A Comprehensive Review Analysis of the Potential Positive and Negative Aspects: Safety, Perspectives and Issues Related To Genetically Modified Foods

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ABSTRACT

It is well known fact that human beings have always altered the genomes of both plants and animals. The earliest method of carrying out this intrusive process, which has been around for thousands of years, often through blunders and failures, was fusing undesirable features. In order to produce new plants and animals that would benefit humans—that is, provide higher-quality food, more ways for people to move and convey goods, higher returns on their labour, resistance to diseases, etc.—this was done. But the process of developing genetically modified organisms is not without disputes. One of the aspect of the equation claimed by the promoters is that genetically modified organisms are merely an advancement of traditional techniques of plant and animal breeding and critics who object to the idea that life is being manipulated. Concerning the dangers of employing genetically modified organisms to the environment and to human health, there are various disagreements. There has been substantial discussion regarding the environmental and health dangers posed by genetically modified products, which has prompted the creation of regulatory frameworks for the assessment of genetically modified crops.

However, the lack of a framework that is widely acknowledged slows technological advancement, which has detrimental effects for areas of the world that may profit from new technologies. So, even though using genetically modified crops can maximise benefits for food safety and adapting crops to current climate change, all those anticipated benefits of using genetically modified crops are suspended due to a lack of reforms, as well as a lack of harmonisation of the frameworks and regulations about the genetic modifications. Nevertheless, it is clear that the development of genetically modified products will still continue.

Keywords: genetically modified products, human health

BACKGROUND

The attempt to shift genes from one organism to another or to change the genes already present in a particular organism results in the development of new traits that were not previously there. Genetic recombination has been the focus of numerous techniques developed by biotechnology. Genetically Modified (GM) foods and Genetically Modified Organisms (GMOs) are products of the above processes which allow gene modifications of a food or an organism. The idea of genetic manipulation has sparked several discussions, with one side opposing unknown consequences and hazards on both public health and the environment, and the other side praising the advantages of genetic modification for the economy and the eradication of a food shortage.

INTRODUCTION

Foods developed from organisms whose DNA has undergone alterations through genetic engineering are known as genetically modified (GM) foods, often referred to as genetically engineered (GE) foods, or bioengineered foods. When compared to earlier techniques like selective breeding and mutant breeding, genetic engineering techniques enable the introduction of new traits as well as more control over traits**.** (Sir David King 2013)

GMOs are species, including plants, animals, and microbes, whose genetic makeup has been changed in a way that does not happen normally through natural recombination or mating. Genetically modified (GM) food and feed are those that have been produced from genetically modified organisms.

The first genetically altered microbial enzymes were granted approval for use in food production in 1988 **(FDA 2014).** Sale of GMF at commercial level began in 1994 when Calgene's failed Flavr Savr delayed-ripening tomato **(James, Clive 2010 and Weasel, er.al.**

2009). The majority of food modifications have mostly concentrated on cash crops in high demand by farmers, such as soybean, maize/corn, canola, and cotton. Crops that have undergone genetic engineering have better nutritional characteristics and tolerance to diseases and herbicides. With the introduction of golden rice in 2000, the nutritional value of genetically modified food kept on increasing **(Ye, Xudong, et al. 2001).** Although GM livestock has been established, as of 2015, none were available for purchase **(FDA 2009).** In 2015, FDA had only approved the Aqu Advantage salmon commercial production, sale, and consumption **(Federal Register 2013 and FDA 2015).** It is the first GM animal that has been given approval for consumption by humans.

BASIC CONCEPTS ABOUT GENETICALLY MODIFIED FOODS

Significant Equivalence

To guarantee the safety of these foods, the idea of substantive equivalence has been adopted in the discussion of genetically engineered products **(Rowland RI 2002).** According to the substantive equivalence principle, no additional safety precautions are necessary if the genetically modified product contains ingredients that are essentially identical to those found in the traditional product. The idea of substantial equivalence can be used in this way to assess genetically modified products and identify drawbacks such as allergies resulting from the presence of novel proteins **(Mahgoub E, Salah O, 2016 and Huang K, 2017).**

Precaution

The precautionary principle states that no new genetically modified product should be made available to consumers unless there is direct proof that it is safe or if there are significant disagreements and divergent views among researchers regarding the product's safety **(Tagliabue G, 2016).** However, a lot of academics have suggested that prevent or delay the development of any new technology that could be used to address society or environmental issues **(Taverne D, 2005).** However, we should be aware that the usefulness and application of the precautionary principle have been questioned **(Fischer E, 2009).**

Safeguard

The safeguard clause enables the countries to restrict the distribution and sale of genetically modified goods that might endanger their citizens **(Weasel L, 2009).**

Labelling

The growing number of products that are genetically engineered has led to the requirement that these products carry labels **(Hannes SR, 2015).** Foods that have been genetically altered should be labelled specifically to state that they contain such components. Despite how straightforward it may seem, there are significant concerns regarding how genetically modified products will be labelled, making this issue particularly complex and challenging **(Codex alimentarius commission: Procedural manual, 2007).** For instance, it has been claimed that goods with either altered proteins or alien DNA need to have a particular label.

There is controversy about whether or not these foods, although being genetically altered, need specific labelling because they do not contain changed proteins or foreign DNA **(Phillips WBP, et.al. 1998).**

Ethical Issues

The main ethical problem with growing genetically modified plants is that it basically interferes life functions in the natural environment. A question of ethics arises as to how to strike a balance when it comes to their use with many countries banning the use of genetically modified products. At the same time, companies that make these products are primarily concerned with making profits and do not consider potential issues that may or may not arise.

The use of genetically modified organisms poses a number of unidentified factors, and this raises a difficulty because the solutions suggested are frequently influenced by monetary and political considerations **(Borraz O, et.al. 2009).** Since consumers are equally purchasing and giving their approval, their attitude is also quite significant. Consumers can be split into two groups: those who support and those who oppose genetically modified organisms. Consumers' opinions are affected by the information provided to them each time, laws, their trust in the government to handle any problems that develop, and the price they are willing to pay **(Stemke DJ, 2010).**

Environmental ethics

Environmental ethics dominates discussions of biotechnology and genetic engineering because many of the objections to genetic engineering focused on whether it is morally acceptable to genetically alter organisms and the environment given that this may have detrimental effects on the environment. This transition can be seen in product advertisements, where businesses declare that environmental conservation is a top priority **(Maghari BM, et.al. 2011).**

Animal rights and ethics

Specifically, with relation to animals, modern ethical and philosophical concepts maintain that, animals, like human beings, have rights, and that these rights should never be violated **(Sunstein RC, et. al, 2004).** Animals must be handled with respect and not as objects or resources for human use.

The physiology and behaviour of an animal can undergo significant modifications as a result of the introduction of genes and the execution of experiments. The outcomes might not be always desirable and they might even be devastating in some situations **(Niemann H, 2007).**

Patenting living Genetically Modified Organisms

It is probable that new species will need to be registered and allocate their ownership. The 'owner' of the new organism must make sure that the genetic modification does not have any negative impacts on the environment or humans, even in the case of registration of a novel product, and he will be held accountable for any issues that may occur **(Trommetter M, 2008).**

POSSIBLE RISK FACTORS ASSOCIATED WITH GENETICALLY MODIFIED PRODUCTS

Environment-related risks

Strong evidence supports the idea that GM plants interact with their surroundings **(Tencalla FG, et.al. 2009).** This implies that genes inserted into plants that have undergone genetic modification could spread to other plants or possibly to other creatures in the ecosystem (**Wilkinson MJ and Conner AJ, et.al, 2003).** Genetic contamination occurs as a result of gene transfer between plants, particularly between related plants, and is facilitated by the movement of pollen **(Oliver MJ, 2013).** Natural wild species of plants might not be able to survive due to their competitive disadvantage compared to GM crops, which would lead to a decline or extinction of wild varieties **(Nap JP, et.al. 2003).** Global biodiversity change will make certain weed species more resilient, some will become dominant, and others will become extinct or decline, leading to a full and universal deregulation of ecosystems **(Kapuscinski RA, 2007).** In the scientific community, it is widely accepted that further research is required in order to more thoroughly and precisely analyse the hazards and advantages of crops.

Human health-related related risks

Other negative impacts on human health, such as allergenic effects, may also exist, particularly in allergy-prone individuals **(Verma C, et.al. 2011).** Weight increase, modifications to the pancreas and kidneys, toxicity to the immune system, modifications to blood biochemistry, and other effects have all been shown in clinical studies on animals **(Metcalfe D, Kieran MT, et.al. 2002).** Researchers are suspicious about the usage of genetically modified crops due to the lack of extensive long-term epidemiological studies that provide secure conclusions on the allergic effects of genetically modified plants.

This is due to the fact that the presence of a gene that expresses a non-allergenic protein does not guarantee that the resulting product will not have an allergic consequence. Additionally, due to the greater allergenic potential of these foods compared to common plants, allergies to genetically modified goods may be more severe and hazardous **(Ntona AA, 2009, Arjó G, et.al. 2013)**

Antibiotic resistance-related risks

We have to clarify at this point that the majority of altered products no longer use antibiotic-resistant genes. The primary issue right now is the widespread use of antibiotics in feed,

which naturally causes human resistance to these drugs in the digestive system through intake of dairy and meat products **(Flachowsky G, 2014).**

To ascertain the differences between transgenic plants and traditional crops and whether genetically modified plants present additional concerns to the general public's health, more research and investigations are nonetheless required **(Smith JM, 2007 and Carter AC, et.al. 2013).**

ADVANTAGES ASSOCIATED WITH CONSUMING GENETICALLY MODIFIED PRODUCTS

Hunger eradication

Eliminating world hunger is one of the justifications offered by supporters of genetically modified food, a claim that has drawn a variety of responses **(Thompson RP, 2011 and Steier G, 2018).** According to a long-term and extensive research, growing genetically modified crops has major advantages in the fight against world food shortages and malnutrition, Researchers are now concentrating on the beneficial effects of developing genetically engineered products as a result of the on-going rise in the world's population rather than the constant risk they may present **(Herring RJ, 2013).**

Resistance to insects and pests

Gram-positive, soil-dwelling *Bacillus thuringiensis*, sometimes known as BT, is frequently employed as a biological pesticide. Many BT strains create crystalline proteins (proteinaceous inclusions) during sporulation that act as insecticides. As a result, they are now used as pesticides, and more recently, BT genes have been used to create genetically modified crops like BT maize. These plants primarily aim to resist the European Corn Borer insect, which is in responsible for destroying maize crops **(Han L, 2010).**

Resistance to Nematodes

Most agricultural losses are brought on by parasitic nematodes. They attack a variety of plants by destroying the roots. Nematodes, which are essentially a type of worm, can withstand the harsh conditions of the soil for lengthy periods of time. Nematode chemical control is not permitted due to the significant environmental risk. Crop rotation, which is the practise of cultivating a number of crops that are distinct or different sorts in the same region in consecutive seasons, is the only natural option to address this, but it is sometimes impractical owing to the high cost **(Lee DL, 2002).** Therefore, the only solution to the issue appears to be the introduction of genes from nematode-resistant plants **(Nyarko-Fosu J and Jones GKM, 2015)**

Resistance to Herbicides

It is well accepted that using pesticides and herbicides in general has a negative impact on the environment and, as a result, human health. We know that in places where wheat is grown, i.e., where the use of herbicides is increased, number of child births is definitely declining, children are born with major health issues, mostly associated with mental retardation and autism spectrum disorders **(Steingraber S, 2011**). Farmers can use fewer herbicides because of genetically engineered crops. An enzyme produced by genetically altered soy beans is resistant to the herbicide's effects.

Resistance to cold

The development of plants resistant to cold temperatures, which would typically cause the plant to freeze and die, is a significant benefit of genetically modified plants thereby minimizing losses. Since the middle of the 2010s, scientists have resorted to transgenic plants to address the issue because of the rapid global climate change and the inability of plants to adjust to sudden changes in temperature **(Lindow SE, 1990)**

Resistance to heat

According to scientists, further global warming would have severe effects on plants in the near future, especially where there are existing water shortages. Production of modified genes ie: Sh2 and Bt2 can help plants survive high temperatures **(Smerdon J and Mathez EA, 2018, Araujo MAV, et.al, 1994)**

CONCLUSION

In the last few years, genetically engineered organisms have undergone tremendous scientific advancement. There will undoubtedly be an evolution in the future that will be influenced by both scientific advancements and public opinion about genetically engineered organisms. However, the development of genetically modified organisms is not without controversy; there are many who oppose them and believe that their creation involves the manipulation of life, as well as disputes about the potential harm to the environment and to human health. Despite the fact that it is evident that genetically engineered crops will continue to evolve. Therefore, further study should be done on the effects of genetically modified crops on agricultural output, commodity pricing, land usage, and the environment.

Additionally, the consumer must be educated in order for them to understand the importance of genetic changes and the role that modern technology plays in crops and agricultural production. In any case, there should be clear references to the impacts and outcomes of genetic alterations, both on the environment and on human health. There should also be rigorous and legally binding rules for the use of genetically modified species.

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