

Should we promote the widespread consumption of biotech foods?



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ABSTRACT

Genetically modified organisms, or GMOs, can be engineered to resist disease, produce more vitamins, and even provide lifesaving vaccines. Recently, scientists have been experimenting with modifying plant and animal genes to create new breeds of crops and livestock that grow faster, provide more nutrition, and minimize pollution. Why, then, are some citizens and experts hesitant about promoting the widespread consumption of these "biotech" foods? As shall be made clear, there are significant drawbacks to this agricultural innovation. As both national and worldwide consumers, we must ask if the benefits outweigh the risks of GMOs in terms of health, environment, economy, and ethics.

Background on GMOs

In 1972, researchers spliced DNA from a virus and a bacterium together to create a "recombinant" molecule. Such a hybrid molecule combines traits from two different organisms to form a new genetic code. Scientists eventually discovered an innovative way of genetically modifying plants by inserting antibiotic-producing DNA into a bacterium and allowing it to "infect" plants, thus transferring the antibiotic producing capabilities to the plant's genetic code. Since then, methods of artificial gene insertion have developed, including using a microsyringe to inject DNA molecules and a "gene gun" that fires DNA-coated metal particles into the cell.^[1]

In the 1990s, the agricultural industry began offering biotech crops to the public. One such product was the FlavrSavr tomato which could retain its firmness for longer and thus boasted an extended shelf-life [Figure 1]. In nature, tomatoes contain a gene producing enzymes which decompose the structural pectin in the fruit. By reversing the gene to block enzyme production, food scientists created a tomato that could ripen without

softening.^[1] Today, the most prevalent GM (genetically modified) crops are soybeans containing bacterium genes that allow the crops to resist herbicides sprayed onto fields. Another example is Bt-corn, engineered to produce Bt (*Bacillus thuringiensis*) proteins that provide resistance to insects. GM corn came under



Figure 1: Image of a FlavrSavr Tomato (Available from <http://inhabitat.com/gmo-tomatoes-could-stay-fresh-for-over-a-month/>)

attack in 2009 when a study claimed that ingestion of Bt-corn could lead to liver, kidney, and heart damage in mammals.^[2] The results were dismissed by food safety authorities, who cited natural variation as the cause. However, this is neither the first nor the last time the safety of GMOs will be contested.

Health and Safety Issues

The fact remains that GM crops could be potentially harmful to human health. In 2000, a genetically engineered feed corn known as Starlink corn contaminated many corn-based processed foods. Starlink, which was not approved for human consumption, reportedly caused allergic reactions among many consumers, raising concerns about the safety of producing GMOs.^[2] Numerous research projects spanning several decades claim that biotechnology is no riskier than conventional planting methods, which are also subject to contamination. In fact, GMOs might even be safer, as antibiotic-producing plants could resist potentially deadly *Escherichia coli* breakouts.^[1] Nevertheless, opponents are still worried about the possible toxic effects of GMOs on the human body, especially concerning the growth hormone use in the milk industry.

One of the largest biotech food companies, Monsanto, injects dairy cows with the bovine growth hormone known as recombinant bovine growth hormone (rBGH). rBGH is used in a third of cows nationwide, and increases milk production by as much as 15% – a great benefit to American farmers. But its use is banned in 15 European nations as well as in Canada. Health Canada cites the issue of safety in both humans and cows, as cows injected with rBGH show higher levels of insulin-like growth factor 1 (IGF-1), a tumor-inducing substance. In addition, a report conducted by Monsanto itself shows that some rats fed with rBGH absorbed it into their bloodstream, suggesting a similar and potentially toxic effect in humans.^[2] Although the Food and Drug Administration of the United States of America (USA) claims that the hormone is safe for cows and humans, a long-term study on the possible toxicity of rBGH has yet to be conducted. However, before this has been carried out, distrust in GM animals injected with hormones has led many consumers to switch to organic milk.

Worldwide Benefits

But, biotechnology holds promising applications on a global scale, which cannot be ignored. GM crops have great potential in alleviating world hunger, as scientists

have found new ways to make plants more nutritious and easier to grow. “Golden Rice” is a new breed of rice containing genes from daffodils and bacterium, which produce vitamin A. Set to be released in 2013, this could lower the malnutrition rates in citizens of third-world countries, who often lack essential vitamins.^[1] In addition to providing more nutrition, GM organisms could possibly be used as edible vaccines in third-world countries that need vaccines but lack the resources and medical workers to distribute them. Harmless pathogen genes inserted into foods like bananas and potatoes would enter the patient’s digestive tract, allowing them to develop immunity to diseases including malaria and measles. While normal vaccination procedures require refrigeration, syringes, and needle sterilization, foods incorporated with medicines are easily distributable and could prevent millions of deaths in vulnerable areas like the African Congo.^[1]

Advances in GMO Animals

Although genetically modified livestock remains a controversial topic, scientists are finding innovative ways to utilize this technology. In recent years, USA’s Agricultural Department has been experimenting with cows and pigs to produce disease-resistant livestock and leaner meat, which would be beneficial to both farmers’ wallets and consumers’ waistlines. In the latest advancement, scientists at Aqua Bounty Technologies have combined genes from Chinook salmon and ocean pout fish to create a breed of salmon that grows twice as fast as normal salmon [Figure 2].^[3] Since faster production leads to cheaper market prices, more Americans will be able to afford this fish that supplies heart-healthy omega-3 fatty acids.

Phosphorus in livestock manure has always been a problem in the farming industry, as it contaminates the run-off and pollutes nearby rivers and lakes. Recently, researchers are experimenting with transferring enzyme-producing genes from bacteria into pigs.^[3] These genes allow the pigs to digest more phosphorous and thus produce less toxic manure. This would reduce the number of fish killed as a result of algal blooms, a harmful by-product of conventional farming methods.

Economic and Environmental Effects

Genetically modified plants can translate to less pesticide and fertilizer usage in the agricultural industry, as GMOs produce their own insect repellents and growth hormones. Moreover, a recent study published



Figure 2: Image of salmon genetically engineered to grow twice as fast as normal (Available from <http://www.nytimes.com/2007/07/30/washington/30animal.html?adxnnl=1&adxnnlx=1313859791-dEvFJk/A2YL/0AWiv7hCgAv>)



Figure 3: Image of Bt-corn (Available from <http://www.ipm.iastate.edu/ipm/icm/1998/1-19-1998/btdiscon.html>)

in Science magazine shows that GM corn [Figure 3] has benefitted American farmers with US\$ 6.9 million since its introduction.^[2] This is not surprising, as the genetically modified corn produces its own pesticides which results in less crop damage. Yet, opponents cite the various ways that GMOs could harm the environment. Pesticide-producing plants could kill beneficial insects such as ladybugs. Introducing disease-resistant crops might inadvertently create new, mutated super-viruses. Also, cross-pollination between wild plants could generate invincible weeds, such as the 1998 case where bio-engineered canola from a Canadian farm spread into the wild, requiring four herbicides to finally kill it.^[1] If

GMOs escape into the wild and spread undesirable genes to their wild counterparts, it could possibly cause the extinction of other native species. Therefore, while biotech foods can reduce pollution and lower costs for farmers, they must be strictly regulated to ensure that GMO genes do not spread into the wild.

Conclusion

Through the ever-expanding field of genetic research, scientists have discovered how to insert, replace, and combine DNA in a plant or animal to produce useful traits and eliminate undesirable ones. GMOs can help to lower global hunger and disease mortality rates, reduce environmental pollution, and increase farmers' income. However, they also pose health and safety risks, and are potentially harmful to the environment, so the production and distribution of GMOs must be tightly regulated. For example, policy-makers should require studies on the long-term side effects of GMO foods before approving them for the market.

Lastly, and perhaps most importantly, we must face the moral dilemma of such a technology – are humans justified in altering an organisms' most intimate characteristic, its genetic code? In the future, will research extend beyond plants and animals to humans as well? One answer remains clear: As we continue to progress in all fields of science, we must uphold responsibility and consider the consequences of each technological advancement.

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About the Author

Karen Wang is currently a senior at Lynbrook High School in San Jose, California. She is studying computer science, statistics, Japanese, physics, economics, and contemporary literature. As hobbies, she participates in the Japanese Honour Society, Women in Science, Aikido, and Character Design clubs at school. She also enjoys watching anime and reading TIME Magazine. In addition to her studies in biology and chemistry, Michael Pollan's books such as *The Omnivore's Dilemma* and *The Botany of Desire* first sparked her interest in biotech agriculture. In the future, she hopes to pursue a career in either technology or engineering.