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Review Article

Public Health Perspectives of Genetically Modified Food: A Comprehensive Review

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ABSTRACT

Now a day food fortification using genetically modified organism was highly popular, secured and affordable for the current food demanded population. Many commendable uses of microbes were found in genetically modified Food. This review paper attempted to address the impact of microorganisms employed in genetically modified food. PubMed, Science Direct, Google Scholar, and other search engines were used to collect papers. The impact of microorganisms in Food Productions was briefly explored and illustrated in the table and figures. Climate resilience, high yield, environmental adaptability, and high protein, 40–50% and 20–40% produced by bacteria and alga respectively, were only a few advantages of foods that have been genetically modified foods with microbes. Additionally, it improves human health by reducing poverty, ensuring food security, and preventing disease. Therefore, genetically modified foods brought a positive impact for human health.

INTRODUCTION

Genetic modification and its practical utilization in processing genetically modified foods(GMF) has the ability to make uncertain risk to human health that may be direct or indirect or short term or long term [1]. The Islamic frame of reference on GMF is complicated and goes deeper than food is halal or haram [2], (even so that is clearly part of it). There are 3 major protests to genetic adjustment including perceive as reason of divine work, damaging human health, prepared from prohibited resources [3]. However, GMFs were prepared from natural resources occurred for

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intended consumers and improve quality of human life through food security without deviate the religious perspective. In accordance to Islamic Jurisprudence Council (IJC), foodstuffs traced from genetic modified organism (GMO) plants are suitable for ingestion to Muslims [4]. Few scholarly people have recommended that foodstuffs traced from biotechnologically modified plants could may be become forbidden if they comprise DNA from prohibited foods. For example use of swine DNA in soy, might render it haram, till the theme of some argument among scholars were certifying organizers [5], to be brought commodity with a gene editing non haram food items, today it would be well thought out more questionable on the consumers sides thus, all biotechnological food items on the marketplace must be authorized resources [6]. However, the Islamic Food and Nutrition Council of America (IFANCA), Islamic Jurisprudence Council (IJC), Majelis Ulama Indonesia (MUI), Majlis Ugama Islam Singapura (MUIS), Saudi Arabia, the government of Malaysia and the Muslim World League were accepted and undisputed Halal food products and attested body developed from biotechnology [5, 7, 8]. This compressive review paper try to justify as witness through grasping researcher suggesting regarding public health perspectives of genetically modified food, which is very significant for reader to catches noticeable evidence from the paper.

Concept of Halal and Haram

All property has been divided into legal and illegal categories, according to the Islamic doctrine every activity, strategy, physical thing, food, and conduct were stated as the terms "Halal" and "Haram" [7, 9, 10]. Thus, non-edible food types had poison character for human beings and it is the reason that protect their followers through underline as taboo [11]. For instant blood, carrion, and swine flesh are "forbidden unto you (for solid food), and those have been devoted else Allah, and the dead by beating, the smothered, the dead by way of falling from an elevation, eat up of wild beasts, which have been killed by outgrowth rescue, which make lawful, and that have been sacrificed unto statue [12, 13].

Genetically Modified Foods

These are the edible items that are made by the organism which have revised deoxyribonucleic acid (DNA) by the processes of genetic engineering in contrast to the natural breeding. Genetic modification, as well as its practical application in the processing of genetically modified foods (GMF), has the potential benefits to human health, either directly or indirectly, in the short or long term [1]. The Islamic viewpoint on genetically modified foods is complex and goes beyond assessing whether a meal is halal or haram [14]. "O ye who believe! Eat of the good things wherewith we have provided you, and render thanks to Allah if it is (indeed) He whom ye worship" (2:172). To form a genetically modified food it takes multiple steps. Firstly, we have to isolate the intended gene of our use from that particular cell or we have to make it in a laboratory [15]. And then add remaining all other components with the gene which is necessary for its maturation and then place it in the targeted gene [16]. So, a whole organism is grown from this gene. GMF in the United States are organized to assure their safety for human use. According to Piedmont clinical dietitian Jennifer Teems, LD, RD, MS, "GMOs are not natural and could never occur organically" But, it's crucial to keep in mind that today's foods and products must adhere to far stricter criteria than in the past [17-19].

According to the point of view of American Academy of Environmental Medicine (AAEM)

According to Teems, "it is challenging to research food and understand the effects of GMOs" because it is so complicated. I advised my patient to give up on trying preventing GMOs because it is almost impossible. Instead, concentrate on eating a heart-healthy diet that is high in fruits and vegetables, low in added sugar, and free of pre-cooked items [20, 21].

Effect of GMOs on body

Despite, GMO brought unremarkable public health benefits for consumers; the negative human health consequences were investigated by researchers [1, 18, 22], it including;

- Infertility
- Changes to major organs and the gastrointestinal system.
- Immune problems
- Accelerated aging, faulty insulin regulations
- Increased quantity of herbicides in food

History

Human-directed genetic processing of food began once plants and animals were farmed through at about 10.500 to 10.100 BC, by artificial selection [23]. The following generations and organisms were employed with desirable features (and hence with the desired genes). Lack of character is not a foundation to the present genetic modification notion [24]. In early 1900s by discovering DNA and creating various advances in genetic technologies, DNA and genes within food have been directly changed. By the United States Food and Drug Administration, which authorized in 1988 the first use of genetically engineered microbial enzymes in food production was used. Recombinant chymosin was authorized in numerous nations in the early 1990s. Scientists had made cheese from cow's milk by introducing bacteria to make chymosin, which can also coagulate milk, leading to cheese curds. Flavor Saver tomato was first genetically modified product to be released in 1994. The product was developed by

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Calgene, Inc. by introducing a gene that delayed its maturation to have a longer lifetime. China was the first nation with virus resistance introductions to sell a transgenic crop in 1993, tobacco. In 1995, the cultivation of *Bacillus thuringiensis* Potato, the first crop generating pesticide to be licensed in the United States, was permitted [25]. Genetically modified plants are also sold. In 1995, transgenic canola, GI, cotton resistant to *bromoxynil*, maize Bt, and cotton Bt were introduced. Other commercially viable genetically modified plants that were approved in 1995 were tomatoes, squash that could survive glyphosate, other varieties of tomatoes, BT maize, and cotton that could withstand herbicides like *bromoxynil* (Figure 1). With the introduction of rice in 2000, scientists had GMF in order to boost the worth of their nutrients first time [18]. The report is in French only. By 2010, 29 nations have been planting marketed biotech crops and 31 more granted transgenic plant regulatory permission for import. The US was the largest manufacturing country. And GMF producer obtained regulatory approval in 2011 for 25 genetically modified crops. 92% in 2015 Maize, 94% cotton and 94% soybeans made in the United States were genetically modified strains. Advantage Salmon in 2015 was the first GM animal to be licensed to utilize food, Salmon has been changed from Pacific Chinook salmon and a growth hormone regulating gene Proponent of an ocean pout that allows it to develop all through the year instead of only in spring and summer. After USDA declared in April 2016 that it would not have to go through the Agency's regulatory procedures, the white button mushroom (*Agaricusbisporus*) was modified handling CRISPR technology obtained de facto approved in the United States [19].

Figure 1: Genetically modified foods. Adapted from: https://pin.it/qGBvoSe

Derived products from GMO

Different countries also incorporate plat based technologies to maximize their production for the demand of population. The derived products of genetically modified foods Figure 2, including;

- Carbonated soft drinks (high fructose corn syrup made from sugar beets)
- Meat (farm animals are raised with genetically modified feed containing soy products)
- Canned soups (corn-based thickeners and flavoring enhancements)
- Tofu(GMO soy beans)
- Cereals (corn and soy products and non-cane sugars)
- Vegetable and canola oils (rapeseed - canola, soybean, corn, sun flower, safflower)
- Sweetened juices (corn- and sugar beet-based sweeteners)
- Frozen foods (starch is added from GM corn, fats and oils from GM plants, citric acid made from GM microorganisms)
- Milk (cows are fed genetically modified soy products)
- Baby formula(GMO corn, sugar beets and soy)

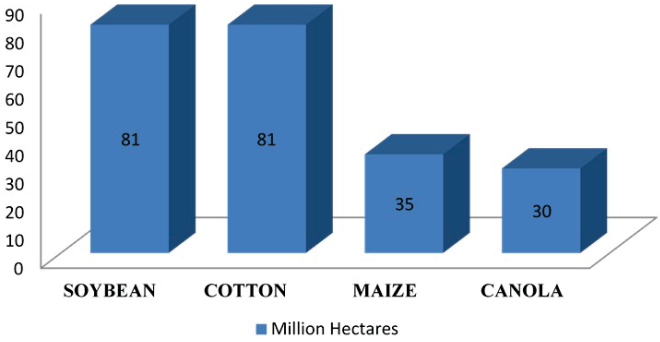

Figure 2: Popular plants production and their traits reported in 2012.

Maltodextrin

A lightweight hydrolyzed starch commodity utilized as filler and thickening for soft-tasting. A number of glucose syrups, often termed American maize syrups, have been employed in many types of Commercial glucose, and is made with full starch hydrolysis. By handling of dextrose solutions which comprises the enzyme glucose isomerase, a huge part of glucose was converted into fructose. Sugar alcohols, like maltitol, erythritol, mannitol, sorbitol, as well as by reducing sugars, hydrogenated starch hydrolysate is made sweeteners.

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GMFs Classification	Strongly Opposed	Strongly Opposed	Relatively Opposed	Natural or Indifferent	Relatively Acceptable	Completely Acceptable
Edible Purpose	(1) Soybean oil from GM soybean	26.3	34.2	25.7	11.1	2.7
	(2) Livestock aquatic products fed with GM Maize	18.3	25.8	37.4	16.6	1.9
Function of Transcribed Gene	(3) Nutrition improving GM crops	12.4	19.5	41.4	25.2	1.5
	(4) Pest or herbicide resistant GM crops	9.5	14.8	41.4	28.2	6.4
Source of Transcribed Gene	(5) GM crops created from another plant spp.	10.0	12.6	45.4	21.4	10-.5
	(6) GM crops created from an animal body)	15.1	14.3	55.0	11.8	3.7
	(7) GM crops created from a microbe	14.0	13.9	54.0	12.6	4.6

Table 1: Public acceptance and objection study survey reported in 2014.

Lecithin

Lecithin is a lipid that occurs naturally. The egg yolks and petroleum plants may be located here. It is an emulsifier and is thus utilized in a large number of meals. Corn, soy as well as safflower oil are lecithin sources, however, most commercially available lecithin comes from soy. The report is not available at all. However, public worries about genetically modified food are extended to these items in Table 1. This worry has led to changes in policies and regulations. In 2000, the labeling of a product containing GMO ingredients, including lecithin, was adopted for Europe in Regulation (EC) 50/2000. Because derivatives such as lecithin have trouble determining their origin with present testing techniques, EU laws call on firms wishing to trade lecithin in Europe to utilize an integrated recognition conservation scheme.

Sugar

The United States fulfills its 90% requirement of sugar from sugar cane and sugar beet and the remaining 10% is fulfilled by importing the sugar. Glyphosate-resistant sugar beet was widely used in the U.S. following isolationism (2005). In 2011, the glyphosate-resistant seed was planted on 95% of beet acres in the United States. The pulp is utilized as animal feed through the refining process. GM sugar beet sugar does not include DNA or protein — it's sugar that can't be distinguished from non-GM sugar beets scientifically. Independent analysis by established worldwide laboratories showed that sugar beets from Roundup Ready are the same as conventional (non-roundup ready) sugar beets produced in comparatively large quantities. There was a small quantity of DNA or protein in vegetable oil from the real crop. By extracting and refining triglycerides from the semis or plants vegetable oils are produced, and then by hydrogenation converting solids from liquid oils. MCT's provide an alternative to traditional fats and oil. Edium-chain triglycerides offer an option. During digestive treatment, the duration of fatty acid affects its fat absorption. Fatty acids appear to be absorbed more readily and to affect glycerol molecules in the mid location, Metabolismin the end positions rather than fatty acids. MCTs are digested like carbohydrates in contrast to conventional fats [20].

Traceability of GMOs in food production chain

Traceability systems and written document product record may service marketing as well as health protection purposes. Traceability systems both Segregation as well as identity conservation technologies enable the separation of non-GM and GM goods from 'farm to fork' in this context. Specific technological criteria for each individual stage of the food production chain are included in implementation.

Testing

GMFs are legal and regulated differently in different countries; some countries prohibit for consumption, while others allow at varying levels. Countries were reported that test is required to recognize GMFs safe for human consumption throughout production and distribution [3, 16]. Further tests on potential toxicity, allergen city, potentiality transference of genes to human people or genetic transmission to other animals may be necessary if novel chemicals are detected [1].

Labelling

By 2015, 64 nations are required on the market to label GMO goods. National policies in the US and Canada only need a label given major variances of content or demonstrated effects on health, despite the fact that certain individual U.S. legislation calls for them. Public Act 114-214 was introduced in July 2016 to regulate on a nationwide level, the labeling of GMO food. The labeling requirement in some countries relies on the proportional measure of GMO in the product. Research investigating voluntary labeling indicated that 31 percent of GM-free items have a GM concentration and exceeding 1.0 percent in South Africa. All food or feed containing more than 0.9 percent of GMOs in the European Union should be labeled (including prepared food).

Detection

GMOs are frequently tested in foodstuffs and feed using molecular methods like poly meres chain reaction (PCR) and bio-informatics. The absence of Roundup Ready (RR) Soybean has been monitored in January (2010) report on detection and extraction of DNA through an entire industrial soybean oil production chain: "In all stages of the extraction and refining operations, soybean lectin generation amplified using an end-point (PCR), until the

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completely refined soybean oil has been completed. In addition to the intermediate stages of refining (neutralization, wash and bleaching), probably owing to try instability, amplification of RR soybeans using PCR tests with event specific primers was attained for all extraction as well as refining procedures. This is a major achievement for the traceability of genetically modified organisms in filtered oils and has never been reported to us previously. The ideas suggested by the Natural Resources Conservation Service and the Farm Service Agency are by the point of view of Thomas Redick, for detecting and preventing cross-cutting pollination (NRCS)[5].

Beneficial Aspects of GMF

GMF provides good pest resistance, flavor, and longer shelf life, and reduces the need for chemical fertilizers [16]. We can reduce the chemicals used for insecticides and pesticides by the addition for the purpose less harmful for human [19] as shown in Figure 4. GMF can produce strong crops which can survive in the harsh environment and adapt climatic condition. China has decreased the quantity of pesticides consumed by more than 75% after acceptance of bio-engineered [17].

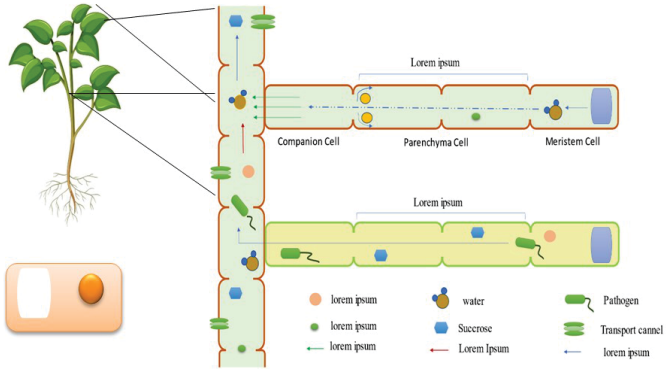

Figure 3: Gene editing plat resist intended pathogens and produced high yield.

Basically, GMF products demand minimal chemicals and take little time, which helps in decreasing the emission of greenhouse gases, eroding soil, environmental impurity, and global warming by a decrease in carbon dioxide levels in the environment. So, GMF have good quality and more protection than the natural foods. Genetically modified food is an attempt to cover up the deficiency of nutrients in food, especially micronutrients. And produced specific vitamin or mineral including; beta-carotene, vitamin E, iron and lysine. Cooking oils (canola, soybean, maize) contain less saturated fat levels and boosted amino acids [8].

Harmful Aspects of GMF

Along with many useful aspects of genetically modified foods have some harmful aspects. Which were included hypersensitivity and allergic reactions. Experts were demonstrated that GMOs are safe and sound for the environment, but they really yet comprise numerous types of elements not clear for public [22]. Genetic engineering alters the ecosystem that harms some organisms which can lower the biodiversity level. In genetic engineering when it removed harmful pests from a specific food, it must be kept in mind that reduces the food resource for convinced species. Few GMOs have antibiotic characteristics and are resistant to some viruses, bacteria, and some diseases and decreased antibiotic drug's efficacy [6].

CONCLUSIONS

By increasing productivity and reducing reliance on chemical pesticides and herbicides, genetically modified organisms (GMOs) have the ability to address the world's malnutrition and starvation crisis and contribute to environmental protection. However, there is currently unresolved ongoing debate that transgenic components from pork or other "harem" or "mushroom" products in food items obtained through biotechnology will continue to play a major role in Halal certification.

Conflicts of Interest

The authors declare no conflict of interest.

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