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## مدى الوعي لإنتشار الأغذية المعدلة وراثياً في السعودية العربية: دراسة حالة في مدينة مكة المكرمة

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### المخلص:

في هذا البحث تمت دراسة مدى سيطرة الأغذية المعدلة وراثياً على أسواق الاستهلاك السعودية. صمم استبيان تم من خلاله طرح جملة من الأسئلة الخاصة بهذا الموضوع ووزع على مشاركين من مدينة مكة المكرمة بالسعودية. البيانات التي تم الحصول عليها استخدمت لإجراء العديد من التحليلات الإحصائية. أشارت نتائج الدراسة إلى أن معظم المشاركين في الاستبيان ليس لديهم أي معرفة عن الأغذية المعدلة وراثياً ولا يعلمون إذا كانوا يستهلكونها أم لا وبالتالي هناك حاجة لبيان مثل هذه المعلومات على أغلفة الأغذية ومراقبة وجود تلك الاغذية في الأسواق بشكل صحيح. إضافة إلى ذلك، فإن المشاركين في الاستبيان أبدوا عدم رغبتهم في استهلاك هذه الأنواع من الأغذية المعدلة وراثياً وطلبوا بأن تكون هناك معلومات على أغلفة الأغذية (ملصق) تفيد بأن المنتج معدل وراثياً وكما طلبوا أيضاً بأن يكون هناك رقابة صحيحة على هذه الانواع من الأغذية.



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ORIGINAL ARTICLE

# Awareness of GM food proliferation in Saudi Arabia: A case study of Makkah city

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## KEYWORDS

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**Abstract** This paper studies GM foods domination of Saudi consumer markets. Questionnaires were developed and distributed among participants in Makkah city. The data were used to conduct several regressions. The results indicate that the majority of participants have no knowledge of GM foods and are oblivious to whether they consume it or not and as such demanded labelling and proper monitoring its existence in the market. Furthermore, participants knowledge created more disagreement with consumptions of GM foods and they required labelling and proper monitoring.

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## 1. Introduction

According to the European Union (EU), genetically modified (GM) foods are foods containing or derived from organisms in which the genetic material (DNA) has been altered in a manner that does not occur naturally. Since the mid-1990s when GM foods were first introduced up to present day, GM foods have continuously generated unresolved controversies such as arguments on precautionary principle (PP) between governments, producers, distributors and consumers (Chang and Huang, 2010).

However, reflection on consumer awareness of GM foods in markets around the world is extremely important to individ-

uals and organizations including producers and politicians. The more famous of GM crops currently cultivated commercially on the consumers markets are soybean, maize, cotton, canola, potatoes, and tomatoes which include new genes that provide herbicide tolerance or insect resistance (König et al., 2004). Other crops developed were those that have improved nutritional characteristics (König et al., 2004). Widely celebrated was the future promise that genomic sciences offer for the discovery of new genes conferring desirable characteristics to crops with fundamental metabolic functions of nutritional enhancement and resistance to abiotic stresses (König et al., 2004).

Due to scepticism about the safety of GM food products, the United States National Research Council (USNRC) decreed that all ingredients in the GM foods should be traceable and the genetic codes are properly selected. This has made studying the impact of GM foods on human health by scientists possible (Handler, 2004). Some scientists viewed GM foods as being similar to conventional foods, and tried to convince consumers that similar to conventional food products, there were no risks associated with GM foods (McHughen, 2007).

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However, consumers around the world suspected risks regarding such food technologies (Taiwan Institute of Economic Research, 2009) and regarded it as unnatural and risky (Magnusson and Hursti, 2002). A meta-analysis of 25 studies on GM foods showed that consumers in different countries on average placed 42–23% higher value for non-GM food compared to GM food (Lusk et al., 2005). Even across the US and EU countries a large proportion of the population are afraid of consuming GM foods due to uncertain health hazards (Teisl et al., 2002; TNS Opinion and Social, 2010). Similar anxieties were expressed in researches across the globe such as by Zhong et al. (2002), Ho and Vermeer (2004) in China and Pattron (2005) in Trinidad to name a few.

Interestingly, the majority of the participants in these studies were unaware or have no knowledge of what GM foods contain. Such consumer anxieties towards GM foods may be due to limited information about the gene-technology involved in the process of GM food production (Fernandez-Cornejo and Caswell, 2006; Pattron, 2005), the perceived safety of the technology or the quality of the food (Lidskog, 1996) as well as ethical and religious concerns. Consumers appear to be highly sensitive to statements from scientists and governments regarding GM food products (Bredahl, 1999).

Research by Teisl et al. (2002) and Raab and Grobe (2003) on US consumer awareness and acceptance of GM foods revealed that some participants were unaware of GM foods. Most of the participants requested that GM foods are labelled. To resolve the anxieties of the general public regarding GM foods, Japan, EU, and other countries have established a labelling system for GM foods in order to inform the public of the use of GM technologies and promote the right of consumers to choose what they consume. The laws and regulations affecting GM foods labelling policy vary across different countries (Premanandh, 2010) where some countries such as US, Canada, Japan, Philippines, Thailand and Taiwan do not require labelling of consumer foods with up to 5% GM material content. However, for countries such as Brazil, Australia, New Zealand, and Saudi Arabia, labelling is mandatory for GM content of more than 1% (Gruere and Rao, 2007).

Contrary to the results obtained in the researches from China and Trinidad, the result reported by Kimenju et al. (2004) on awareness of GM foods in Kenya revealed that almost half of the respondents were aware of GM foods and plants. Likewise, reports of TNS Opinion and Social (2010) and Kikulwe et al. (2011a, 2011b) showed greater awareness of GM foods among consumer in EU and Uganda respectively. Unlike awareness in the EU countries, there were discrepancies among the urban and rural Ugandan consumers on the acceptance of GM banana. The rural consumers were in favour of GM banana while the urban consumers were against it.

However, in the middle-east specifically in Saudi Arabia the media plays an important role in consumers' knowledge about GM foods whether the media has reported intensively or not on the risks and benefits associated to GM food is questionable and needs further research. Therefore, the current research aims to study the awareness of Saudis' in relation to GM foods and its positive and negative effects measured through variables such consumption, labelling, government policy, Islamic fatwa (Islamic legal rulings) and Saudi media. The samples were selected from Makkah city.

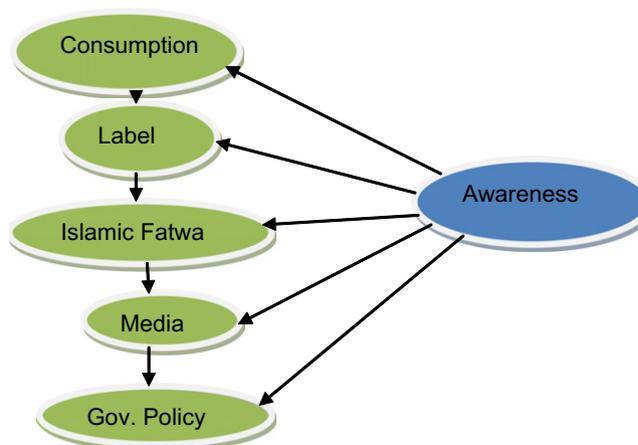


Figure 1 The conceptual model.

## 2. Research model

The positive and negative effects of GM foods on human live have been widely studied during the recent few decades. This has consequently contributed in the establishment of a number of awareness, social-economic, environmental, behavioural, and perception models as well as foods' regulatory framework (Nuffield Council on Biotech, 1999; Bocalletti and Moro, 2000; Weiswasser et al., 2001; Lake, 2002; Cohen et al., 2003; Brookes and Barfoot, 2006). Others, such as Winter and Gallegos (2006), Domingo (2007), Wachenheim et al. (2008) and TNS Opinion and Social (2010) considered the time lag of awareness and perception in one domain compared to another.

However, in the current study we use the TNS Opinion & Social model and the questionnaire designed accordingly as well as the model.

According to TNS Opinion and Social (2010) GM foods awareness among Europeans is quite high but varies from one region to another. Generally, most of the respondents across European countries have negative feelings and health concerns about GM foods thus they required strict regulations and labelling.

This model is shown in Fig. 1. Below goes inline with the TNS Opinion & Social model which layed out circumstances to be considered on GM foods based on public or consumers' opinion. These were assumed inline with the objective and structure of awareness of GM foods in Saudi Arabian consumer markets. Although there are no studies that tested this model before, but the researchers have designed this research model according to the norms of Arabs specifically, the Saudis. Accordingly, the following hypotheses are posited and analysed by Chi-square:

- H1: There is full awareness of GM foods in the Saudi Arabian consumer markets among the citizens.
- H2: Islamic fatwa serve as machinery in the awareness programme.
- H3: The government policy helps in creation of awareness of GM foods in Saudi Arabia.
- H4: The Saudi media did influence the circulation of information.

### 3. Methodology

In this research, the data were collected through questionnaire developed purposely to measure the awareness, which was randomly distributed among Saudis specifically the Makkah city residents. It is worth noting that Makkah is a centre of Islamic abode with residents from all parts of the world with different languages, cultures, and Islamic religious sects. However, the researchers ensure that the sample studied reflects original Saudis that is, those with nationality without ethnic discrimination. The targeted sample in this research was 100 respondents calculated based on the following formula:

$$SS = \frac{(Z^2) \times (p) \times (1 - p)}{C^2}$$

SS = Sample size

Z = Z-value

P = Percentage of population.

C = Confidence interval

The questionnaire contained only one part. This was designed to collect information about the early stage of respondents' knowledge and awareness of availability of GM foods in Saudi Arabia this were measured using four points likerts scale (1 = strongly agree and 4 = strongly disagree).

The questionnaire was made in English language translated into Arabic language and was distributed as such. This was because Arabic is the only medium of communication in Saudi Arabia. The data analyses were subsequently done using central tendency, correlation and regression analysis.

The only demographic criteria set was the participants were Muslims living in Makkah city. The researchers did not recruit uneducated people as samples as it was assumed that they might not know or understand what genetic engineering or foods mean.

### 4. Material

The researchers developed the questionnaire after consultation to previous literature on the subject matter. The questionnaire used a 1 "strongly agree", 2 "agree", 3 "disagree" and 4 "strongly disagree" response format. Neutral option was omitted from the questionnaire and is a deviation from previous research questionnaires. The researchers' initial hypothesis is that the majority of Saudi is not aware of the present GM foods and products in the consumer markets across Saudi Arabia. Thus, questionnaire consisted of 6 items designed to measure various correlations and awareness of the public about GM foods. These items were modelled according to previous literatures across the globe on lack of understanding and awareness of positive and negative consequences of GM foods and products on human beings, environment and ecological problems at both short and long runs (Zhong et al., 2002; Teisl et al., 2002; Raab and Grobe, 2003; Ho and Vermeer, 2004; Kimenju et al., 2004; Pattron, 2005; TNS Opinion and Social, 2010).

### 5. Procedures

The questionnaire was developed by the researchers after long consultation to existing literature on all sides of awareness and perspectives. This questionnaire was edited technically and linguistically, thereafter 150 questionnaires were printed and a

convenient sample of participants was recruited through simple random sampling method by visitation to places in Makkah. Following their consent, the researchers then handed each participant a copy of the questionnaire without keen supervision as the participants are regarded adults regardless of race, ethnic, and sectarian discriminations. Total 100 responses were received.

### 6. Statistics analysis

In this research series of statistical analysis such as reliability test of the model, central tendency, Pearson correlation among individual variables and analysis of variance (ANOVA) with Friedman's Chi-square Test were evaluated. The results were analysed by using SPSS®.

### 7. Participants

Participants ( $N = 100$ ) were randomly selected from Makkah city and are averagely educated or literate, regardless of their specializations. Respondents' Age ranged from 20 to 60 with a mean age of 35.5 (SD = 16.26). Half of the pool identified themselves as male and 50% females. More than half of the sample pool was affiliated to either government or private institutions and 25% were university students.

Although, the demographic data are vital to this research, however, the researchers ignore this information fearing the conservative nature of the Saudis in response to private matters. As expected the demographic data have great significance in this study. However, the researchers did not recruit non-educated as samples as it was assumed that they are not qualified to answer the questions.

### 8. Results and preliminary analysis

The model reliability test using Cronbach's Alpha (coefficient  $\alpha = .52$ ) showed on average the model is explanatory of the dependent variable which is awareness of proliferation of GM food in Saudi Arabia specifically in Makkah.

Table 1 showed that 46.7% of the participants disagreed and 26.7% strongly disagreed that they consume GM foods daily, indicating that majority of the respondent were not aware of GM foods in the market. However, 3.3% agreed and 23.3% strongly agreed that they were aware of consuming GM foods daily. Similarly, from the sample pool 53.3% strongly disagreed and 20% disagreed that there is labelling of GM foods in Saudi Arabia as required by the government. Nevertheless, 13.3% agreed and 13.3% strongly agreed that there were labelling of GM foods in Saudi. It is unclear whether they comprehend the question or not. This was followed by 50% disagreed and 16.7% strongly disagreed that Islamic fatwa positively influenced and created awareness of GM foods in the country, yet 10% agreed and 23.3% strongly agreed that Islamic fatwa created awareness of GM foods in the Saudi Arabian consumer markets. Regarding Saudi Arabian media contributions to the creation of awareness 53.3% disagreed and 16.7% strongly disagreed that the media created awareness about GM foods in the consumer markets. Nonetheless, 10% agreed and 20% strongly agreed that the media created awareness of GM foods in the markets. Relating to the government policy on

**Table 1** The Descriptive statistics of respondents on awareness of GM foods in Saudi Arabia.

| Variables   | Agree (%) | Strongly agree (%) | Disagree (%) | Strongly disagree (%) | Mean | SD   |
|---|-----------|--------------------|--------------|-----------------------|------|------|
| I did consume GM foods daily  | 3.3       | 23.3               | 46.7         | 26.7                  | 2.97 | .81  |
| GM foods are labelled in the Markets  | 13.3      | 13.3               | 20.0         | 53.3                  | 3.13 | 1.11 |
| Islam did not oppose consumptions of GM foods                                     | 10.0      | 23.3               | 50.0         | 16.7                  | 2.73 | .87  |
| Is there any oral or published news on the side effect of GM food in Saudi Arabia | 10.0      | 20.0               | 53.3         | 16.7                  | 2.77 | .86  |
| The Government has good systems of checking GM foods reliability                  | 16.7      | 53.3               | 16.7         | 13.3                  | 2.27 | .91  |

**Table 2** The correlation between the awareness variables.

| Correlations      |                     | Consumption | Label  | Islamic Fatwa | Media | Government policy | Awareness |
|-------------------|---------------------|-------------|--------|---------------|-------|-------------------|-----------|
| Consumption       | Pearson correlation | 1           | .121   | -.013         | .336  | .013              | .345      |
|                   | Sig. (2-tailed)     |             | .525   | .945          | .069  | .948              | .062      |
| Label             | Pearson correlation | .121        | 1      | .469**        | -.039 | .376*             | .072      |
|                   | Sig. (2-tailed)     | .525        |        | .009          | .839  | .041              | .705      |
| Islamic Fatwa     | Pearson Correlation | -.013       | .469** | 1             | -.133 | .400*             | .150      |
|                   | Sig. (2-tailed)     | .945        | .009   |               | .485  | .029              | .428      |
| Media             | Pearson correlation | .336        | -.039  | -.133         | 1     | .171              | .418*     |
|                   | Sig. (2-tailed)     | .069        | .839   | .485          |       | .366              | .022      |
| Government policy | Pearson correlation | .013        | .376*  | .400*         | .171  | 1                 | .335      |
|                   | Sig. (2-tailed)     | .948        | .041   | .029          | .366  |                   | .070      |
| Awareness         | Pearson correlation | .345        | .072   | .150          | .418* | .335              | 1         |
|                   | Sig. (2-tailed)     | .062        | .705   | .428          | .022  | .070              |           |

\*\* Correlation is significant at the 0.01 level (2-tailed).  
 \* Correlation is significant at the 0.05 level (2-tailed). N = 100.

GM foods 53.3% strongly agreed and 16.7% agreed that there are adequate government policies on GM foods production, imports as well as export. However, 16.7% disagreed and 13.3% strongly disagreed there are regulations on GM foods entry and exist in Saudi Arabia.

The analysis focuses on the six items of the questionnaire. Table one above shows all preferred answers for the questions given. Specifically when asked, do you consume GM foods daily, the results show that the mean is 2.97 (Std. deviation = .81) which means on average respondents strongly disagree that GM foods are major components of their daily foods consumptions. When asked whether there were labelling of GM foods in the markets, the results show that the mean is 3.13 (Std. deviation = 1.11) which means on average the respondents strongly disagreed that there is labelling of GM foods in the markets. In other words, probably there was no labelling of GM foods in Saudi Arabia. Similarly, when asked about influence of Islamic fatwa in the creation of awareness, the results show that the mean is 2.73 (Std. deviation = .87) which means on average the respondents strongly disagreed that Islamic fatwa created awareness about availability of GM foods in the consumer markets. Concomitantly, when asked about the Saudi Arabian media in creation of awareness of GM foods ingredients in the consumer markets, the results show that the mean is 2.77 (Std. deviation = .86) which means on average the respondents strongly disagreed that Saudi Arabian

media created awareness about available GM foods in consumer market in Saudi. Likewise, when asked about standard government policy on GM foods, the results show that the mean is 2.27 (Std. deviation = .91) which means on average the respondents strongly agreed that there are adequate government policies in addressing the entry to and exist from of GM foods in Saudi Arabia.

Table 2 showed significant correlations between variables were found using Pearson correlation two tail tests. The correlations showed that no similar relationships exist between the variables under observation in this study. Furthermore, the initial analysis does not indicate which variables are better at predicting relationship between awareness on proliferation of GM foods in Saudi at any stage. Furthermore, series and simultaneous regression analyses were conducted to examine the relationship between awareness and proliferation of GM foods in Makkah.

The variables mentioned above were used to measure the level of awareness of proliferation of GM foods in Saudi. Several models were developed to measure the relationship among these variables with each of the four scales being used as separate dependent variables. Three models accounted for a significant amount of variance among variables on respondents. Independent variables were measured however found to be insignificant except media which is significant at 0.022  $p < 0.05$  (Table 2).

**Table 3** The analysis of variance of respondents on awareness of GM foods in Saudi Arabia.

|                |               | ANOVA with Friedman's test |     |             |                       |      |
|----------------|---------------|----------------------------|-----|-------------|-----------------------|------|
|                |               | Sum of squares             | Df  | Mean square | Friedman's Chi-square | Sig  |
| Between people |               | 145.158                    | 99  | 1.466       |                       |      |
|                | Between items | 11.388 <sup>a</sup>        | 4   | 2.847       | 14.770                | .005 |
| Within people  | Residual      | 297.012                    | 396 | .750        |                       |      |
|                | Total         | 308.400                    | 400 | .771        |                       |      |
| Total          |               | 453.558                    | 499 | .909        |                       |      |

Grand mean = 2.8780

<sup>a</sup> Kendall's coefficient of concordance  $W = .025$ .

The analysis of variance (ANOVA) table showed the grand mean was 2.88 and the general model was significant at .005. This showed that the model was sufficient and serves as an indicator of the level of awareness of proliferation of GM foods in Saudi. The 2.88 grand mean perhaps was as a result of almost uniform deviations of the variables from the mean. The degree of freedom (df) is 99 with  $\alpha = .05$  and  $p$ -value = .005 i.e.  $p$ -value  $\leq \alpha$  we reject the H0(initial hypothesis) and accept H1(alternative hypothesis) indicating that there is no or little awareness of GM foods in the Saudi Arabian consumer markets Table 3.

## 9. Conclusions and policy implications

The statistical results of this study vindicated some useful clues to conclusion about awareness of Saudis of proliferation of GM foods in consumer markets across cities of Saudi Arabia. Lack of awareness can be predicted using consumption, labelling, Islamic fatwa, media and government policy as independent variables. Perhaps, the most interesting is discovering that when genetically modified foods or products were holistically evaluated numerous conclusions can be drawn from the findings. Particularly, variables used to measure awareness of proliferation of GM foods were not significantly correlated with awareness such as in the research of Teisl et al. (2002). This is consistent with the results of awareness proliferation data in Saudi. On the other hand, confidence in the production and importations of foods into Saudi is effectively predicted by media. Thus, other variables did not significantly serve as eyes opener to the populace.

Furthermore, the variables intercorrelation findings reveal only variables such as label, government policy, and Islamic fatwa were correlated. This may indicate that if these variables that is, label, government policy and Islamic fatwa were effectively implored the information asymmetrical situation would have been minimized or eliminated. This assertion is supported by the research of Abdel-Mawgood et al. (2010) which revealed that out of two hundred and two samples of foods sampled and tested across Saudi markets they found that twenty products contained genetically modified substances directly or indirectly. In addition, the majority of participant demonstrated in one way or the other uninformed characteristics towards GM foods. Although, previous research such as Gruere and Rao (2007) revealed that Saudi law imposes labelling of any consumer product that contained 1% of GM substances. On the contrary, the present research established lack of awareness and non-availability of labelling of either GM or traditional foods. Perhaps, this is one of lackadaisical attitude

of third world nations particularly, Saudi government in implementation or enforcement of rule of laws across Saudi.

However, generally, the model seems to have shielded some important lights to the theme of this research. As evident from the ANOVA table the  $F$ -test showed that the researchers' initial hypothesis that there is lack of awareness of GM food consumptions among Saudi populace. Plausible, the Saudi populace demonstrated a negative perception against consumption of GM foods. The result indicated that even if GM foods were labelled they would not consume it on the ground of possible future health hazards. This has consisted to findings by Zhong et al. (2002), Teisl et al. (2002), Ho and Vermeer (2004) and Patron (2005) in other countries across the globe. Nevertheless, we observed contradictory result when the respondent gave high score to the government policy on GM foods. Perhaps, they meant there are laws prohibiting entering and selling of GM foods but there is no enforcement.

This research may not be a good ground for policy making as the data serve as pioneering data for this type of research. Importantly, the non-correlation between awareness, consumption, label, Islamic fatwa, and government policy may be as a result of small sample used in this research.

The awareness and perceptions of Saudis on productions and availability of GM foods at Saudi Arabia consumer markets have been tested in this research. The results showed the consumers have no knowledge or were not aware of existence of GM foods and have been consuming GM foods without their knowledge. Similarly, the authorities might not aware about entering and availability of GM substances in the markets and perhaps they knew and pretended not to have knowledge about its existence. The researchers recommend future research on a large scale with substantial respondents selected across Saudi Arabia. The large scale research should involve in-depth using mantel model such as Otto-Banaszak et al. (2011) approach. This would allow exploration of differences in the perception of GM foods among representatives of different stakeholder groups in Saudi Arabia. Considering the significant amount of variance among variables on respondents found in this study the mantel model approach would help to deepen our understanding about consumers' attitudes.

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