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Assessment of People's Perception of Genetically Modified Foods and their Risk or Benefits to Human Health in Saudi Arabia

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There is a significant growth in the human population worldwide which leads to increasing the demand for food, which typically results in additional use of food industries to make a new form of food such as genetically modified food (GMF) to meet the need for global nutrition. GMF starts to invade our diet which results in increase the concerns and debates about their safety. The present study is investigating the following: Assess people's knowledge about GMF and evaluate its risk on health. An online survey was carried out to assess consumer knowledge about GMF. The study showed that 74.3% of the respondent know what GMF is and in terms of the risk of GMF on the environment and human health about 43.7% believe there is a risk. The majority of the respondents assume that the risk of GMF is greater than its benefits. Some of the respondents believe that there is an effect of consuming GMF on their genes, but it is still unknown. Expert knowledge on the scientific issues surrounding genetically modified food is far behind what the general population believes. The conclusion that may be drawn from the scientific method is almost always solely the truth, despite the fact that culture and attitudes can vary

Keywords: Consumer Attitude Toward GMF; GMF; Genetic Modifications; Health Benefits; Knowledge; Risk Factors.

Genetically modified food (GMF) is food produced by genetic engineering techniques that cause alteration in the genetic materials of animals and plants by introducing a new DNA to the gene of these organisms in order to make a desirable trait or characteristic that does not occur naturally [1].

The origins of GMF can be traced back to the middle of the 19th century, when Gregor Mendel, an Austrian monk and botanist, presented an experiment in which he introduced a tall pea species into a short pea species, resulting in the inheritance of certain traits. His work was not recognized until the 20th century. Mendel's findings influenced the creation of the first genetically modified plant, an antibiotic-resistant tobacco [2]. The rapid growth of the human population around the world increased the need for food. Scientists approved that genetically modified food would solve the food insecurities globally. Its benefits include producing crops with supplements such as vitamins, probiotics, unsaturated fatty acids, and other nutrients, some of GMF are more delicious and have more nutrients and better appearance than natural food and have a long life span [3]. Genetic engineering technology plays an important role in eliminating hunger in the developing world by

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increasing the crop yields also producing crops that use less chemical fertilizers and pesticides, climate stress-resistant plants [4]

Natural fruit such as apples is affected by polyphenoloxidases (PPOs) which turn peeled, cut fruit into brown color due to oxidation effects. Scientists applied some genetic modification techniques including knockout of PPOs gene of the arctic apple which produces 3 types of arctic apple available commercially (Arctic® Golden Delicious, Arctic® Granny Smith, and Arctic® Fuji)[5].

It has been proved that the use of GM application has a great impact on the crops for example when scientists integrated gene that codes for insecticide toxin production in the subspecies of *Bacillus thuringiensis (Bt)* into plants it resulted in producing crops that are resistant to insect pests. Genetically modified plants with Bt (Cry) protein showed an active control against pests as a result of their toxicity to number of insects [6].

Concerns have been raised about the potential adverse effects that GMF could have on the health of consumers. There have been concerns in the United States over the potential for humans to develop allergic reactions as a result of their use of GMF. Although, there are no studies linking the allergic reaction with consuming GMF. Some concerns, including metabolic disruption, cancer, genetic interference, prolonged toxic effects, and the emergence of resistance to antibiotics, were observed to be connected with the use of GMF. There is some evidence to show that GMF is involved with infertility conditions such as endometriosis, sex hormone imbalance, endocrine-metabolic aberration, and reproductive relevant cancers [7].

Environmental disaster is another great concern toward GMF. Some research suggested that the utilization of pesticides and herbicides might have a great impact on developing GM resistant plants. As well as, whether these GM crops are influencing ecosystem and field properties such as the quality of water and soil. There are several studies showed that there is limited effect of GM crops on the environment [8].

Food labeling is the communicator between the food industries and consumers which represents the most important information about the factors and nutritional values of the product that effect on the consumer purchasing decisions. Regarding to the differences between commercialization, regulatory framework, and consumers there is a significant difference between countries toward food labeling policy. Countries such as the USA and Canada are more flexible toward GMF products the US Food and Drug Administration (FDA) does not require food labeling of GMF. USFDA only requests of firms that they conduct their own tests of new GMF. While EU countries have more concerns about products that affect environmental change such as GM food crops, they obligate food industries to label each food product which have even 1% additives or flavors containing GMF materials [9].

The aim of this study is to assess and evaluate people's knowledge about GMF and its effect on their health.

MATERIAL AND METHODS

To assess people's knowledge about GMF, an online questionnaire was designed using google form consist of 21 questions as follow (19 closed questions and 2 open questions). The questionnaire has five parts include (socio-demographic, awareness and source of knowledge, food labeling, consumption and risk of GMF). The survey was then distributed online through social media in Saudi Arabia. The average time taken to complete one questionnaire was 3 minutes and the number of respondents was 206.

The analyzes were performed using standard statistical methods.

RESULTS

Socio- demographic

Respondents were 198 females (96.1%) and 8 males (3.9%) with the majority of age ranged between 20-30 years old (78.6%) while the least age group was between 41-50 years old (6.3%). In terms of level of education attained by respondents, 168 (82%) had an undergraduate degree and 26 (12.6%) completed their secondary education, the minority had a postgraduation degree with (1.6%) (as shown in table 1).

Assess public awareness and knowledge of GMF

Regarding the other parts of the questionnaire assessing public knowledge and

awareness of GMF the majority of 74.3% answered that they know what GMF is. However, respondents were varying in evaluating their knowledge of GMF rate from five where 1 means (I am not sure) and 5 means (I know very well). the results were as follow: 6.3% chose 5, 9.2% chose 4, 21.8% chose 2, 28.2% chose 1 and 34.5% chose 3 as neutral (table 2). In regard to respondents' source of knowledge of GMF, 51.5 % admitted that they read about GMF from social media, 18% from broadcasting and 13% from public education. 82.5% of the respondents believe that GMF was made for profit purposes over human health. When they were asked which source of information do you trust 53.9 % of the respondents trust the information released by WHO and 37.4% trust the ministry of health information. Regarding to which food item do you think is most exposed to genetic modification, 131(63.6%) reckon fruit and vegetable are the most exposed to genetic modification. 82 (39.8%) think it is canned food, 68 (33%) think it is meat and poultry, 51 (24.8%) assuming that it is sugar and sweet, 49 (23.8) it is

Table 1. The socio-demographic profile of the respondents with reference to their gender, age and education

Characteristics	N	%
Gender		
Male	8	3.9
Female	198	96.1
Age		
20-30	162	78.6
31-40	31	15
41-50	13	6.3
Education		
Intermediate school	8	3.8
Secondary school	26	12.6
Undergraduate degree	168	82
Post graduate degree	4	1.6

Table 2. Questions assessing public knowledge and awareness

Questions		N	%
Have you heard about GMF?	yes	53	25.7
	No	153	74.3
How much would you evaluate your knowledge of GMF?	1	58	28.2
	2	45	21.8
	3	71	34.5
	4	19	9.2
	5	13	6.3
Where have you heard about GMF from?	newspaper	15	7.3
	News broadcast	37	18
	Social media	106	51.5
	Public education	21	10.2
	High education	27	13
Do you think GMF is produced for economic purposes only?	yes	170	82.5
	No	36	17.5
What of the following sources of information do you trust regarding to GMF?	WHO	111	53.9
	MOH	77	37.4
	Internet (Wiki.etc)	10	4.7
	Journals	2	1
	Family and friends	6	3
Which of the following food do you think is the most exposed to GM techniques?	Fruit & vegetable	131	63.6
	Meat & poultry	68	33
	Cheese	30	14.6
	Canned food	82	39.8
	grains (rice, corn, wheat, etc)	49	23.8
	Sugar and sweet	51	24.8
	oil	1	0.5
	All of them	1	0.5

grains, 30 (14.6%) think it is cheese while only 1 (0.5%) responded it is oil similarly to all types of food are exposed to genetic engineering (table 2).

Evaluate the usefulness of food labeling

The online survey indicated that a number of consumers actually read food labeling as 49% responded with yes, they do. Most of the public thinks it is important to label or tag the GM products. As well as, most of the public believes that GMF products should be subjected to allergy tests (table 3)

Public behavior toward GMF consumption

Most of the respondents admitted that they do not know if they consumed GMF with 64.6%, nearly 23.3% believe that they consumed GMF products and 12.1% responded that they never had GMF products. While 124 (60.2%) denied purchasing GMF and 82 (39.8%) would buy GMF products. 88.3% of the respondent were positive about consuming natural food without any genetic modification (Table 4).

Table 3. Questions assessing public thoughts of food labelling.

Question		N	%
Do you read food labelling before purchasing?	Yes	106	51
	No	100	49
Do you think it is important to tag GM products?	Yes	199	96.6
	No	7	3.4
Do you think it is necessary to subject GMF to allergic test?	Yes	187	90.8
	No	19	9.2

Table 4. Question assessing public attitude toward GMF consumption

Question		N	%
Would you buy food that is genetically modified in order to enhance the outer shape (eg: corn)?	Yes	82	39.8
	No	124	60.2
Have you ever had a GMF?	Yes	48	23.3
	No	25	12.1
	I do not know	133	64.6
On the table 2 items one is GMF and the other is natural which one would you eat?	GMF	24	11.7
	Natural	182	88.3

Table 5. Questions assessing public awareness of GMF risks.

Question		N	%
Do you think GMF and GM crops are any risk on human health or environment?	Yes	90	43.7
	No	14	6.8
	Maybe	102	49.5
If your answer was yes. How much would you rate their risk out of 5 (as 5 is most dangerous and 1 is less dangerous)?	1	12	7.8
	2	16	10.4
	3	56	36.4
	4	43	27.9
	5	27	17.5
Do you think GMF	Benefit is greater than risk	42	20.4
	Risk is greater than benefit	164	79.6
What is the impact of GMF consumption on your gene?	Cause gene mutation	52	25.2
	Has no effect	30	14.6
	Unknown effect	124	60.2

Risk of GMF

Regarding to the public perception of the risk of GMF and its affect on the environment and human health, about 49.5% believe it may cause a risk, while 43.7 % believe that there is a risk while only 6.8% do not see that there is a risk. Respondents who said that GMF was dangerous assessed its severity from five where five was the most dangerous and the results were as follows 17.5% rated of five, 27.9% rate of four, 36.4% rate of three, 10.4% rate of two and 7.8% rate of one. 79.6% believe that the risk of GMF are more than their benefits and 20.4% believe that the benefits of GMF are greater than their risks. Regarding the question, what is the effect of GMF on your genes? 60.2% believe that the effects of GMF on genes are unknown, 25.2% believe it cause a gene mutation and 14.6% believe it has no effect (Table 5).

DISCUSSION

Genetically modified food could be an exit option for depending on the natural food resources. Although the safety of GMF is not yet known, several factors might affect consumers' decisions about purchasing GM product [10].

Regarding to Hahn and Truman (2015)[11], the basic education expertise and skills such as basic knowledge, values, socio-emotional awareness, and interactional abilities are critical components of health. In respect of GMF information surveys, the data presented have revealed that the educational levels of respondents were: 81.9%, 12.7%, for university and tertiary persons consecutively. These high variations might be due to the differences in the social concepts of education and health.

The results regarding the question assessing their knowledge about GMF the majority of 34.5% were neutral even with the varieties of knowledge sources available (subjective and objectives) which impact consumer behavior toward GMF. Most of the respondents denied purchasing GMF. The results of this study are similar to the research conducted by Shori and Olorogun (2014)[12] on Arabs' attitudes toward GMF which were revealed that most of the consumers prefer traditional food. A number of studies worldwide showed that the consumer attitude toward GMF vary regarding to their self-evaluation and basic knowledge of products for example consumer in the EU refused to purchase any GMK food due to their risk and benefit perception. The Chinese consumers also have a negative attitude toward GMF, the data showed that the majority of respondents who denied purchasing GMF have no idea about it while the ones who aware of GM technology received their knowledge from the internet and social media [9].

These differences may be attributed to the social conditions which include health education, learning level, social media, media, university and school education, newspapers or magazines reading.

According to the current study, when asked about the risk of GMFs, approximately 93.2% of respondents believe that GMFs pose a risk to human health. As well as 85.4% assume that GMF might cause a negative effect on their genes such as causing genetic mutation. Some studies showed that the EU and the developing countries' consumers have also a negative attitude toward GMF due to lack of labeling, and regulation policies about GMF safety issues. Some of these issues are related to human health, such as allergic reactions, while others are related to the environment, such as agricultural diversity destruction and antibiotic resistance [9-8-13] .

CONCLUSION

Disagreements in public opinion about GMF must be recognized. Genetic modification is not a beneficial within itself, however it is means for balancing public and private science. GMF has both beneficial and negative impacts. These can be either direct affects on species that eat on or engage with crops, or wider effects on food web produced by alterations in other organism populations.

Customer acceptability is influenced by the threat that they experience from bringing food into their consumption patterns processed using technology that they rarely comprehended. The final assumption was that the deployment of GMF into improved food marketplaces should be complemented by sufficient consumer safety measures. These steps would permit for a reduction in customer perception threat by paying extra attention to the data presented, specifically relevant

to health. Concern about health is, after all, the most powerful element in consumer perception of risk from these foods.

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Author contribution

Ashjan Shami conceptualized the study, wrote the manuscript, and analyzed the data.

Conflict of interest

The author declares that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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Statement of Informed Consent

The respondents had the option to withdraw from the study at any time and offered their responses without being coerced.

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