

Genetically Modified Organisms (GMOs)

What is GMO?

GMOs are organisms whose DNA has been altered by genetic engineering. When scientists generate GMOs, they combine existing pieces of DNA in new ways to give an organism new characteristics. In most cases, GMOs are created by introducing genes from other organisms. For example, Rice Grassy Stunt Virus (RGSV) has been virtually eliminated from rice production in Southeast Asia through the introduction of rice cultivars with a gene resistant to RGSV.

How is a GMO developed?

The development of genetic engineering techniques has changed how breeders and scientists select positive characteristics, or traits. For thousands of years, the way to encourage a particular trait in an animal or plant was through selective breeding which involves breeding organisms with beneficial traits in order to produce offspring with those traits. Radiation and chemicals were, and are still, used to encourage mutation and produce novel traits. Those novel traits judged as beneficial are then bred into the population. The end products of these established techniques are not considered to be 'GMOs'.

By using genetic engineering to create GMOs, scientists can identify genes that code for useful traits and directly manipulate those genes, leading to specific outcomes more quickly than the techniques described above.

Are GMOs safe?

In Canada there is no overall approval process for the technique of genetic engineering. Rather, the safety of each genetically engineered product is evaluated individually. Specific

concerns regarding the safety of GMO foods include issues associated with gene transfer and with allergenicity.

Gene transfer:

- Gene transfer is the insertion of new DNA into a cell. The transfer of antibiotic resistant genes from genetically modified foods to bacteria in the gut has been raised as a concern.
- The frequency of gene transfer from plants to bacteria is extremely low. As a result, the potential health risks associated with gene transfer from GMO foods to gut bacteria are negligible. As well, humans consume naturally occurring antibiotic resistant microorganisms with no known negative effects.

Allergenicity:

- Non-allergenic foods could potentially become allergenic as a result of the transfer of genes from commonly allergenic foods.
- Allergenicity standards for GMO foods are higher than for traditionally developed foods, which are not tested for allergenicity.
- Protocols for testing genetically modified foods have been evaluated by the Food and Agriculture Association of the United Nations (FAO) and World Health Organization (WHO); no allergic effects have been found related to genetically modified foods currently on the market.

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What GMO crops are available today?

The most common genetically modified crops grown around the world are herbicide - and insect - resistant soybeans, corn, cotton, canola and alfalfa. The majority of the cotton, corn and soybeans planted in the US (>90%) are genetically engineered.

In Canada, herbicide resistant canola is grown on about 80% of the acreage in western Canada, with exports valued at more than \$3 billion. Herbicide resistant crops are designed to tolerate specific broad-spectrum herbicides, which kill the surrounding flora, but leave the cultivated crop intact. Other genetically engineered crops grown in Canada include corn, soybean and beets. And, in May of 2016, Health Canada approved the sale of genetically modified Atlantic salmon.

To date, over 82 genetically modified foods have been approved for sale in Canada. This includes different varieties of the same type of food, such as multiple varieties of canola, and products which are not currently available in stores.

Some estimates indicate that as many as 30,000 different products on grocery store shelves contain genetically modified ingredients. Many processed foods contain soy, corn syrup and other derivatives of the common GMO crops listed above. Even 'non-GMO label' processed food products can contain small amounts of genetically engineered material.

Can genetically engineered products be detected?

It is not possible to reliably determine whether an organism has been genetically engineered. That is particularly true for genetic engineering techniques that involve the 'knock out' or silencing of existing genes. GMO labelling therefore requires tracing through the supply chain, which can be very complex for processed foods with multiple ingredients.

Ethical Issues

GMOs promise a number of economic, environmental and societal benefits. But, as with any new technology, there are concerns about the development of GMOs and their impact on the environment and society and how such risks and benefits are considered.

The **economic benefits** of GMOs include increased productivity for farmers and the elimination of the effects of some plant diseases. These benefits are not achieved without costs and risks. The GMO industry is dominated by a small number of large firms which can impede innovation and contribute to the high cost of GMO seeds. Farmers who adopt GMO products can face economic uncertainty through trade sanctions imposed by governments opposed to GMOs.

The **environmental benefits** of GMOs include the decreased use of chemical insecticides on insect resistant crops; decreased greenhouse gas emissions from crops engineered to produce less methane; water conservation through drought resistant crops; and reduced food waste through GMO fruit and vegetables that bruise less easily and can be stored for longer. There are, however, many associated risks. Many GMO crops are closely related to and cross-compatible with weeds, to which modified genes can be transferred through cross-pollination. The transfer of modified genes confers GMO benefits, such as herbicide resistance, on weeds. Cross-pollination can also contaminate non-GMO crops growing in proximity to GMO crops. Other unanticipated effects on the environment are emerging, with potential but unknown consequences for ecosystems.

The **societal benefits** of GMOs include improved nutrition for those lacking a diverse diet. For example, Golden Rice is a GMO that was developed to produce beta-carotene, a precursor of Vitamin A. Food supply will be a constant concern in the future, with the UN estimating that food production will have to double to meet global human demand by 2050. Innovative strategies will be required and these will likely include some form of GMOs.

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More Information and Resources

Impact of Genetically Engineered Crops on Farm Sustainability in the United States, National Academy of Sciences.

Visit genomebc.ca to learn more.