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## **Socio-Demographic Factors Influencing Public Perception of Genetically Modified Food in Saudi Arabia**

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### **ABSTRACT**

Consumers' awareness and attitude towards GM food vary among different nations and thought to be affected by socio-demographic attributes. The present study was conducted to assess the consumer knowledge about GM food and to determine the level of acceptance of GM products in Saudi Arabia. A consumer questionnaire was designed to generate a demographic profile for participating consumers and assess their perception. Data were collected in Al-Hassa, Eastern Province, based on 420 randomly selected participants. The results indicated that distribution of information about GM food is limited. This was reflected in the percentage of subjects that were familiar with GM food which was only 65%. Though, their knowledge in basic biology was relatively higher, nearly 90%. Differences in knowledge and acceptance about GM food of males and females were not significant but females were slightly more opposed. The study has shown that education, income and age play a crucial role in consumers' decisions regarding GM food. Overall, only about 46% of the population tested indicated acceptance of GM food; whereas, nearly 54% rejected consuming GM food. The vast majority of the studied subjects preferred GM food labeling. It can be concluded that the commercialization of GM foods may receive some resistance from over half of the Saudi consumers.

**Key words:** GM food, consumer awareness, knowledge, public perception

### **INTRODUCTION**

Biotechnology is widely recognized as one of the most innovative technologies developed in the 20th century with promising applications to enhance food security, economic growth, human health, environment and agricultural trade (Zhong *et al.*, 2002). Genetically modified crops can contribute significantly to global food security and poverty reduction, especially for developing countries (Qaim, 2009). Food security in the Middle East and North Africa is most threatened by price volatility due to reliance on imported food and limited agricultural production as a consequence of water shortage. Strategies to improve food security in these countries recommend investing in biotechnological research to produce genetically modified crops tolerant to drought and global climatic changes (El-Obeidy, 2009; Lampietti *et al.*, 2011).

Genetically modified food (GM food) promises to solve many of the world's hunger and malnutrition problems and preserve the environment by increasing yield and reducing reliance upon chemical pesticides and herbicides (Pandey *et al.*, 2010). Studies of insect-resistant and

herbicide-tolerant crops show that these technologies are beneficial to farmers and consumers as well as positive effects for the environment and human health (Qaim, 2009). In addition to contributing to increasing food supplies to meet the increasing demands of the rapidly growing world population, biotechnology would also reduce the operation cost for farmers and commodity prices for consumers due to increased production efficiency (Chen and Li, 2007).

Genetically modified food involves the deliberate modifications of the genetic material of plants or animals using innovative recombinant DNA technology (Insel *et al.*, 2011; Srivastava *et al.*, 2011). This raises concerns and risk perceptions among some consumers and policy makers (Pandey *et al.*, 2010). Like other new products, the success of GM products is subjected to consumer perception and acceptance. Unlike other products, however, novel foods are actually ingested by the consumer which may explain the heightened concerns and risk perceptions of consumers (Ronteltap *et al.*, 2007). Studies aimed at deciphering the factors affecting the consumers' attitudes toward GM food would have important implications on decision makers, biotechnology industry, food manufacturers and food retailers (Huang *et al.*, 2006).

The literature indicates that the perception of GM food varies among nations. Consumers in Japan (McCluskey *et al.*, 2003) and European countries (Lusk *et al.*, 2004; Noussair *et al.*, 2004) are less accepting to GM foods compared to consumers in the US (Ganiere *et al.*, 2006) and developing countries including China (Li *et al.*, 2002; Huang *et al.*, 2006), Columbia (Pachico and Wolf, 2002) and Taiwan (Chen and Li, 2007). Curtis *et al.* (2004) suggested that the generally positive perception of GM food in developing nations is thought to be motivated by the unavailability of adequate food quantity and quality. This was supported by Pachico and Wolf (2002) who found that willingness to try or purchase GM food was high among respondents expressing dissatisfaction with the available food supply and quality.

There has been limited research addressing consumer attitudes towards GM food in developing countries (Curtis *et al.*, 2004). Scarceness of relevant research is even more noticeable in the Arab nations, despite the fact that they are major importers of food. Exploration of the attitude of Arab consumer towards GM food would greatly benefit decision makers in setting up and implementing food policies and would help economist in developing successful marketing strategies.

The presence of GM food on the Arab market has been reported in Egypt (El-Sanhoty *et al.*, 2002) and Jordan (Al-Hmoud *et al.*, 2010). The unavailability of data from other Arab countries does not guarantee the absence of GM products at their markets since they rely heavily on imported food. Furthermore, studies related to the awareness and attitude of Arab consumers toward GM food are scant. A study by Al-Jebreen (2010) assessed student's perception in Riyadh University, Central Province of Saudi Arabia showed that only 23% of respondents were willing to buy GM products; whereas, 42% would try it. In that study, the participants sample was treated as socio-demographically uniformed. Because of the influence of socio-demographic factors on the perception of GM food (Costa-Font *et al.*, 2008), the current study was designed to establish a relationship between correspondents' perception of GM food and socio-demographic distribution of consumers living in Al-Hassa District, Eastern Province of Saudi Arabia.

## **MATERIALS AND METHODS**

A questionnaire was distributed to 420 students and staff at King Faisal University, Al-Hassa District at the Eastern Province of Saudi Arabia. Socio-demographic characteristics collected included participants' gender, marital status, place of residence, education, income and age. The questionnaire was comprised of six categories of questions measuring participants knowledge of basic biology, knowledge of GM food and biotechnology, awareness of GM food spread, believe in

Table 1: Categories and statements comprising the questionnaire to assess the awareness and attitude toward of GM foods

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Categories and questions

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**Knowledge in basic biology**

- The cell nucleus is the main center of the genetic material
- Cell division leads to growth
- Genetic material determines the character of living organism
- Genetic material consists of DNA
- Living organisms consists of cells

**Knowledge in GM food and biotechnology**

- Genetic engineering enable to transfer genes from animals to plants and vice versa
- Genetically modified foods include wheat, rice and maize
- Genetically modified organisms contain new genes
- Genetically modified foods is produced by biotechnology
- Genetic engineering is used to modify the characteristics of living organisms

**Knowledge in GM food spread**

- Development of genetically modified food is occurring in developing countries
- There are GM foods in the markets of developing countries
- There are GM foods in the markets of Saudi Arabia
- There are GM foods in the markets of developed countries
- Development of genetically modified food is occurring in developed countries

**Believe in GM foods safety**

- I would recommend others to consume GM food but not for me
- I would consume GM food because it is safe
- Genetically modified food is safe for human consumption
- Genetically modified feed is safe for animal feeding
- Genetically modified foods are tested to ensure safety before marketing

**Importance of labeling GM food**

- No need for a sign distinguishing GM foods on the label at all
- No need for a sign on the label but should be indicated in writing
- Regulations in Saudi Arabia currently require to label GM foods
- The sign of GM food should indicate a warning
- GM foods should be labeled to distinguish it from regular products

**Acceptance of GM food**

- GM foods is important to meet the population needs in KSA
  - Importation of all GM foods to the KSA should be permitted
  - Importation of GM foods of plant sources only to KSA should be permitted
  - Production of GM foods should be permitted in KSA
  - Production of GM foods in KSA is essential to be concurrent with scientific progress
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GM food safety, attitude about importance of labeling GM food and acceptance or rejection of GM food. The test statements (questions) pertaining to each category are shown in Table 1. The

participants were asked to response to each of the questions by selecting one of the following phrases: strongly agree, agree, neutral, disagree and strongly disagree.

Using descriptive statistics, the demographic data was analyzed in terms of frequency distributions, percentages and compared with questionnaire data using t-test. The respondents' knowledge and acceptance were measured by sum of choices phrases as a measure for each item. The questionnaire was coded and scored then, using descriptive statistics, the data was analyzed in terms of frequency distribution, percentage and t-test utilizing the SPSS computer program.

## RESULTS

A summary of respondents' characteristics in term of the socio-demographic data is presented in Table 2. The study targeted the younger generation as they are the potential consumers of GM products but older generations were also included to establish a relationship between age and preference. The majority of participates was less than 29-year old whereas 40% were older. About two third of sample were students and one third were employees. The sample consisted of about equal numbers of males and females. The majority of the respondents (66%) were single whilst 29% were married. Only 20% of the sample was living in suburb areas but the majority was living in urban areas. With regard to educational status 56% is enrolled in or completed the bachelor degree and 16% were holders of higher degrees. The largest proportion of participates (41%) earned less than 2000 Saudi Riyal (SR) per month, reflecting their student status, whereas 29% ranged from 2000-8000 SR and 30% earned higher amounts.

Table 2: A summary of socio-demographic characteristics of participants

Variable	Participants (%)
<b>Gender</b>	
Male	49
Female	51
<b>Marital status</b>	
Married	29
Single	66
<b>Place of residence</b>	
Urban	80
Suburb	20
<b>Education</b>	
High school	12
Diploma	16
Bachelor	56
Master	7
PhD	9
<b>Age</b>	
<29	63
29-39	14
40-50	13
>50	10
<b>Monthly income (SR)</b>	
<2000	41
2000-4000	13
4001-8000	16
8001-12000	14
>12000	16

Table 3: Percentage distribution of responses to questions related to awareness and attitude towards GM food expressing participants preference based on a 5-point scale

Indicator	Preference				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
<b>Awareness assessment</b>					
Knowledge in basic biology	67.6	24.4	6.1	1.2	0.6
Knowledge in GM food/biotechnology	30.8	32.1	28.0	6.4	2.6
Knowledge in GM food spread	30.1	36.5	27.7	4.4	1.3
<b>Attitude assessment</b>					
Believe in GM food safety	12.9	27.2	35.3	16.1	8.4
Importance of labeling GM food	48.2	22.6	14.2	8.3	6.6
Acceptance of GM food	19.1	27.2	36.5	11.4	5.4

Table 4: Analysis of mean scores of participants' responses reflecting their awareness and attitude towards GM foods

Indicator	Mean	SD	t- test	p-value
<b>Awareness assessment</b>				
Knowledge in basic biology	87.21	12.70	103.68	0.0001
Knowledge in GM food/biotechnology	68.06	12.22	83.95	0.0001
Knowledge in GM food spread	71.82	12.55	85.29	0.0001
<b>Attitude assessment</b>				
Believe in GM food safety	53.26	16.78	47.29	0.0001
Importance of labeling GM food	64.83	11.82	81.53	0.0001
Acceptance of GM food	58.69	19.30	32.89	0.0001

The majority of sample (67.6%) had good knowledge in basic biology (Table 3). The respondents scored 87.2% suggesting their good knowledge about biology (Table 4). Concerning their awareness of GM food and biotechnology only 63% were familiar with this technology (Table 3), but the average score of respondents' knowledge was only 68% reflecting their limited knowledge on this subject (Table 4). In relation to awareness of GM food spread, the majority of participants (67%) is familiar with GM food spread in world and believes that these products can be found in food goods in Saudi Arabia (Table 3). Respondents scored 72% reflecting their medium knowledge about GM food spread (Table 4).

About a quarter of the respondents did not believe that GM food is safe, whereas 40% were comfortable with the safety measures while about one third were not sure (Table 3). The overall assessment of the respondents believe in safety indicates limited trust in GM food safety as they only scored 53.3% (Table 4).

Most of studied sample (71%) preferred a term or a sign indicating genetic modification on the content labels of products. Although (15%), did not think labeling was necessary (Table 3). As reflected by their average score (65%), respondents were moderately insisting on the labeling of GM products (Table 4).

Approximately 15% of participants rejected GM food; however, 48% were in favor of consuming GM food (Table 3). The degree of acceptance was low as reflected by the low mean score 58.7% (Table 4).

The results indicated that although, there were no significant differences between males and females in relation to their knowledge and acceptance of GM food, but we found that males' awareness of biology, biotechnology and GM food was slightly higher than awareness of females (Fig. 1). There were no significant differences in awareness of GM food according to marital status

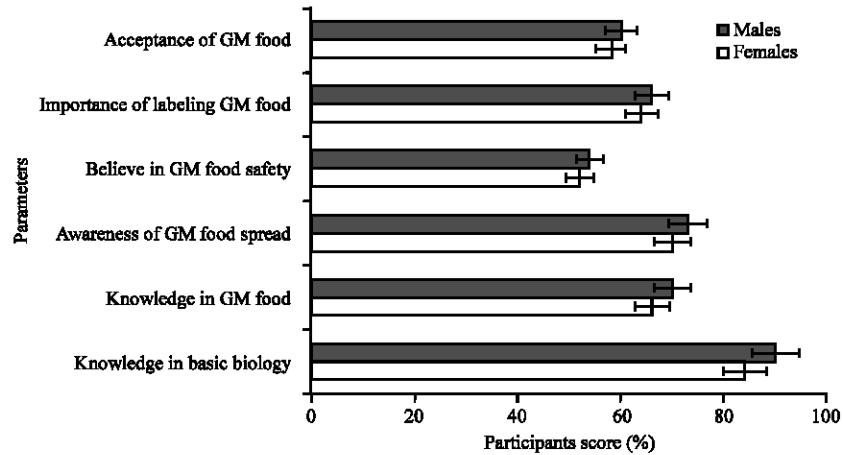


Fig. 1: Responses of participants based on gender reflecting awareness and attitude towards GM food expressing participants

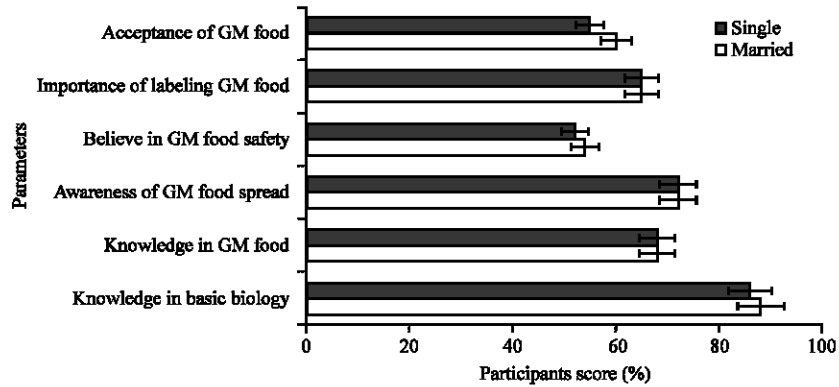


Fig. 2: Responses of participants based on marital status reflecting awareness and attitude towards GM food

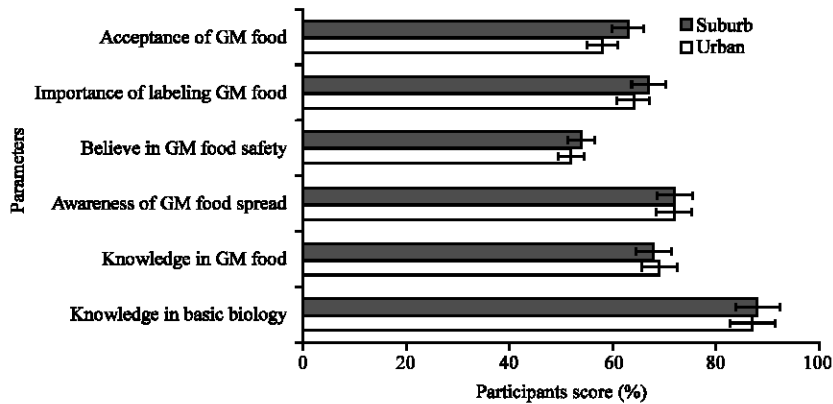


Fig. 3: Responses of participants based on place of living reflecting awareness and attitude towards GM food

(Fig. 2) and place of residence (Fig. 3), but it could be noticed that the married and suburb residents had more knowledge about biology, GM safety and were more acceptance of GM food than singles and residents of urban areas.

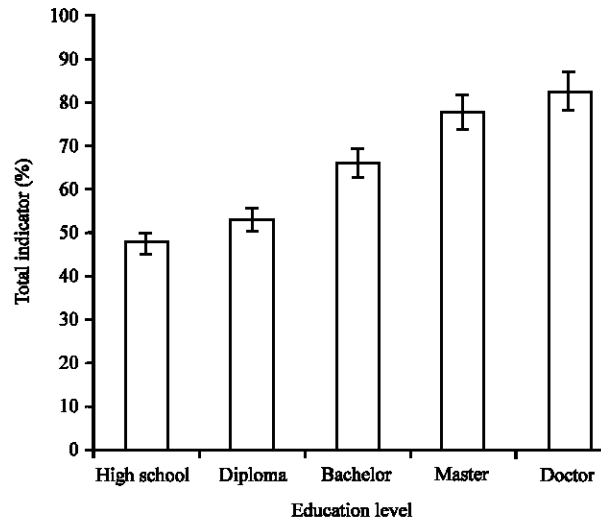


Fig. 4: The total indicator scores of participants responses based on education level reflecting awareness and attitude towards GM food

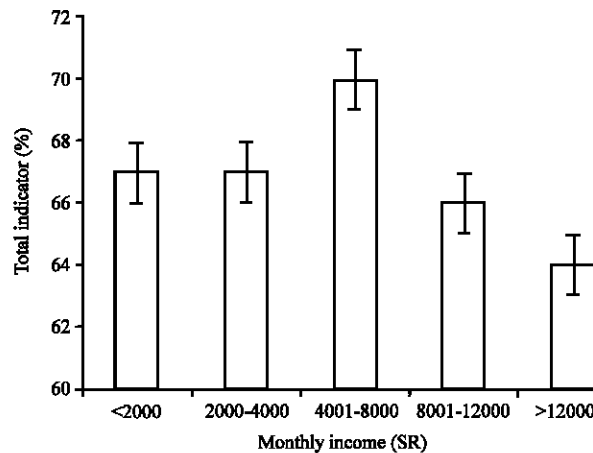


Fig. 5: The total indicator scores of participants responses based on income reflecting awareness and attitude towards GM food

However, there was a significant difference in participants' knowledge about GM food between different education levels. The value of total indicator of GM food knowledge was higher for master and doctorate than other education levels (Fig. 4). That means knowledge of GM food increases in accordance with education level.

Significant differences in the total indicator of knowledge and acceptance of GM food were observed. The highest values obtained were associate with the group of a monthly income between SR 4001 to 8000. Whereas, the group of a monthly income higher than SR 12000 comprised the least knowledge (Fig. 5).

Figure 6 shows the differences between age groups in the total indicator of awareness of GM food. The most aware group ranged between 40-50 years followed by 29-39 group, however, groups younger than 29 years and older than 50 years were less aware of GM food.



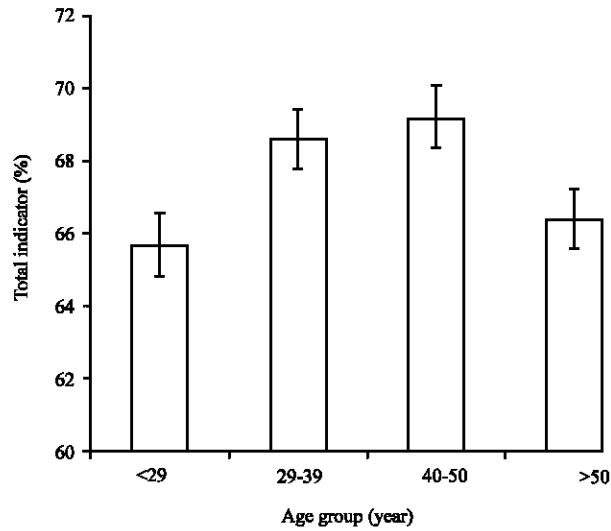


Fig. 6: The total indicator scores of participants responses based on age group reflecting awareness and attitude towards GM food

## DISCUSSION

Perception of food biotechnology can significantly influence consumers' attitude (Costa-Font *et al.*, 2008). The acceptance of food innovations are affected by perceived benefit, perceived risks and perceived naturalness of food products (Siegrist, 2008). Researchers have studied the relationship between socio-demographic factors and the perception of GM food; however, published reports appear contradicting concerning the effect of various factors on consumer acceptance. Some researchers contend that some of these factors had no influence the acceptance of GM food. For example, Huffman *et al.* (2003) showed that socio-demographic attributes including gender, education and income did not significantly alter consumers' willingness to purchase GM food. Similarly, others concluded that economic and demographic attributes were not important in defining consumers' attitudes towards GM food (Baker and Burnham, 2001; Hossain and Onyango, 2004). Conversely, Boccaletti and Moro (2000) found that willingness-to-pay generally depends on socio-demographic factors, such as income, education, place of residence and other demographic characteristics. This behavior variation demonstrates the obvious need for further research to disentangle the behavioral mechanisms underlying consumer acceptance to GM food (Costa-Font *et al.*, 2008). The seemingly opposing views may be attributed to country-dependent differences including limited geographical coverage and small sample sizes typical of GM food studies (Boccaletti and Moro, 2000). The current study has shown that some of the socio-demographic attributes of Saudi consumers including education level, income and age had significant impact on perception of GM food; whereas, other attributes including gender, marital status and place of living had negligible effects.

We observed a general tendency of Saudi females to be more objectionable to GM food as compared to males; however, the difference was not statistically significant. In agreement to our finding, the gender variable was found to have no significant impact on consumers' attitude toward GM food (Frewer *et al.*, 1998; Vilei and McCarthy, 2001; Huffman *et al.*, 2003). Conversely, others have detected differences in attitude according to gender; mainly, females had more negative attitude toward GM food (Moerbeek and Casimir, 2005; Buah, 2011; James and Buton, 2003). In a related study, Burton *et al.* (2001) concluded that female shoppers were willing to pay more

premiums to avoid GM products than males suggesting less acceptability of GM food among women. Moreover, studies have shown that women perceive lower benefits and are less likely to accept gene technology than men (Siegrist *et al.*, 2000; Costa-Font *et al.*, 2008).

Some studies revealed that middle age, less affluent and those who live in suburban areas are more concerned with GM food (Costa-Font *et al.*, 2008). Our results revealed that income and age had significant impact on perception of GM food among Saudi consumers but the place of residence had no significant effect. We found that middle class income consumers are more accepting to GM food than other income groups. In accord to our finding, Boccaletti and Moro (2000) indicated that income affects consumer behavior and perception of benefits from GM products. In contrast, some studies detected no influence of income on consumers' attitude towards GM food (Baker and Burnham, 2001).

Consistent with our study, James and Buton (2003) found that age affected preference with older people generally more accepting of biotechnology. In our study; however, people above 50-year old were more concerned about biotechnology than 40 to 50 year-old age group. This may be explained by the limited information among the older generation of Saudi consumers. Genetic engineering is a relatively new science and is unfamiliar to many people particularly older generations (Chen and Li, 2007).

Consumers with higher education were more receptive to GM benefits and perceived less risks (Traill *et al.*, 2004). Moreover, Lusk *et al.* (2004) indicated that information about potential benefits of biotechnology has a significant impact on consumer acceptance of GM food. The current study has revealed a direct relationship between the education level and acceptance of GM food among Saudi consumers. Similarly, other studies reported a significant influence of education and on consumer acceptance of GM food technology (Onyango, 2004; Sjoberg, 2008).

Knowledge about biotechnology in general and GM food in particular plays some role in determining the consumer's perceptions of risks and benefits and eventually in the consumer's attitude toward GM foods (McCluskey *et al.*, 2003). However, most individuals lack sufficient knowledge on the risks and benefits of new and unfamiliar technologies such as GM products (Costa-Font and Mossialos, 2007). Present study has shown that the knowledge of GM food technology among Saudi consumers averaged (68%) lower than the scores of Europeans (50%), but comparable to the Americans (67%); whereas, in relation to knowledge in biology, the Saudis scored (87%), higher than Europeans (84%) but less than the Americans (94%) (Huang *et al.*, 2006). This indicates that although knowledge in general biology is above average, knowledge about biotechnology was universally limited. Costa-Font and Mossialos (2007) reported that most lay individuals lack sufficient knowledge on the risks and benefits of biotechnology. Costa-Font *et al.* (2008) recommend the dissemination of GM knowledge with high levels of objectivity to consumers in order to allow them undertake informed and ideally reasoned choices. Siegrist (2008) indicated that it is very important for the public to be informed and educated about possible benefits of novel food technologies in order to increase consumer acceptance. He explained that the public may have difficulties in assessing risks and benefits associated with novel food technologies and most likely to reject these new products without sufficient knowledge. Both public and private sectors are responsible for increasing public awareness of biotechnology. Moreover, governments should take the responsibility of monitoring the proper functioning of the safety mechanism in producing GM foods to gain trust from the consuming public (Chen and Li, 2007). Implementing these recommendations may alter the attitude of the Saudi consumers in favor of biotechnology.

Labeling is a mechanism for communication of information to enable consumers to undertake an informed choice consistent with their preferences. It provides additional information about GM

technology and its benefits thus raising awareness and improving transparency and consequently increases consumer trust in the biotechnology (Costa-Font *et al.*, 2008). However, product labels indicating genetic modification were found to decrease consumers' willingness purchase GM products (Huffman *et al.*, 2003). Like other countries including Australia, Japan, New Zealand and the European countries, Saudi Arabia authorities require mandatory labeling of GM products; whereas, other nations like the US and Canada have a voluntary labeling system (Gruere and Rao, 2007). Consumers labeling preference appears to related to consumer trust in government policies, regulatory institutions, scientists performing genetic engineering, information sources and industry (Hunt and Frewer, 2001; Ehakanem *et al.*, 2004; Frewer *et al.*, 2004; Loureiro and Hine, 2004; Chen and Li, 2007; Siegrist, 2008). In our study, the majority of the Saudi participants (71%) preferred labeling of GM products. This high percentage may be indicative of low trust in biotechnology due to limited awareness of the benefits. Likewise, in many countries, consumers supported labeling of GM food (Chern *et al.*, 2002).

The literature indicates that country differences exist in relation to GM food preferences. For examples, 65% of the surveyed US population accepted GM food (Ganiere *et al.*, 2006), 42% of French consumers were willing to purchase GM products (Noussair *et al.*, 2004), 66% of the survey Colombians respondents were willing to try genetically modified foods (Pachico and Wolf, 2002) and 50% of Ghanaians respondents were accepting of FM food (Quaye *et al.*, 2009; Buah, 2011). In a study assessing attitude of students in Riyadh University, Central Saudi Arabia, Al-Jebreen (2010) found that 42% was willing to consume GM food. Comparably, the current study showed that 46% of the surveyed sample accepting GM food in Eastern Saudi Arabia. The slightly different results between the two Saudi locations may be attributed to demographic differences between the two surveyed populations. The location effect on consumer attitude concerning GM feed was observed by Komirenko *et al.* (2010) in Canada where respondents' residing in Quebec and British Columbia tend to be more concerned than those in other locations.

Based on both Saudi studies, it can be concluded that over half of the surveyed populations reject GM food. Subsequently, commercialization of GM food may receive considerable objection among consumers in Saudi Arabia. The public seems to lack sufficient knowledge to make an educated decision. Knowledge dissemination about GM food may be an approach to alter public opinion in favor of GM food. Although, these studies provide an insight to the perception of Saudi consumers to GM food, a country-wide survey would provide more precise assessment concerning the preference of the Saudi public. This is particularly necessary because of the evidence presented here, as well as shown by other studies in different countries which suggest the existence of an interaction between socio-demographic characteristics and perception of GM food among consumers.

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