

Genetically Modified Food: Health Benefits and Concern

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Abstract

Genetic Modified Organisms (GMO) are created by manufacturers by introducing genetic material, or DNA, from a different organism through a process called genetic engineering. In most cases the aim is to introduce a new trait to the plant which does not occur naturally in the species like resistance to certain pests, diseases, environmental conditions and herbicides etc. Most currently available GMO foods are plants, such as fruit and vegetables. Existing GM crop includes maize, rice, wheat, soybean, rape, canola, chicory, potato, tomato, cotton etc. GM 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. There are many challenges ahead for governments, especially in the areas of safety testing, regulation, industrial policy and food labeling.

Key Words: *GMO, GM Foods, DNA, Genetic engineering*

Introduction

Genetically modified foods (GM foods/Biotech foods) are foods derived from organisms whose genetic material (DNA) has been modified by genetic engineering techniques in a way that does not occur naturally, e.g. through the introduction of a gene from a different organism¹. Commercial sale of genetically modified foods began in 1994, when Calgene first marketed its unsuccessful Flavr Savr delayed -ripening tomato². The United States is the world's biggest producer of genetically modified foods. In 2015, 94% of soybeans (and cotton) and 92% of corn grown in the United States were genetically modified (i.e., herbicide tolerant). Genetically modified soybeans, corn and other crops are used to make the ingredients (e.g., flour, cornmeal, oils) for a variety of processed foods such as breads, cereals, dairy products, hot dogs, snacks and soda. Genetically modified plants may also be used as animal feed or for non-food purposes (e.g., starch potatoes or cotton)³.

HISTORY OF GM FOODS

Genetic engineering of foods has been with man since time immemorial. The DNA modification techniques had its roots in the year 1944 when when scientists discovered that genetic material can be

transferred between different species⁴. The history really begins with Charles Darwin's notions of species variation and selection. In 1954, Watson and Crick discovered the double helix structure of DNA, and the "central dogma" – DNA transcribed to messenger RNA, translated to protein – was established. In 1973, Cohen et al. developed DNA recombination technology, showing that genetically engineered DNA molecules can be transferred among different species⁵.

NEED OF GM FOODS

The following points indicates that why there are such great efforts to develop GM Foods:

1. Global expansion of population
2. Continuous decrease in cultivable land
3. Congestion of conventional and modern breeding

BENEFITS OF GENETICALLY MODIFIED FOOD

1. Health:

- a) Improved nutritional value of food and a valuable alternative to tackle malnutrition

b) Decreased infection by bacterial and fungal pathogens

c) Improved shelf life, increased food availability

d) Reduced exposure of workers to potentially harmful agrochemicals

e) Reduced toxicity⁶

2. Pharmaceutical benefits

a) Plants can be engineered to produce proteins, vaccines, and some other pharmaceutical products. Several fruits and vegetables (e.g., banana, carrots, corn, lettuce, potatoes) are being explored as potential sources of proteins that could function as edible vaccines for diseases such as hepatitis B, measles, cholera and diarrhea³.

b) In 2012, the Food and Drug Administration approved the first plant-produced pharmaceutical for the treatment of Gaucher's Disease⁷.

3. Economic:

a) Increased income and profitability for farmers

b) Increased productivity

4. Agriculture:

a) Tolerance to climate change

b) Pest and disease resistance: Bt proteins are highly effective in low doses against most important cotton insects such as tobacco budworm, cotton bollworm and pink bollworm. The insecticidal compound is a protein produced from a single gene which is specific for insects⁸.

5. Increased Farm income

a) Due to the enhanced productivity and efficiency gains, genetically modified crops have had a positive impact on farm income worldwide.

b) In 2016, the direct global farm income profit was \$18.2 billion. Over 21 years, between 1996-2016, farm incomes have increased by \$186.1 billion (PG Economics, 2016)⁹.

6. Environment:

a) Reduced tillage practices.

b) Reduced need to use agrochemicals.

c) Reduced agrochemical residues in food and feed crops.

7. Herbicide Tolerance

a) Herbicide-resistant crops help farmers to eliminate weeds without harming their plants.

b) These crops have alluring advantages like more lenient weed management, lessened crop damage, and even the potential for environmental benefits⁹.

8. Pest Management

a) Food and Agriculture Organization estimates that around 5 billion pounds of pesticides are used each year globally, costing more than 35 billion dollars¹⁰.

b) However, with the arrival of crops resistant to pests, new and profoundly targeted procedures for pest control has become accessible in the form of transgenic plants. And they have both insecticidal and pesticidal traits¹⁰.

9. Improved taste or appearance

a) Genetic engineering is used to make new crops that taste better, look better, ripen slower and stay fresh longer. Examples include citrus fruits with less bitterness, apples that do not brown when sliced, potatoes that do not get bruises during transportation, tomatoes with more flavor that also stay fresh longer after ripening, and other fruits and vegetables with improved shelf-life³.

REGULATORY MECHANISM IN INDIA

There is an argument that genetically modified foods should be labeled differently from conventionally produced food. Critics argue that there is uncertainty regarding the long-term health impacts on consumers, as well as the impact on the environment¹¹.

Genetically modified crops are currently grown in 29 nations around the world, while dozens ban farmers from planting GMO crops. Countries like Germany and

France have banned farmers from growing genetically modified crops, though imports of GMF animal feed is still allowed. Several regions such as Northern Ireland, Scotland and Wales have also joined the anti-GMF movement, but the United Kingdom has no formal GMF ban.

Recently, a number of developing countries have allowed cultivation of GMOs, often on a case-by-case basis. These countries include Kenya (case by case), Zimbabwe (corn), India (Bt cotton), Burkina-Faso (Bt cotton), eSwatini (Bt cotton), Zambia (all crops) and Cuba (corn and soy)¹².

The top biotech regulator in India is Genetic Engineering Appraisal Committee (GEAC). The committee functions as a statutory body under the Environment Protection Act 1986 of the Ministry of Environment & Forests (MoEF). It was earlier known as Genetic Engineering Approval Committee. Under the EPA 1986 "Rules for Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells 1989", GEAC is responsible for granting permits to conduct experimental and large-scale open field trials and also grant approval for commercial release of biotech crops¹³.

The Rules of 1989 also define five competent authorities i.e. the Institutional Biosafety Committees (IBSC), Review Committee of Genetic Manipulation (RCGM), Genetic Engineering Approval Committee (GEAC), State Biotechnology Coordination Committee (SBCC) and District Level Committee (DLC) for handling of various aspects of the rules¹³.

There are some of the concerns regarding Genetically Modified Food. These are:

1. Genetically modified foods could increase antibiotic resistance:

Consumption of GM food can change the genetic make-up of our digestive system and could put us at risk of antibiotics resistant infections. Repetitive exposure to foods with medication qualities may not only reduce the effectiveness of that medication in each individual, but it may also speed up the resistance factor. Over the time, it may cause such health consequences that may have no

feasible cure¹⁴.

2. There are legal issues involved with growing genetically modified foods:

Many genetically modified foods are patented. This is done to protect the investment of the company involved. The average cost of a new GMO food product is \$136 million. Without patents, companies would experience financial losses. Yet farmers who have their fields contaminated with GMO crops face legal liabilities that would normally not be present. Farmers growing patented crops, even without intent or knowledge of doing so, are held financially responsible by courts around the world¹⁵.

3. It creates unnatural combinations of DNA:

Genetic migrations are known to occur within species. This happens with plants and animals. What GMO foods do is combine unnatural combinations of DNA to create a new food product. These combinations may create allergy triggers and unintended consequences, even if research shows certain combinations are not harmful to humans¹⁵.

4. There may be health risks due to the consumption of certain GMO foods:

We can have the combination of blueberries and tomatoes as an example. This food is intended to improve the consumption of a certain antioxidant. In doing so, there may be health benefits that can help people fight cancer when consumed in significant amounts. Yet, at the same time, large doses of antioxidants may be harmful for the people who have been diagnosed with cancer or are cancer survivors. Transgenic DNA is known to survive digestion in the gut and may jump into the genome of mammalian cells, raising the possibility for triggering cancer¹⁶.

5. Some genetically modified foods may alter natural habitats:

In December 2017, the U.S. Food and Drug Administration approved a genetically modified food called AquAdvantage Salmon for use. It was ruled that the salmon are safe to eat, and the DNA introduced into the fish is safe for the creature. The fish grow faster than

typical salmon, so if they were to escape their enclosure, natural salmon populations could be greatly reduced, if not eliminated.

6. Cross-pollination could have unintended consequences:

Farmers have the right to choose GMO crops or non-GMO crops. In a community the ratio is 80% non-GMO and 20% GMO. Cross-pollination between these crops is going to occur because of insect interaction, wind dispersion, and other methods that nature uses to ensure plant maturity. When a GMO plant interacts with a non-GMO plant, a new species is essentially created. What happens to those seeds may have long-term consequences that are completely unpredictable. Even worse, the DNA from a GMO crop may be patented and then found in the non-GMO fields, exposing everyone to a higher legal liability risk¹⁵.

GMO CROPS IN INDIA

1. Bt Cotton: it is the only GMO crop cultivated in India in more than 10.2 million hectares.

2. Bt Brinjal: The GEAC in 2007, recommended the commercial release of Bt Brinjal, which was developed by Mahyco (Maharashtra Hybrid Seeds Company) in collaboration with the Dharward University of Agricultural sciences and the Tamil Nadu Agricultural University. But the initiative was blocked in 2010.

3. GM-mustard: The researchers at Delhi University have created hybridised mustard DMH-11 using “barnase / barstar” technology for genetic modification. It is Herbicide Tolerant (HT) crop¹³.

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