Full Length Research Paper

Public knowledge and acceptance of genetically modified organisms in Shiraz, Iran

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Abstract. The application of new technologies, such as biotechnology, has its proponents and opponents. Public acceptance is an essential factor to develop biotechnology as a modern technology. The present study was conducted to assess the level of public perception and attitude toward the risks and advantages of genetically modified organisms (GMOs) in Shiraz, Iran. A questionnaire survey was conducted among people between the ages of 15 and 65 years old, with an average age of 33 years old. This study revealed that various education and expertise have the strongest impact on public attitude based on socio-demographic data. Approximately 75% of respondents had an optimistic attitude to GMOs. Based on the current study, many people (60%) have inadequate knowledge about GMOs, and correspondingly, the overall public attitude to these organisms in Shiraz is unstable. Moreover, most of the respondents were not familiar with biosafety regulations to control the claimed risks of GMOs. In summary, scientists, industries and agencies involved in GMO business should improve public trust and awareness to increase global acceptability of GMOs.

Keywords: Biotechnology, Consumer's perception, Public trust, GMO acceptability, Shiraz

1. INTRODUCTION

Since 1996, genetic engineering (GE) involved the development of strategies that enhance resistance of crop plants in a sustainable way (Vincelli, 2016). GE involves a modification of genetic material, such as DNA, and transformation of genes to create new variations of plants or animals (Phillips, 2008). In agriculture, genetically modified organisms (GMOs) have some advantages, such as tolerance to pesticides, adaptation to stress and resistance to disease (Rosculute et al., 2018). The cultivation of genetically engineered crops has been globally expanded from 1.7 million hectares to 185.1 million hectares from 1996 to 2016 (Zhang et al., 2019). Zilberman et al. (2018) stated that GE may play a vital role in the economics of sustainable development worldwide because it decreased the application of pesticides, increased yield per unit, contributed to more efficient land use and decreased greenhouse gas emissions during the process of growing crops and foods. Similar to other technologies, GMOs do not occur under vacuum conditions but work as a socio-technical or socio-ecological system (Herrero et al., 2015). Meanwhile, the specific fears, such as modification in nutritional quality of foods, possible spread of antibiotic resistance, allergenicity and carcinogenicity of GM foods, have been expressed by opponents of GM technology. In addition, several studies have confirmed considerable reluctance among consumers to accept modern biotechnologies (Lockie et al., 2005). These objections are principally based on the deleterious influence of this technology on the consumers' health and environment safety, as well as moral and ethical concerns on GMO (Maghari and Ardekani, 2011). Consumer attitudes toward agro-biotechnology may vary across cultures and geographic regions in the world. For example, Cui and Shoemaker (2018) stated that many people in China are mostly opposed to GMO foods without any certain reason. Apart from that, Brosig and Bavorova (2019) expressed that the fear of using GM food, because of its dangerous property for human health, is generally spread in the population of Ukraine, Russia and Czech Republic. Moreover, developing countries may be unwilling to recommend GM crop varieties because of fears of jeopardizing their current and future export markets (Hug, 2008).

Public knowledge about GMO may play a vital role in determining the consumers' advantage and risk perceptions, and ultimately, in the consumers' attitude toward GM foods. Some studies stated that knowledge and education might have an important influence on consumer perception regarding genetically modified foods (Costa-Font and Mossialos, 2005, Traynor et al., 2007). Currently, only a limited number of surveys are available among GM food consumers in Iran. Thus, the present study aimed to analyse the attitudes toward genetic modification, the knowledge about such technology and its acceptability in different application areas among people in Shiraz, Iran. A questionnaire was used to provide a representative and quantitative picture of Shiraz public's attitudes.

2. MATERIALS AND METHODS

2.1. Selection of the survey sample

Shiraz is one of the important cities in the south of Iran. In the present study, the goal was to survey a minimum of 250 participants in Shiraz City. Other surveys, such as Mucci et al. (2003) and Šorgo et al. (2011), have used a similar number of participants.

The ages of the respondents varied from 16 to 65 years old, with an average of 33 years old, and 58% were female. Respondents were selected from a wide range of occupations and educational backgrounds to reflect the structure of the Shirazi population. Enrolment to the current study was voluntary, and respondents were not paid. In the present study, questionnaires were distributed personally among the sampled individuals. After an agreed upon period, the forms were collected.

2.2. The questionnaire

After briefly explaining the goals of the survey to the participants, they were asked to fill out a semi-standardized questionnaire of six pages. As described by Aerni (2005), the first part of the questionnaire comprised questions about participants' knowledge of GMO, as well as biosafety and their purposes. The second part included questions regarding their understanding of problems in agriculture and the potential of genetic engineering to solve these issues. The third part comprised some negative and positive statements about the potential benefits and risks of agricultural biotechnology. The final part was about trust in legislation and institutions.

2.3. Statistical analysis

Data analysis was done using the computer software program called SPSS Version 13.0 (Statistical Package for Social Scientists). All data analysis were done using a significance level of 0.05 or less.

3. RESULTS

3.1. Descriptive analysis

At the beginning, the questionnaire started with questions about socio-demographic information of the participants such as gender, education, age, expertise and occupation. As shown in Table 1, almost 60% of participants were university degree holder. Moreover, 58% of participants were female.

Table1. Surveyed population demographic information

Variable	Percentage
Gender	
Female	58
male	42
Age	
15 - 18	14
19 - 25	33
26 - 35	27
36 - 45	17
46 - 60	9
Educational level	
Under diploma	14
High school diploma	26

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University levels	60
Occupation	
Students	40
Employee	14
Seller	16
Faculty member	10
Unemployed	20
Expertise	
Agriculture engineering	19
Biology and medicine	6
Engineering	11
General sciences	18
Others	46

3.2. Participants' biotechnology knowledge

The survey results indicated that participants' knowledge on biotechnology and GMO was limited. Figure 1 shows that almost 60% of participants have no idea about the GMO topic and its purposes. Half of the participants have limited knowledge about potential applications of genetic modification. The majority of participants were not familiar with biotechnology methods (70%), and most of them (about 70%) were not aware of the beneficial and risky applications of GMO.

Then, we tried to identify whether different socio-demographic factors have an impact on respondents' biotechnology knowledge. No significant correlations were available among gender, age and occupation with biotechnology knowledge. Meanwhile, education and expertise were the most important factors among socio-demographic variables that have an impact on participants' biotechnology knowledge (Table 2). Thus, a significant difference (at 0.01 level) was noted between the educated and uneducated respondents regarding biotechnology knowledge, and the participants with a high level of education had more knowledge on biotechnology and GMO than the uneducated respondents. Participants with an expertise in agriculture engineering, biology and medicine have a high level of genetic engineering knowledge compared with others (correlation is significant at 0.01 level). Figure 2 indicates that male and female in all age ranges had the same biotechnology knowledge.

Table 2. Correlation between socio-demographic variables, biotechnology knowledge and respondent approval

	Knowledge	Acceptance	Gender	Age	Education	expertise	Occupation
Knowledge	1.00	0.080	0.018	-0.035	0.275**	-0.190**	0.036
Acceptance		1.00	-0.055	-0.092	-0.048	0.123*	-0.075
Gender			1.00	-0.010	0.263**	-0.097	0.166**
Age				1.00	0.083	0.209**	0.477**
Education					1.00	-0.129*	-0.155*
expertise						1.00	0.214**

** P< 0.01 (Correlation is significant at the 0.01 level)

* P< 0.05 (Correlation is significant at the 0.05 level)

3.3. Information sources for public bodies

More than half of the respondents had an extremely low information about GMO. Therefore, we were interested in knowing whether they are properly informed by the mass media on issues related to genetic engineering. They had not been informed sufficiently about these issues by reading popular newspaper or watching TV programs because of limited media, which covers information about GM food and agricultural biotechnology in Iran (Fig. 3).

3.4. Shirazi public's evaluation of biotechnology applications

Our results indicated that only 12% of respondents were strongly against GMO technology. However, perception and acceptance of gene technology varied according to the type of its application. The public's ethical concerns were associated with applications that involve the use of animals or of human genetic material, rather than plants. Thus, plant modification appeared to be more acceptable than animal modification (Fig. 4).

Figure 1. Participants' knowledge of biotechnology

Figure 2. Significant interactions for gender, age and participants knowledge of biotechnology

Figure 3: Mass media's role in disseminating information to the public

In our survey, expertise and gender differences were significant ($P < 0.01$) for GMO acceptance. Women are generally more likely to express concern about GMO application than men. Table 2 shows that among socio-demographic characters, only the experts have significant correlation (at 0.05 level) with GMO acceptance. Finally, in our survey, no significant differences of GMO acceptance emerged in connection with age, education and occupation.

Approximately 75% of respondents believed that using GMO in agriculture is essential and can play an important role in its improvement (Fig. 5a). According to our results, more than 60% of respondents believed that biotechnology might have a high potential as a new tool to solve some agriculture problems, such as crop yield improvement and insect and pest control, in comparison with conventional ways, such as chemical and biological methods (Fig. 5b). Perception and acceptance of gene technology varied according to the type of application, and participants' attitude was more favourable with regard to GM application to decorative plants rather than crops and medicine plants. Some people believe that the artificial manipulation of genomes is an affront to nature, which is beyond the right of man and which should be left to God (Moses et al., 1999). However, most participants in our survey believed that biotechnology activities are not opposed to ethical considerations.

3.5. Public demand for information about genetically modified foods

When participants were asked about their preference for food, most of them strongly expressed concern about food quality, unknown health risks and health standard, but not many were concerned about genetic modifications and biosafety considerations. Our data indicated that benefits to health may represent more acceptable modifications than science improvement and environmental, financial and political considerations.

Regardless of respondents' agreement with GM foods, when asked they were asked about "the right to choose" more than 85% of the participants agreed with the labeling policy for GM food.

Figure 4. Public's evaluation of biotechnology applications.

Figure 5. Public perception of GMO application in agriculture

4. DISCUSSION

The application of biotechnology to agriculture is a vital factor in developing countries, such as Iran, in which the economy is based on their agricultural activities. The results of current study displayed that the public is not well informed about genetics and its implications in modern biotechnology. Lusk and Sullivan (2002) found that the level of knowledge on GM foods influenced the acceptability of these foods. Their result is in line with the results obtained by many studies (Finucane and Holup, 2005, Pidgeon et al., 2003).

The main information about new technologies, such as GM food, is broadcasted by the mass media. However, the mass media in Iran, such as newspapers, TV and radio, have not provided sufficient information on agricultural biotechnology and GM food. Limited media coverage may clarify the reason of inadequate information about biotechnology and GM food in Shiraz.

Some scientists believe that a positive and direct relationship exists between the growing knowledge of GM and the increasing support to GM use in the media (Traill et al., 2004, Bruhn, 2007). Meanwhile, evidence proposed that although the public's knowledge regarding biotechnology has increased, people are still less optimistic about GM foods (Chen and Li, 2007, Costa-Font and Mossialos, 2005, Hwang et al., 2005). According to our results, the respondents generally had positive attitudes toward the use of gene technology in food production, and this outcome is in contrast with the European consumers' negative attitudes toward GM foods (Chen and Li, 2007, Einsele, 2007, Moseley, 2002). Such result is consistent with the result of previous studies in Asia (Li et al., 2002).

In a further analysis among socio-demographic variables, educated women revealed more concern and had greater active intention to purchase GM foods, which is similar to the previous findings of Cardello (2003) and Lockie et al. (2005).

Our study indicated that participants considered GM technology on plants in a less negative way than on animals or human genetic material. This result is in line with findings of Grunert et al. (2003), Mucci et al. (2003) and Savadori et al. (2004). Therefore, the current study indicated that participants had more positive attitudes toward the use of gene technology for decorative plants and medical purposes than for food production purposes. A potential explanation of this result is that the public has no real experience of the advantages and risks of GM food. Thus, their optimistic attitude might not be based on clear and convincing reasons. People cannot directly gain knowledge about gene technology and its benefits and risks. Thus, they have to rely on information provided by experts or other sources, such as institutions involved in GM.

Results from the present study revealed that most people did not have detailed knowledge of the institutions involved in the use or regulation of gene technology. In addition, substantial scepticism is noted about them. Although government agencies play vital roles in GM technology, the respondents consider scientists as the main actors in this field. Hence, trust in government and industry might be an important factor affecting attitudes toward GM technologies.

Consumer advocacy groups claim that consumers have a right to know which products comprise a GM ingredient to make a rational purchasing decision, i.e., the consumer has the "right-to-know" (Marchant and Cardineau, 2013). In our present study, almost all respondents considered the labeling of GM foods. They believed that regulation would decrease their anxiety and promote confidence in new and unfamiliar developments to some extent. The similarities were found between the present study and other studies in US, Norway, Japan, Taiwan and Canada (Chern et al., 2002, Loureiro and Hine, 2004). Furthermore, labeling may provide further information regarding GM and its advantages, thereby raising awareness. As a consequence, consumer trust in the biotech industry will increase.

5. CONCLUSION

Genetic engineering of organisms comprise deliberate modification in the genetic material and transformation of certain genes to form new varieties. In the present study, knowledge and acceptance of genetically modified organisms among the people in a part of Iran were investigated through the questionnaire method. The main results of the study are as follows:

1. Around 60% of people were not sufficiently familiar with GMOs.
2. Almost 12% of people were strongly against GMO technology.
3. About 75% of participants responded that GMO in agriculture is vital and may play a role in the improvement of agricultural activities.

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