

Emerging Risks of Genetically Modified Foods

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Introduction

Thirty years of exposure to Genetically Modified Organisms (GMOs) in our food system has created more differences in scientific views and consumers perception than the intended agricultural, economic and social values. The purpose of the study is to review the scientific, public and environmental health issues surrounding the safety of genetically modified foods that are commercially cultivated for human consumption and animal feed and the skepticism of consumers about GMO food products.

Methods

Several studies published in peer reviewed scientific journals, articles, and books on different aspects of GMO research were examined. The major issues that emerged in many public and scientific debates on the safety of GMOs to human and animal health and the environment were reviewed by collecting data from different sources including governments, regulatory authorities, industries, research institutions and consumer groups. Relevant opinion was gathered from agricultural biotech experts in the field.

Results

Current development of the GMO technology

As of 2014 the GMO technology is offering insect resistant and herbicide tolerance to four major crops, namely soybeans, corn, canola and cotton which are commercially cultivated in 28 countries at an estimated area of 182 million hectares. USA, Brazil, Argentina, Canada, India and China are the largest cultivator of GM crops [1]. Small scale field trials are also taking place in a few countries. As of 2014 around 53% of the 182 million hectares of GM crops were cultivated in developing countries [2].

Insect resistant crops (Bt) are made using toxin from the bacterium *Bacillus thuringiensis* and the herbicide tolerance (Ht) use the chemical Glyphosate (Roundup) or Glufosinate ammonium (Liberty). There are also limited virus resistant crops but many more are on experimental and field trial stages including Golden rice with high vitamin A content. The second generation of genetically engineered plants, animals, fish and insects which are on experimental stage are more complex and they are intended for pharmaceutical, industrial, and agricultural uses. GMO salmon is the only animal food that has been so far approved for production [3]. 70 - 90 percent of GMO biomass mostly corn and soybean is used for animal feed [4].

The controversy surrounding the safety of GMOs

A review of over 150 scientific research conducted on major GMO crops commercially cultivated at present show that so far there are no statistically significant hazards directly connected with the use of GMO crops.

The great majority of corporate, national and international scientists worldwide including 89% of GMO experts that have examined the safety of food and feed derived through biotechnology have concluded that no significant risk to human and animal health is posed by consuming GM food and feeds [5]. There is no evidence that approved GM foods introduce any unique allergen or toxins into the food supply. This is because GM crops are tested against a data base of all known allergens before commercialization and any crop found containing new allergen is not approved for marketing [6]. This means the regulatory machinery has been sufficiently strict so far to ensure public

safety. The current official position of WHO, FAO and world renown Research Institutions is not far from this view as they are convinced that risky technologies that make GM foods unsafe to human health and the environment are screened effectively prior to application.

A large set of data from observational and experimental studies in the past 20 years show that GMO feed is safe. There is no indication of health risk to the animals and less likely to affect the health of the humans who eat these animals. There had been no reports of unusual problem among the livestock specifically related to GMO feed consumption for over 20 years after consuming feed containing GMO ingredients from maize and soybean [7].

Emerging risks

On the contrary, some scientists believe that there are more risks than currently envisaged as there is no way to predict the outcome when one gene is removed from an organism and transferred to another one changing its context and behavior. Furthermore, the technology is new and most of the researches are done by corporate scientists without peer review of the research methods, data analysis, and expression of results. Most of the studies are also kept confidential as trade secret. There is lack of harmonization of research approach and methodology among independent and corporate scientists who have easy access to the patented seeds.

The studies such as DNA from GMO is broken down in the digestive track and are rendered innocuous are challenged by recent analysis of how food genes are transferred from the digestive track into the blood stream. It is now apparent that DNA fragments from GMOs are fully capable of transferring their genes directly in the blood stream and their presence is associated with major inflammatory conditions such as inflammatory bowel diseases, adenoma, colorectal and other forms of cancer. The presence of trans gene in the small intestine is also found to affect the composition of beneficial bacteria which are responsible for protecting the gut from foreign invaders and help the body to absorb nutrients [8].

In March 2015 WHO's International Agency for Research on Cancer (IARC) declared 'Glyphosate' to be a probable carcinogen to humans. However, a New Report from the United Nations and the World Health Organization has concluded that the controversial pesticide glyphosate is 'Unlikely to pose a carcinogenic risk to humans from exposure through diet. However, WHO says the two reports are "different, yet complimentary" [9].

The research on environmental health risks of GMOs has focused on the crop land and its surroundings. They include, contamination of conventional crops by GMOs as a result of cross pollination, water pollution affecting aquatic life, soil damage, destruction of beneficial microorganisms in the soil, and transformation of some insects into pests. Some weeds develop resistance to the herbicide over time evolving into super weeds and this increases the amount of herbicides to be applied [10]. Herbicides affect biodiversity, pollute water and soil, and cause health problems in humans and animals. Accidental release of biohazards from industrial, experimental testing laboratories, green houses and other waste discharge sources are also considered as a pathway for GMOs escape that need regulatory review and stringent surveillance.

International Standard

There is no International Standard for GMO products and the current regulations vary from country to country. Some countries like the European Union that acknowledge the lack of scientific evidence concerning the potential adverse health risks of GMOs set strict standards to control the import of GMOs as a precautionary measure [11]. The joint WHO/ FAO food standard commission Codex has adopted guidelines for GMO labeling which is considered as voluntary action [12]. Countries like USA and Canada are unlikely to adopt mandatory labeling in the near future in spite of the current public outcry. The Codex guidelines has benefited the World Trade Organization by resolving trade disputes in countries where mandatory labelling is a requirement.

Consumers perception

There is a huge literary gap between scientists and consumers on GMOs. There is also lack of public trust on the scientific data showing that GMOs are safe due to poor reporting about the science behind GMOs and their social and economic benefits. The general public is not

aware of GMOs where these foods are not labeled. The most serious concern of consumers is the possibility of serious allergic response and the rise of food related diseases in countries where GMO crops were introduced [13]. Informed public have negative thoughts about GMO for fear that the food system is under corporate monopoly and the patent and legal requirement to benefit from GMO seeds creates unsustainable agriculture for small farmers particularly in developing countries [14].

The mandatory labeling of food including GMO food is to inform consumers about the safety and nutritional value of a product. Mandatory labeling is a requirement particularly if the food raises a safety or health issue in order to alert sensitive consumers to the potential risk or any other characteristics that would make it different from its conventional counterpart. In the case of GMO labeling consumers are suspicious why so much money is spent to prevent the labeling in countries like USA and Canada.

Ethical and religious doctrines also prohibit the acceptance of GMO as foods for human by some consumers [15]. A survey in US comparing the views of scientists and the general public on biomedical research including GMO showed that 88% of the scientists think eating GM food is safe while 37% of the public believes so. Similarly, 68% of the scientists say it is safe to eat food grown with the use of pesticides compared to 28% of consumers in favor [16]. The major public demands are mandatory labeling of GM foods and ingredients and the setting of international regulations for GM food production including risk assessment.

Conclusion

The current diversity of scientific views on the safety of GMOs is a challenge and opportunity to build a consensus on the issue by creating an international forum of all stake holders, representing industries, governments, regulatory authorities, scientific institutions, universities, international agencies, non-governmental organizations, food safety activists and consumer's associations to improve the efficiency of scientific communication by sharing research experiences.

The adoption of strict international standards for GM product, instituting mandatory labelling of GM foods and ingredients, and narrowing the literary gap between scientists and consumers through public education and communication would result in better realization of the GMO benefit. In this way, the full potential of GMOs to benefit mankind by alleviating hunger and disease worldwide without significant harm to the environment, could be exploited leading the way to advancing research and bringing an end to the continued debate.

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