



General Overview: Awareness of Genetically Modified Food Among Consumers

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ABSTRACT

Current review was aimed to collect evidences of consumer's attitude and knowledge about genetically modified food (GMF). Almost 150 articles of GMF with respect to social aspects were reviewed. Many consumers had negative attitude towards GMF because of health risks, low naturalness, lack of trust on experts and food safety management, and some consumers showed high inclination towards local food. Fear and emotional consideration, lack of information, lack of education and low dissemination of knowledge about GMFs were identified as factors in creating negative attitude towards genetic modification in food. Moreover, some consumers showed positive attitude due to their good socio-economic situation and their concerned were food freshness and quality. According to the literature, During the emergence of GMF, various organizations and consumers showed negative attitude and left unsolved conflicts regarding precautionary principle between governments, producers, distributors and consumers. The marketing sectors of GMF or crop faced different issues created by consumer's attitude around the world. The basic purpose of the GMF was to fulfill the consumption requirement but the rapid negative reactions from consumers hindered the consumption of GMF. Due to such situation, researchers need to investigate the real situation of consumer's attitudes towards the GMF consumption in future.

Key words: Genetically Modified Food (GMF) and Consumers.

INTRODUCTION

With the rapid population growth in the world, the demand for food and grain has highly increased. Parallel to increased food demand, continuous climate change and shortage of natural resources have increased food insecurity in the world (Abdel-Mawgood *et al.*, 2010). According to FAO (Food and Agriculture Organization of the United Nations), limited amount of arable land is available per person, which could further decrease from the current 0.242 ha to 0.18 ha by 2050 (Zhang *et al.*, 2016). Consequently, decrease in food production can result in malnutrition. For overcoming this adverse condition, high yield per acre is required, which is possible by applying better agricultural practices, better insect and pest management practices and genetic improvements. Such a complicated scenario could create different issues like high demand of biofuel, growing urbanization, land salinization and degradation, climate change and natural resources depletion (Oliver, 2014).

Under such condition, the commercialization of genetically modified crops was started in 1996. The developing and under developed countries started to get

benefits by producing these crops (Verma *et al.*, 2011). The technology of genetically modified crops was referred to fulfill the consumption demand of humans and animals. Genetic modification is a biological method that artificially introduces modification in the genetic mechanism of all types of living organisms, including plants, animals and microorganisms (WHO, 2016). It is also known as genetically modified food (FAOSTAT, 2016).

For the consumer market, soybean, maize, cotton, canola, potatoes, and tomatoes were sown for commercial purpose (König *et al.*, 2004). A number of productivity, economic, societal and health benefits regarding GMF have been documented. There was an increase of about 370 million tons in food production from 1996 to 2012. In US, genetically modified crops produced one-seventh of total production. Conventionally, such high production could be achieved by adding 300 million acres of land with more fertilizer, irrigation water or carved out tropical forests, which could create adverse biological and ecological stress for the world (James, 2011). Brookes and Peter's report estimated that 138, 274, 21.7 and 8 million tons of soybean, corn, cotton lint and canola production were added by biotechnology from 1996 to 2013 respectively.

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Similar production by traditional techniques required 11% more arable land in the United States and 32% of the cereal area in the Europe (Cong *et al.*, 2013). The commercialization of GMF in the markets brought billions of dollars by opening new markets. In 2008 and 2009, GM seeds and commercial GM maize, soybean and cotton valued 130 and 10.5 USD (James, 2010). Sixteen billion dollars were added to global farm income by GMF from 2006 to 2012, which was three times more than previous ten years. Moreover, about 42% of economic gain was improved because of pest, weed resistance and genetic modification of crops, which ultimately reduced the production cost (Brookes and Barfoot, 2014).

The food produced by genetic modification have high therapeutic and pro-health values through added nutrient elements including vitamin A, C and E, probiotics and unsaturated fatty acids (Schell and Van Montagu 1977). Such biotechnology procedure for producing the GMF could reduce global hunger problem and improve economic and environmental issues by producing new and better food products.

During the emergence of GMF, various organizations and consumers showed negative attitude in Europe (Frewer *et al.*, 2014), and left unsolved conflicts regarding precautionary principle between governments, producers, distributors and consumers (Chang and Huang, 2010). The marketing sectors of GMF faced different issues created by consumer's attitude around the world. The basic purpose of the GMF was to fulfill the consumption requirement but the rapid negative reactions from consumers hindered the consumption of GMF. Such situation forced researchers to investigate the real situation of consumer's attitudes towards the GMF consumption.

Many consumers buy GMF for daily uses. Numerous food products hold GM ingredients (Bawa and Kumar, 2013). Nevertheless, GM food has become a discourse in the general public (Kim *et al.*, 2014) and different expressions were given about it (Wohlers, 2015). The supporters of GMF believed that such kind of products have useful effects on health and environment. They considered that the GMFs are produced by low application of pesticides and its cultivation results low soil degradation and ground water contamination (Raspor, 2006). They also believed that the GMFs are rich in nutrition than traditional products and easy to buy at affordable prices (Phillips and Hallman, 2013). The users of GMFs assumed that such products are contributing in sustainable agro-food practices and reducing malnourishment in under-developed countries (Kim *et al.*, 2014).

The opponents of GMFs were not willing to consume these products. The opposition varied county to country. Many factors had been investigated that negatively affected consumer's attitude like lack of trust in experts involved in GMF production, lack of trust in risk management and food safety regulations. Many consumers wanted proper labeling on GMFs. In US, the labeling on the GMF is not compulsory while in Japan, Australia and European countries, China and Korea etc. required labeling for foods which contain GM components (Kim, 2012). Fear and emotional consideration, lack of information, education and low dissemination of knowledge about GMFs were identified as factors in creating negative attitude towards genetic modification in food (Boccia *et al.*, 2018). It was

also believed that the GM techniques might change the natural uniqueness of the product (Frewer *et al.*, 2014). Researchers found that consumers showed anxiety toward innovative food technology, which created negative attitude towards the GMFs (Rozzman *et al.*, 2017).

Genetically Modified food (GMF) and its Transition

In the agricultural food system, the GMF has become an international debate all around the globe. According to European Union, GMF produced by altering the genetic manner which does not happen naturally. Historically, the modification in plants and animals was originated in 1970s. In 1973, the first recombinant DNA found by Stanley Cohen and Herbert Boyer which started genetic engineering. Tobacco and Petunia plants were first time went through transgenesis process. But the introduction of the FlavSavr tomato plant in the market in 1994 was the actual success. The verities of GMF was firstly including plants and limited verities of animals and microbes (Maghari and Ardekani, 2011). Soybeans, maize and rapes were mostly transformed. Furthermore, Potatoes, cotton, tomatoes and tobacco went through transgenesis process. Cattles and Pigs were subjected to transgenesis process among animal species (Lemaux, 2008). Since the mid of 1990s, it created unsolved conversation regarding precautionary principles between consumers, administration, producers and distributors (Chang and Huang, 2010). In 1994, USA first approved genetically modified potatoes for commercial purpose. After that, different countries started to grow GMF. In 2013, twenty-seven countries had cultivated more than 175 million ha of genetically modified crops including maize, cotton, canola and soybean, which provided economic, health and societal advantages to millions of farmers (James, 2013).

Risks of GMF

Risks of GMF consumption are similar to conventional food. The opponent claimed that GMF caused food allergies, antibiotics resistance and creation of toxic material (Ekici and Sancak, 2011). The complete negative impacts of GMF on human health have not been documented yet (Azadi and Ho, 2010). Scientific investigation revealed that no health risks have been detected by risk assessment procedure done for international markets (Kim, 2012). In 2016, National Academies of Sciences, Engineering, and Medicine (NASEM) reported a research regarding the health, environmental, agricultural and societal effects of GM crops. Experts of the field analyzed more than thousand publications and more than seven hundred public comments. No evidence had been concluded regarding the environmental effect of GM crops. There was no case that GM crops causing unfavorable effects on a related wild species. The NASEM reexamined various original studies and failed to investigate credible confirmation of undesirable health effects of GM food consumption. Importantly added that health impacts might be developed over time and new GM foodstuffs should be cautiously evaluated (NASEM, 2016).

Benefits of GMF

According to several scientists, GMF has potential to combat hunger problem around the world by improvising

high nutritional food (James, 2009). The *Bacillus thuringiensis*(Bt) toxin coded corn is good example of genetically modified corn which has ability to resist herbicides and insect pests (Wu, 2006). Genetically modification, particularly in products related to nourishment having high utility value than conventional food. It is also rich in nutraceuticals substances, which provides therapeutic and pro-health values. The nutraceuticals substances provide multivitamins including vitamin A, C and E, prebiotics and probiotics (Kosicka-Gębska and Gębski, 2009). Besides the high nutritional values, genetically modification reduced production cost. It is very safe, because the continuous monitoring and testing of GMF is necessary for getting in trade market (Twardowski, 2010). Wilson *et al.* (2003) revealed various consumers' benefits of GMF including quality products for example, improved quality of protein, freshness, storability, nutritional substance, taste, various kinds of novel starch, reduced allergens and high shelf life of baked food. The Golden rice is a good example of GMF, which reduced the malnutrition. By using such technology, the alteration of amino acid composition of protein and contents of carbohydrates is possible (Rizzi *et al.*, 2012).

Consumer's Attitude and Knowledge Towards GMF

In the United Kingdom, London and the Polish Capital, Warsa, almost 50% of the selected consumers were well aware of GMOs. The unpredictable effects of DNA modification, specific toxin and food allergic reaction were considered as disadvantages of GM. The 27.7% of the consumers had demonstrated negative attitude and 19.8 % were showing positive attitude towards the GMF (Popek and Halagarda, 2017).

Another study performed in European Union pointed out that European were distrustful in GMF (Boccia, 2016). Almost 53% of the respondents were against GMF. Very low number of opponents were identified in Portugal, Ireland, Spain, Finland. The highest number of opponents were found in France and Denmark 65%, while in Norway and Hungary, Cyprus, Italy, and Greece were 70%, 76%, 77% and 81% respectively (Vlontzos and Duquenne, 2016).

In Lithuania, older consumers who earned less income were highly against GMF as compare to young and rich. More than 72% of the consumers demanded labeling. Some consumers were avoiding GMF components mentioned on the product, very less number of consumers were focusing on label (Lukošiūtė and Petrauskaitė-Senkevič, 2017). The European males having high income and science education were more in favor of GMF than female and older people having low income with no science education (EC-European Commission 2010).

A research conducted in Malaysia depicted that females have more awareness than male. The generation having higher education had better understanding than who had lower education (Teng *et al.*, 2018). The information and acceptance of GM products were the main factors, which influenced consumption. On the other side, those consumers who had low concern with food additives, herbicides and pesticides were highly interested to try GMF than those had high concern with it (Singhal, 2018).

Ibrahim *et al.* (2013), investigated that Malaysian consumers had low knowledge about GMF. Because of

education and advance technology, some consumers were having knowledge about the existence of GMF. In Johor Bahru Malaysia, although purchasers were familiar about the availability of the GMF but were not having enough knowledge but the quality was perceived as most significant factor in deciding their purchase decision towards GMF in Malaysia (Ismail *et al.*, 2012).

Wolf *et al.* (2012) compared the consumer's attitudes towards the GMF in America, Italy and Japan. Results depicted that the consumers in Japan and America demonstrated positive attitude and were concerned with quality and freshness and value of GMF. While Italian consumers showed negative attitude and were concerned with local food and environment.

A research was conducted in Ajara region of Georgia, consumers had low knowledge about GM engineering and showed negative attitude towards the food produced by genetic modification and were expecting government regulation regarding import and production. Most of the consumers were not willing to buy GMF even at low price (Todua *et al.*, 2015).

Another study revealed that the Sri Lankan public had 96% average awareness of GMF. The source of information for GMF through Television and Radio was high. High knowledge about GMF was shown by the respondents belonged to academic and research institutes (Sajiwani and Rathnayaka, 2014).

A research conducted in Punjab, Pakistan revealed that urban people had more knowledge than rural people did. Females were more agreed to take GM food than Males. The knowledge about GMF was less among female, uneducated and old but they were more likely to agree to take GMF. The economic status was found positively associated with the acceptance of GMF. Wealthy respondents were having more knowledge about GMF and were willing to pay than poor (Ali *et al.*, 2016).

A meta-analysis of 25 researches revealed that 23-42% of the consumers preferred non-genetically modified food (Lusk *et al.*, 2005). Large number of consumers in the US and Europe were afraid of consuming GMF because of unpredictable health risks (TNS Opinion and Social, 2010). Attitude of consumer in Nigeria depicted that 33.3%, 28.3% and 26.7% of the consumers had positive, negative and uncertain attitude toward the GM food. The reasons behind the negative attitude were health risks and naturalness (Eneh *et al.*, 2016).

The attitude of the Chinese consumer regarding GM food safety highly varied. Compared with ten years back, higher number of customers perceived that GMF is not secure for consumption. The consumers having same perception increased from 13% to 15% from 2002 to 2012. The consumers who believed that GMF is a safe food turned down from 37% to 13% (Huang and Peng, 2015). Senarath and Karunagoda (2012) stated that some Sri Lankans had negative attitude on health issues of GMF.

It was first July 2016, only one State of US took labeling initiative. Many organizations were opposing it including the American Association for the Advancement of Science. Opposition was considered that the labeling might signal that GMF is harmful for environment. They also suggested that labeling may improve the trust and lower the risk perception. Under this mixed arguments, a research conducted in Vermont State of US regarding the

attitude of consumer before and after mandatory labeling of GMF. Results showed that 19% reduction in GMF opposition after labeling (Kolodinsky and Lusk, 2018).

Conclusion

According to various studies around the world revealed that awareness of GMF among consumer was varied. Awareness of GMF among consumers is not satisfactory. Proper knowledge and awareness is required to reduce food insecurity issue. Proper labelling and clear advantages of GMF could promote its consumption. Agricultural extension department around the world should establish programs to improvise awareness of GMF at local level.

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