchers discovered that MON 810 does share a sequence with an egg yolk allergen.

GM proteins have been put into test tubes with acid and digestive enzymes to see how quickly they break down in a simulated stomach. Health Canada says that MON 810's "protein is rapidly degraded." These tests, however, were conducted by Monsanto, which uses

stronger acid than is found in the human stomach and as much as 1,000 times more digestive enzymes than recommended by the WHO. When tested under proper conditions, MON 810 protein lasts far longer than the WHO criteria.

Health Canada claims that the MON 810 protein is "equivalent to that produced in the naturally occurring [Bt]." But the Bt gene that was spliced into the corn was truncated during insertion, so the Bt protein has a different amino acid sequence than in the natural form.

In one study Monsanto scientists tested the toxicity of Bt by feeding a single concentrated dose to mice and watching them for a week or two. The mice survived, so the scientists deduced that Bt toxin was safe for people to consume for a lifetime. Health Canada proclaimed that this test showed "no indication of toxicity" for MON 810. The protein tested, however, was not even from the corn itself, but rather derived from GM bacteria.

MON 810 corn is processed into a variety of derivatives found in the Canadian diet, including high-fructose corn syrup and corn oil (see sidebar). But on January 11, 2008 the French government decided to ban the planting of MON 810. "Inadequate scientific assessment" was cited as one reason for its rejection.

### WHAT ANIMAL STUDIES SHOW

Although there hasn't been enough independent, third-party, credible research on the health effects of GMOs, we do have some animal studies-with disturbing results. Animals fed GM soy showed profound changes in their livers, kidneys, and hearts. But the most worrisome damage related to

reproduction. Testicles of mice and rats fed Roundup Ready soybeans showed dramatic changes: in rats, the organs were dark blue instead of pink; in mice, sperm cells were altered; and embryos of GM soy-fed mice also showed changes in DNA function.

In other studies, when female rats were fed GM soy two weeks before mating, 51.6 percent of their offspring died within three weeks, compared to 10 percent from the non-GM soy group, and 8.1 percent for non-soy controls. The GM-fed offspring were also smaller, on average and, in a follow-up study, were unable to get pregnant. In addition, when a laboratory started feeding all their rats a GM soy-based feed, after two months the rat infant mortality at the facility increased to 55.3 percent. Even Monsanto's own study on the transgenic corn MON 863 showed evidence of toxicity in the rat's liver and kidneys. In the only human feeding study on GM food, published in Nature in 2004, the controversial evidence showed that genes inserted into GM soybeans were found to transfer into the DNA of human

gut bacteria.

# MONITORING THE HEALTH OF CANADIANS-NOT

In 2002 Health Canada finally announced that they would monitor Canadians for health problems from eating GM foods. A spokesperson said, "I think it's just prudent and what the public expects, that we will keep a careful eye on the health of Canadians."

But according to a CBC TV report, Health Canada "abandoned that research less than a year later saying it was 'too difficult to put an effective surveillance system in place." The news anchor added, "So at this point, there is little



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research into the health effects of genetically modified food."

# THE TIPPING POINT

Leading companies in the North American natural foods industry are starting a process to remove all remaining GM ingredients from their products. As knowledge of the dangers of GM foods disseminates and more non-GMO alternatives become available, the numbers of consumers avoiding GMOs might reach a tipping point, forcing all food companies to stop using them.

When such a tipping point was achieved in Europe in April 1999, several of the world's largest food manufacturers there committed to remove GMOs from their products. The Institute for Responsible Technology has a campaign designed to achieve the tipping point in North America before the end of 2009. In the meantime, safe eating. **a** 

Jeffrey M. Smith is the executive director of the Institute for Responsible Technology and the author of Genetic Roulette: The Documented Health Risks of Genetically Engineered Foods (Chelsea Green, 2007).