



Original research

Evaluation of general knowledge on transgenic products as a biosafety needs: A case study of Iranian universities students

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ABSTRACT

The use of genetically modified organisms (GMOs), their benefits, dangers, safety and their limitations is the subject of scientific, political and social discussions in various countries, specially developed and developing countries. Consumers of genetically modified products have the right to have a comprehensive and in-depth educational interface with the biotechnology of these products, but conflicting sensitivities and perceptions seem to be misused. A descriptive-analytical questionnaire was used to survey the level of general knowledge of students at different fields in universities of Kermanshah, as an example of a well-educated Iranian society (1000 people), in relation to different uses of GMOs. There was a significant difference between the information and knowledge of students related to biological sciences and non-biological at undergraduate and postgraduate education levels in both sexes of men and women about transgenic products ($p < 0.05$). All the people that were studied required the creation of strict national, international and ethical rules by policy makers and producers of transgenic products. Social networks were the largest source of information for individuals. The present study emphasizes the need for the development of evidence-based science education programs for the general public, in order to increase general awareness of the GMOs technology's advantages and limitations in the country.

Keywords: Transgenic products, Bio-safety, General knowledge, Students

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1. Introduction

Considering the advanced laboratory techniques for determining the sequence of the genome, the use of genetically modified organisms (GMOs) as a new technology for the production of recombinant drugs, agricultural products (Walsh, 2005), food production (Brookes & Barfoot, 2015), Precise diagnosis (Panteli et al., 2015), humans and animals therapies (Jefferson et al., 2015), disease prevention and environmental management (Alphey, 2014; Marinotti et al., 2013), bio-improvement processes (Rylott et al., 2015) is increasingly on the rise in various markets. Biotechnology, especially genetic engineering, has created an opportunity to reduce poverty, create food security, eliminate malnutrition and prevent degradation of natural resources and enhance plant breeding by producing transgenic products. However, the arrival of biotechnology in the research and production of transgenic products has faced challenges in many countries with regard to ethical, social, cultural, environmental, biological, commercial and religious aspects. On the other hand, genetically modified organisms (GMOs), and in

particular GM foods, are the subject of scientific, political and social discussions related to their use, benefits, risks, safety and limitations in various countries. What's certain is that any technology, along with its many benefits, also brings risks and dangers with it. This is the essence of every technology, and in fact none of the technologies are 100% safe. Obviously, when a new technology can solve a problem and not create a specific problem with other technologies, it will be ethical to use it. The public debate is about safety, dangers, rules, labeling and restrictions on these products. Consumer communities have the right to have a comprehensive and educational information in biotechnology, but they seem to be manipulating the paradoxical views and sensitivities (Burke, 2012; McHughen, 2013). On the other hand, the attitudes of the consumers toward them differ in cultures and geographical areas (Chen & Li, 2007). On the other hand, irrational and non-intellectual arguments to oppose a new technology are equally unethical. Therefore, unwanted and skeptical attitudes, such as the lack of a general understanding in the definition of the exact science of GMOs, the lack of perception or any of the benefits that GMO products have, and ethical or religious beliefs as potential are responsible for some of the reasons for opposition to

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GMO-based technology (Aerni, 2015; Ruse & Castle, 2002; Sturgis et al., 2005). Also, the strongly paradoxical views of pro-camps and anti-GMO camps that have been expressed in media discussions have also contributed to creating false information and public confusions (Kuntz, 2014). In addition, in recent years, some of the media's actions against GM have been widely influenced by the lack of acceptance of GMOs by a significant portion of the general public. This, in turn, affects government policy decisions and reflects internal disputes and problems in achieving a common position on GMOs, in particular GM products among countries (Fedoroff, 2015; Lucht, 2015; Paarlberg, 2014). Given that, the public opinion has a significant impact on the development and marketing of GMOs, identifying current public attitudes to biotechnology in different countries is essential (Boccia & Sarnacchiaro, 2015). In some countries, GM foods can be imported and distributed under the obligatory labeling requirement (Twardowski, 2008). It is also important to pay attention to the key role of promoting general knowledge, information, laws and resources related to genetic engineering in successful policy-making in biotechnology and stakeholders (producers and consumers). Based on a number of previous studies in different countries regarding the evaluation of GMO products (Verdurme & Viaene, 2003). The purpose of this study was to investigate the current knowledge and attitudes of various students of Kermanshah universities as part of Iran's higher education on production, distribution, policies, laws, general concerns and potential benefits of using GMOs products in the country.

2. Material and Methods

In this research, by using a descriptive-analytical questionnaire, knowledge and general attitude towards transgenic products and foods among different student groups of Kermanshah universities were evaluated as part of educated society in Iran.

2.1. Statistical population and survey of participants

The questionnaire was distributed and completed in oral and directly by a questioner among students of different levels at universities and scientific communities of highest education centers of Kermanshah province (1000 =N). To select individuals, the stratified sampling method was used. Then, the questionnaires were completed and the statistical analysis of the data was done based on Pearson and Tukey's test in SPSS Ver18 software.

2.2. Demographic characteristics

Given that the students from different fields are different in their viewpoints, each person examined on the basis of age, gender and education includes those who may potentially make a decision on GMOs in the future, the theory was determined and evaluated in two main groups, N = 1000, including undergraduate students of N = 500 and postgraduate N = 500 (Master's and Ph.D.) (Table 1).

2.3. Persons involved in GMO issues

That may potentially have new information about GMOs, include students of agriculture, animal sciences, biology, medicine, biotechnology & veterinary medicine (N = 500).

2.4. Persons not related to GMO issues

Students of humanities & engineering (N=500).

2.5. Gender of Persons evaluated in all sections and fields of study

Women (N = 500) and Men (N = 500).

2.6. General knowledge questions about CMOs

Students' attitude to ethics in the production of transgenic products by policymakers and manufacturers?

Students' attitudes about the need for accurate national and international precision rules for the production and consumption of transgenic products?

Students' information and attitudes about the likelihood of bio-tourism and the dependence of countries on strategic food products with utilization of transgenic products? Is it possible to use genetically modified products as weapons and targeted threats against national security target countries?

Students' information and attitudes about the probability of a health Impairment of immunity in humans and animals due to the new, unknown diseases, infertility, specific racial diseases, cancers, allergic reactions, mortality in consumers of transgenic products?

Students' information and attitudes about whether cloning a gene from an existing one in a plant or animal cell (genetic manipulation) as a human or livestock feed in its biological and biochemical processes of causing disruption, damaging and breaking down in health Environment Life and ecosystem?

Students' information and attitudes about the use of transgenic animals as laboratory models for the production of drug molecules, active protein, useful recombinant, therapeutics, enzymes and gene transfer technology for vaccination in the treatment of human and animal diseases?

Students' information and attitudes about the respect of consumers' rights with the necessity for manufacturers to label to genetically modified products in order to enter the consumer market?

Students' information and attitudes about the nutritional value of genetically engineered products with the superiority and appropriateness substitute into natural products (the benefits of specialty products and the approval of these products)?

Students' information and attitude about the inability to answer current knowledge and scientific studies (articles, reports and scientific documentation) to all ambiguities regarding the potential risks of transplants to humans, animals and the environment (disadvantages of special products and Opposed to producing these products)?

Information resources of knowledge of students evaluated about genetic products (radio, television, books, social networks, journals, congresses and scientific conferences)?

3. Results and Discussion

The results of the research on the knowledge of the students of the Kermanshah universities about the transgenic products in a total of 1000 people based on gender (50% male, 50% female), different fields of study of biological sciences (50%), non- biological sciences (50%), undergraduate degrees (50%), postgraduate

degrees (50%), Also, the information sources of the research groups were shown (Table 1, Fig. 1 and 2).

Table 1. General knowledge of undergraduate and postgraduate students about GMO products.

Students, section, gender, number	Postgraduate Woman N=250	Postgraduate Man N=250	Undergraduate Woman N=250	Undergraduate Man N=250	Total N=1000
	%	%	%	%	%
Positive answer to questions?					
1. The requirement to observe ethics in the production of genetically modified organisms by policy makers and manufacturers	100	100	100	100	100
2. The requirement to establish precise national and international precision rules on genetically modified organisms	100	100	100	100	100
3. The likelihood of the risk of terrorism and the dependence of countries through the use of genetically modified organisms	27.6	22.8	13.2	14.4	19.5
4. The probability of a disorder of immunity and the emergence of new and new diseases in consumers of genetically modified organisms	28.4	26.8	18.8	12.8	21.7
5. The possibility of damaging to the environment and ecosystem by transgenic products	20.8	19.6	18.4	15.6	18.6
6. Proper use of biotechnology for genetically modified organisms in the production of drugs, vaccines for the treatment and diagnosis of human and animal diseases	24.8	22.4	18.8	13.2	19.8
7. Observing the rights of consumers with the requirement to label to genetically modified crops	35.6	21.6	17.2	12.8	21.8
8. General agreement to production of genetically modified organisms	17.2	15.6	19.6	14.8	16.8
9. General disagreement to production of genetically modified organisms	22.8	24.4	20.4	25.2	23.2
10. Total amount (information and general knowledge about transgenic products)	41.91	39.24	36.26	34.31	37.93

Currently, one of the most important human challenges is the production of food for a growing population, the elimination of poverty and the preservation of the environment. This requires the use of scientific findings and new technologies (Falk et al., 2002). The use of transgenic products is one of the achievements of biotechnology as a solution to some of the human problems in this area. Also, the use of any new technology, such as the production of transgenic products, has created questions and concerns from the health, economic, social, environmental and ethical aspects (Clark, 2006; Konig et al., 2004; Lemaux, 2008). On the other hand, non-academic arguments to oppose a new technology are too disturbing. In some cases, it may be necessary to use transgenic technology, but scientific assessments should be sufficient in such cases in order to promote the use of these products in international organizations under appropriate conditions of superiority. In none of the evaluations, transgenic products are not mentioned as the

only solution, but as an important factor in solving some of the problems (James, 2007). Transplanted revolution, though it may not be so significant, will still be challenging until the general fears in this area diminish. Only by continuing basic research on the risks and benefits of transplantation and dissemination of information in this field is enough that the society is introduced to the benefits of genetic engineering and its products, and then approaches will change (James, 2015; Macer, 2001).

The views on transgenic products are more based on value judgments and have no scientific basis. Probably, these criteria will vary with time and changing cognitive conditions systems. Unwanted, skeptical, ethical attitudes, religious beliefs, lack of public understanding of the exact definition of GMO as a potential factors are part of the reasons for disagreement with this technology (Amin et al., 2013; Tsourgiannis et al., 2011). Also, the highly contradictory views of pro-camps and anti-GMO camps that

have been expressed in media discussions have also contributed to generating misinformation and public confusion (Hallman et al., 2013).

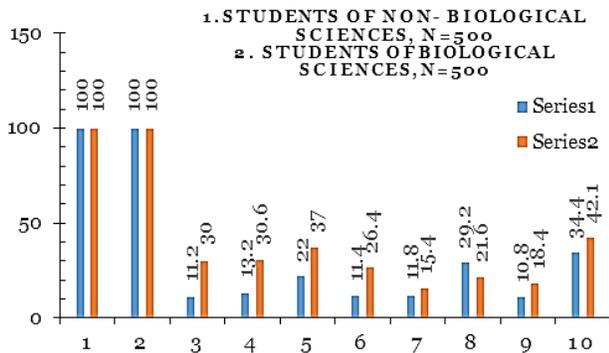


Fig. 1. General information and knowledge of students about GMO products Separated from biological and non-biological sciences.

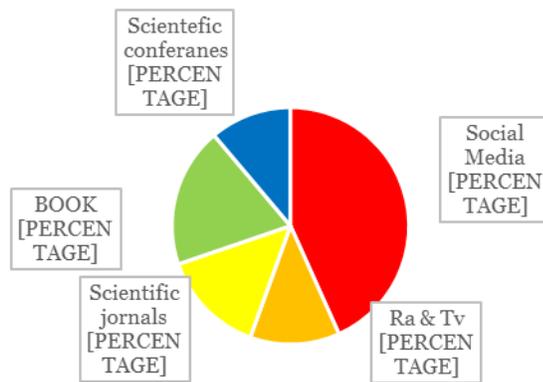


Fig. 2. Information resources of the studied statistical community.

On the other hand, the promotional activities against GMOs done by nongovernmental organizations have added to the GMOs rejection by a significant portion of the public. By affecting government policy decisions, this issue is reflecting internal disputes and the emergence of problems in reaching a common stand on GM products among countries (DeRosier et al., 2015). Concerns about this category of products can easily be solved by scientific arguments. What is certain is the adoption of rational and prospective policies at the national level, while avoiding the possible risks of this technology, can benefit the people. Also, attention to the main role of general knowledge, information, laws and resources related to genetic engineering is important in successful decision-making and policy-making in the biotechnology industry and beneficiaries (producers and consumers). Given that public opinion has a significant impact on the development and marketing of GMOs, identifying current public attitudes toward this biotechnology in different countries is essential (DeRosier et al., 2015). For example, in some European countries, GM foods can be imported and distributed under the obligatory labeling requirement (Rzymiski & Krolczyk, 2016; Warringer & Blomberg, 2014). In this survey, general information and knowledge of the statistical community were studied about transgenic products respectively, for undergraduate students (men 34.31%, women 36.26%), postgraduate students (men 39.24%, women 41.91%) and a total of 37.93%. While in similar studies,

among non-biosciences and biosciences students in Poland, the overall percentage of GMO information was 41.7% and 75%, respectively (Rzymiski & Krolczyk, 2016), Among Korean students in 10 different fields non- biosciences 87%, among American students, 58% (Finke & Kim, 2003), and in Slovakia, among the students, 5 related and non-related biosciences fields were 43% (Prokop et al., 2007).

Table 2. General Information and Knowledge Students about GMO products Separated from biological and non-biological sciences.

Positive answer to questions?	Total Students %Non-biosciences N=500	Total Students %biosciences N= 500
1. The requirement to observe ethics in the production of genetically modified organisms by policy makers and manufacturers	100	100
2. The requirement to establish precise national and international precision rules on genetically modified organisms	100	100
3. The likelihood of the risk of terrorism and the dependence of countries through the use of genetically modified organisms	11.2	30
4. The probability of a disorder of immunity and the emergence of new and new diseases in consumers of genetically modified organisms	13.2	30.6
5. The possibility of damaging to the environment and ecosystem by transgenic products	22	37
6. Proper use of biotechnology for genetically modified organisms in the production of drugs, vaccines for the treatment and diagnosis of human and animal diseases	11.4	26.4
7. Observing the rights of consumers with the requirement to label to genetically modified crops	11.8	15.4
8. General agreement to production of genetically modified organisms	29.2	21.6
9. General disagreement to production of genetically modified organisms	10.8	18.4
10. Total amount (information and general knowledge about transgenic products)	34.4	42.1

This difference can be related to the way students respond or the difference in designing a questionnaire according to local and national conditions. Also, the difference in awareness among communities in these different countries may be the source of educational policies. In a similar study in South Korea, among the students studied, women were significantly more informed than men (Finke & Kim, 2003). In the research, women were significantly more knowledgeable than men in all the fields of study ($p < 0.05$). Individuals studying at all levels and fields 100% demanded that ethics in the production of genetically modified organisms be made by policymakers, manufacturers with the requirement to establish precise national and international rules on

transgenic products. Although it responded to a general agreement on the production of transgenic products with 16.8% for the entire statistical society. Also, the observance of consumers' rights with the requirement to labeling transgenic products with a total of 21.8% was the most positive response after the requirements of ethics and the creation of precise rules for this type of products. At least the minimum of the subjects' attitudes with 18.6% was the probability of damage to the environment and the ecosystem by transgenic products (Table 1).

In addition, the total amount of information and knowledge of non-biosciences and related to biosciences students about transgenic products there were significant differences with 42.1% and 34.4%, respectively ($p < 0.05$) (Table 2 and Fig. 1). In total, there was a significant difference between students' general information and knowledge about transgenic products at different degrees of undergraduate and postgraduate studies with 70.57% and 81.15%, respectively ($p < 0.05$). It seems that the level of information and knowledge about transgenic products was not proportional between male and female sex. Thus, at all undergraduate and postgraduate levels, women had a more significant knowledge than men in the subject matter. Women are likely to have more information than men due to more attention to food health and the impact of Iranian culture. Also, the sources of information used by the students were investigated. Social media 44%, books 19%, scientific journals 14%, radio and television 12% and scientific conferences 11%, showed a significant difference in the pace of social media networking in the statistical population ($p < 0.01$), (Fig. 2).

4. Conclusion

Biotechnology, and especially genetic engineering, is a scientific opportunity to produce transgenic products. What's certain is that any technology, along with its many benefits, also brings risks with it. However, entry of biotechnology in the research and production of transgenic products has been challenged in many countries by commercial, religious, ethical, social, cultural, environmental and safety challenges. The results of this study can be useful in developing educational programs based on scientific evidence and public understanding of the possibilities, limitations, risks and benefits of biotechnology to help make good policy in agreeing or opposing GMO technology. Recommendation: (1) Introducing new issues such as transgenic, requires more policymakers planning through official media, national social networks and academic communities to raise public awareness; (2) The adoption of clear national and international rules for producers and distributors of transgenic products is mandatory.

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