

GENETICALLY MODIFIED FOODS PERCEPTION OF CONSUMERS IN THE GLOBALIZING WORLD: A CASE STUDY FROM TURKEY

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Abstract

The study was conducted by estimating logistic regression analysis to understand the factors affecting consumers' perception and purchasing intention of genetically modified (GM) foods in Isparta, Turkey. The information was gathered through face-to-face interviews with 264 consumers in the city of Isparta, Turkey. It was determined that being younger and having a higher education level positively affect the purchase intention of GM foods. Also, trust in health and safety is a sufficient factor to increase purchase intention even if there is distrust of the government. However, perceived risks do not significantly affect consumers' intentions to buy, and thus, benefit perception is more effective than risk perception. Consequently, the consumers' attitudes determine their purchase intentions for GM foods. This research has practical implications for food industry policymakers and producers, who might devise methods to enhance consumer expenditure on GM foods based on their excellent taste and favorable contribution to a healthy diet. This will be valuable for doing consumer-oriented evaluations and product development to understand better and predict consumer reactions and behavior.

Key words: consumer behavior, perception, purchase intention, genetically modified (GM) food, logistic regression, Turkey

INTRODUCTION

In many parts of the world, consumers are usually interested in safe, healthy, and unmodified foods [12]. Politicians, on the other hand, pursue agricultural policies using modern agricultural technology such as genetically modified organisms (GMOs), which are intended to advance product quality, yield, and disease resistance. Consumers generally tend to reject genetically modified (GM) foods, although there is a widespread agreement in scientific studies that GM foods are not more dangerous than conventional substitutes. This doubt is associated with mostly undiscovered long-term environmental and health outcomes [11]. The World Health Organization (WHO) defines GM foods as “foods derived from organisms whose genetic material (DNA) has been modified in a way that does not occur naturally” [46]. The genetics of living organisms has been modified using modern biotechnological methods since the 1970s [22]. Since the day it first appeared, the public

and professionals have heavily discussed the advantages and disadvantages of GM foods. Its possible benefits include reducing agricultural costs, poverty, and starvation and increasing both farm productivity and the quality of food [51, 39]. In the health sector, it can be ensured that drugs and vaccines can be produced more cheaply and safely [18]. Also, water pollution can be prevented by reducing excessive fertilizer use by GM technology [47]. On the other hand, the potential risks are various allergic diseases, birth anomalies, and decreases in plant species [47, 35].

According to International Service for the Acquisition of Agri-biotech Applications ISAAA data [21], GM food production, which started at 1.7 million hectares in 1996, increased by 112-fold, and reached a total area of 190.4 million hectares worldwide in 2019. Biotechnology benefited approximately 1.95 billion people (26% of the world's population) and 17 million GM food farmers and their families. In 2019, the number of countries cultivating GM foods increased to 29, and the top countries with the broadest

cultivated area are the USA (71.5 Mha), Brazil (52.8 Mha), Argentina (24 Mha), Canada (12.5 Mha), and India (11.9 Mha), respectively. Soybean is the foremost biotech crop with 91.9 Mha (48% of the world's GM crops) and is followed by maize (60.9 Mha), cotton (25.7 Mha), and canola (10.1 Mha). However, by diversifying these crops, it has become possible to offer more options to producers and consumers. Some of them are alfalfa (1.3 Mha), sugar beets (473,000 Ha), sugarcane (20,000 Ha), papaya (12,000 Ha), safflower (3,500 Ha), and potatoes (2,265 Ha), etc. [21]. Furthermore, between 1996 and 2016, an income of \$186.1 billion was obtained from the production of GMO products worldwide. The USA (\$80.3 billion), Argentina (\$23.7 billion), India (\$21.1 billion), Brazil (\$19.8 billion), and China (\$19.6 billion) received the lion's share of this income (Brookes & Barfoot, 2018, as quoted in [47]).

The regulations in Turkey regarding GM foods are quite firm. The Cartagena Protocol on Biosafety, which was approved by Turkey in 2003, has greatly influenced Turkey's national legislation.

The Cartagena Protocol on Biosafety is an international treaty (adopted on January 29th, 2000 and ratified by 180 countries) that deals with the possible adverse impacts of living modified organisms by considering the safe transportation, use and risks to human health [44].

According to Biosafety Law No. 5977, importing, exporting, and placing on the market require permission based on risk assessment using scientific principles. Also, these products must be labeled [30]. In 2018, the Biosafety Board allowed the import of GM products solely for animal feed, and the production of GM plants and animals was prohibited [41]. Although GM foods are not presently produced, since various products are obtained from GM-fed animals, these products reach consumers obliquely. For this reason, GM food producers and decision-makers need to understand better how they can focus on consumers' apprehensions, behaviors, and purchase intentions about GM foods. The literature on consumers'

perception and purchase intention toward GM food is expanding. However, studies that systematically appraise and investigate consumer perception and purchase intention of GM foods are limited. Most of them only provide independent empirical evidence or theoretical clarification of the data. Also, there has been little research relating to Turkish consumers' perceptions and purchase intentions for GM food. At the same time, the fact that no similar research has been conducted in Isparta province highlights the importance of the study. For these purposes, the study aims to investigate econometrically the consumers' perceptions and the factors that may affect their purchase intentions of GM foods in Isparta province, Turkey. Therefore, the present research tries to investigate consumers' perceptions and purchase intentions and their influencing factors. This research is fundamental in ascertaining the purchase intentions, perceptions, and characteristics. Logistic regression analysis is employed to examine the impact of individual characteristics, consumers' perceptions of trust, benefit, risk, and attitude. Thus, this study aims to provide a reference for producers and policymakers.

The article is structured as follows: The next section the econometric model is presented, and the research method is discussed. Then, it is followed by the results and discussion sections.

Literature review

Different methods and theoretical models have been employed to analyze consumer behavior toward GM foods. There has been a lot of scientific interest in exploring the factors that affect consumers' acceptance [29, 10, 4, 13] and willingness to pay [11, 27, 5, 40] for GM foods considering the significance of predicting consumer attitudes and behavior. For instance, Kimenju and De Groote (2008) [23] estimated consumer awareness and the factors determining their willingness to pay for GM foods by surveying 604 participants in Nairobi, Kenya. They found that most of the participants, having limited knowledge of GM crops, were willing to pay for these crops at the same price as their favorite equivalent. However, they were worried about the

potential adverse impact on the environment and biodiversity.

Bruschi, Teuber, and Dolgoplova (2015) [4] examined young Russians' acceptance and willingness to pay for novel functional food bakery products. The results showed that respondents had a low level of knowledge of anthocyanins, but they considered health-enhancing products more important than base products when information was provided. The respondents who did not have information on anthocyanin were willing to pay more for the purple wheat bakery products.

López et al. (2016) [25] calculated participants' perceptions and attitudes toward the production and consumption of GM foods in Mexico. A survey of 11 latent factors was conducted in the urban areas of Mexico to achieve this goal. Similar to previous studies, the results showed that the participants did not have enough knowledge of GM foods (31.28%). They were extremely insecure and perceived a high risk of GM foods (59.13%). Participants with a high level of education had a lower acceptance of GM foods. The authors also reported that they did not perceive positive health effects or social values of GMOs even if an increase occurred in agricultural productivity.

Zhang et al. (2018) [50] aimed to investigate Chinese consumers' purchase intention toward GM foods under the frameworks of benefit-risk analysis (BRA) and the theory of planned behavior (TPB) and to identify which framework affected the purchase intention. In this regard, the model was applied using the data obtained via an online survey with 408 participants. The analysis results explained that the consumers' positive attitude and trust in GM foods increased their purchase intention and perceived benefits under the BRA framework. On the other hand, trust decreased their perceived risks and indirectly purchased intentions. Under the TPB framework, attitude was the most important predictor of purchase intention. Furthermore, the BRA had a stronger impact in explaining the purchase intention compared to the TPB.

Regarding the studies focused on Turkey, Tas et al. (2015) [39] analyzed the consumers' awareness and perception of GM foods in

Istanbul, Turkey. A nonparametric test was applied in the study to achieve this aim. The survey results presented that consumers generally had sufficient information about GMOs, but they were uninformed about the genetic modification process. Consumers were most concerned about the carcinogenic effect of GM foods on humans. The areas where GMO usage was most approved by consumers were the health sector and the prevention of environmental pollution. However, most consumers opposed its use in food applications.

Celik and Dagistan (2016) [6] investigated consumers' perceptions and purchase intentions of GM foods in the province of Hatay, Turkey. They analyzed data via Spearman Correlation Analysis. The risk perception level was considerably high for the participants and played a crucial role in determining the consumers' opinions and purchase intentions. Consumers preferred to purchase conventional foods over GM foods. Also, they had a low level of awareness and knowledge of GM foods. At the same time, their perceptions and attitudes were mostly based on prejudices.

The present research tries to investigate consumers' perceptions and purchase intentions and their influencing factors. This research is fundamental in ascertaining the purchase intentions, perceptions, and characteristics. Logistic regression analysis is employed to examine the impact of individual characteristics, consumers' perceptions of trust, benefit, risk, and attitude. Thus, this study aims to provide a reference for producers and policymakers.

MATERIALS AND METHODS

Questionnaire design

After the purpose of the study was determined, a large literature review was conducted, and similar studies to our subject were examined. Therefore, the questionnaire was developed in light of the information obtained from the literature.

The survey contains basic socio-economic information (individual characteristics) items as well as four other sections. These items

include gender, age, marital status, education level, profession, monthly income, number of household members, whether there is a minor in the household, and primary household food buyer. The first of four other parts investigated whether consumers' trust in GM foods influences their intent to buy the products. The second part aimed to investigate the effects of the perceived benefit on the respondents' purchase intention for GM foods. In the third part, the perceived risk was questioned to identify respondents' purchase intention for GM foods. The final part of the survey asked if attitude influences consumers' purchase intention toward GM foods (see Table 1 for more details).

Likert-type scale

Trust, perceived benefits, perceived risk, and attitudes, except for individual characteristics of the respondents, were measured using appropriate labels on a Likert-type scale. In the social sciences, the Likert-type scale is the most commonly used research method for surveying attitudes. Respondents are asked to indicate how much they agree with a declarative statement. Each scale point in a five-point method could be labeled by its agreement level as follows: Definitely yes, yes, no opinion, no, definitely no. The scale labels could be expressed differently depending on what is being measured [49]. The Cronbach's Alpha and Principal Component Analysis were used to assess the reliability and validity, respectively.

Sampling methods

The necessary data were obtained from the surveys conducted by face-to-face interviews with 264 consumers in the urban part of Isparta from January to February 2020. The sample population was selected by a single-stage, non-clustered, simple random probability sampling method based on main mass ratios [9].

$$n=(z^2*p*(1-p))/d^2 \quad (1)$$

where, n=required sample size, z=confidence level at 95% (standard value of 1.96), p=expected proportion of the event in the study area, and d=precision or margin of error at 5% (standard value of 0.05).

First of all, according to the results of the 2020 census, the population of the city center (262,255) was determined to calculate the sample size of the research. To determine the prevalence value in the formula, 80 preliminary surveys were conducted in the city center of Isparta. According to the preliminary survey findings, it was found that 80% of the families in the research area consumed GM foods. Thus, a sample size of 264 was calculated using Equation (1). After determining the required sample size, the total neighborhoods in the city center of Isparta were divided into three groups according to their socio-economic characteristics: low, middle, and high income. Then, a survey was conducted in 15 neighborhoods that could represent the research area. The number of surveys to be conducted in each neighborhood was distributed in proportion to the population of the neighborhoods, and consumers were chosen randomly.

Econometric modeling methods

A logistic regression model was used to analyze consumers' perceptions and the factors affecting their purchase behavior. In the model, the dependent variable is consumers' purchase intention toward GM foods, and the affecting factors are classified into five categories. These are individual characteristics, trust, perceived benefit, perceived risk, and attitude toward buying. Each category was developed in light of the information obtained from the literature review. The variables applied in the analyses under these five categories and their definitions are provided in Table 1. Furthermore, the model was developed and empirically tested using the defined data in the research via SPSS software (IBM Corp., Version 26.0, Armonk, NY, USA) [38].

The model is a nonlinear regression model conceived especially for the dichotomous dependent variable. A logistic binary choice model was employed to estimate the impact of those factors on consumers' intention to purchase GM foods. The model assumed that $y=1$ if the consumer intends to purchase GM foods and $y=0$ otherwise. Thus, the econometric model based on the logistic probability function is as follows [17]:

$$\text{Prob}(Y_i=1)=P_i=F(Z_i)=F(\alpha+\beta X_i) \quad (2)$$

$$=1/(1+e^{-(Z_i)})$$

$$=1/(1+e^{-(\alpha+\beta X_i)})$$

$$\text{Prob}(Y_i=0)=1-P_i=1/(1+e^{(\alpha+\beta X_i)}) \quad (3)$$

where: F is the cumulative probability function, e is the exponential constant, α is the constant coefficient, β is the parameter to estimate for each explanatory variable, and X_i refers to the i th independent variable.

From equations (2) and (3),

$$\text{Prob}(Y_i=1)/\text{Prob}(Y_i=0) = P_i/(1-P_i) = e^{Z_i} \quad (4)$$

The following equation is obtained by taking the natural logarithm of both sides of the equation (4).

$$L_i = \ln[P_i/(1-P_i)] = Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon_i \quad (5)$$

Logistic is an advantageous regression model because binary logistic models do not rely on the assumption of linearity between dependent and independent variables and do not assume homoscedasticity.

RESULTS AND DISCUSSIONS

Descriptive statistics

The sample size consists of 264 observations which are 132 females and 132 males. When the educational status is examined, nearly half of the respondents (48.86%) have a high educational level (i.e. undergraduate and over). It is also observed that 50.8% of them are married. There is a significant variation in the respondents' income level from 1,500 TL \leq to 10,500 TL \geq . Approximately half of the participants (47%) indicate being in the monthly income group of 4,501 – 7,500 TL, and 20.8% of them is in the 1,501 – 4,500 TL group. Regarding profession which depends on an International Labour Organization (ILO) and its International Standard Classification of Occupations (ISCO) [20], most of the consumers are professionals (21.6%) and students (18.9%). Concerning the number of household members, 58% of them have at least four persons in the family. Furthermore, 28.4% of the respondents are the

primary household food buyer and the proportion of households with minors is 57.2%. Descriptive analysis of the variables is given in Table 2 in detail.

Estimated results

As mentioned earlier, the logistic regression model was employed to determine the consumers' perceptions and the factors affecting their purchase intention for GM foods in Isparta province, Turkey. Following the data processing, the results of the estimated logistic regression model are presented in Table 3. The goodness of fit measurements shows that the model fits the data reasonably well. The Nagelkerke R^2 is 0.56, and the 2 log-likelihood value, which measures the significance of the logit function, is 91.686. The chi-square value is 82.580 ($P=0.004$), and the Hosmer-Lemeshow test result is 21.973 (0.005). It means that the independent variables have good explanatory power for the dependent variables. It should also be noted that Logistic regression coefficients do not reflect the magnitude of the change. However, it only reflects the direction.

For every five factors, the results of the consumers' purchase intention towards GM foods and the affecting factors in Isparta province, Turkey are presented below.

Individual characteristics

Firstly, we hypothesized that consumers' perception and purchase intention for GM foods primarily depend on their individual and family characteristics. The characteristics examined in this category in the study are gender, age, marital status, education, profession, monthly income, number of household members, whether there is a minor in the household, and primary household food buyer.

As explained by the results in Table 3, some of the individual characteristics are significant at the level of 1%. These are marital status (A3, married), and whether the family has a minor (A8). The education level (A4) and the number of family members (A7) are statistically significant at the 5% level.

On the other hand, gender (A1), age (A2), profession (A5), monthly income (A6), and primary household food buyer (A9) turn out

to be insignificant although most of the signs are as expected.

Table 1. Definition of variables

Variable name	Definition
A	Individual Characteristics
A1	Gender
A2	Age
A3	Marital Status
A4	Education
A5	Profession
A6	Monthly Income
A7	Number of family members
A8	The family has a minor
A9	Primary household food buyer
B	Trust
B1	Do you think GM foods will improve the quality of human life?
B2	Do you have confidence in the effective implementation of the biosafety law in Turkey?
B3	Do you have confidence that GM foods are properly labelled or that the ingredients of the products are sufficiently accurate and clear?
B4	Do you have confidence that there is sufficient control of GM foods in Turkey?
B5	Do you have confidence in food products obtained from animals consuming GMO feed are healthy?
C	Perceived Benefit
C1	Do you think individuals should consume genetically modified products at an early age?
C2	Do you think that GM foods are beneficial for human health?
C3	Do you think that foods will become better quality thanks to genetically modified organisms?
C4	Do you think genetically modified organisms cause increases in food production?
C5	Do you think that products resistant to some agricultural diseases have been obtained thanks to genetically modified organisms?
C6	Do you think that GM products are rich in nutritional structures?
C7	Do you think that GMO is fighting hunger in the world?
C8	Do you think the storage and shelf life of GM foods become longer?
D	Perceived Risk
D1	Do you think that GM plants harm living things in the soil?
D2	Do you think that GM animal feeds negatively affect the health of animals and cause organ problems?
D3	Do you think GM foods are not nutritious enough?
D4	Do you think that GM foods have harmful side effects such as toxic, allergic, teratogenic (structural anomalies seen in the unborn baby)?
D5	Do you think GMO cause the loss of biodiversity in plants?
E	Attitude towards buying
E1	Would you buy GM fruits and vegetables with an extended shelf life?
E2	Would you buy herbal products made resistant to pests to reducing the use of pesticides?
E3	Would you buy GM foods if the quality of GM foods is better than the quality of non-GM foods?
E4	Would you buy GM foods if GM foods are cheaper than non-GM foods?
E5	Would you buy non-GM products from an unrecognized brand if the brand of GM foods is a well-known and reliable brand?
E6	Would you buy GM products if the GM foods are better in terms of nutritional properties than the non-GM foods?
E7	Would you buy GM foods if GM foods are better in terms of colour, taste, aroma and size than non-GM foods?
E8	Would you buy chickens that have been gene transferred from a different animal species to have less fat?
E9	Would you buy foods such as carp, catfish, salmon, and tilefish that are made resistant to cold conditions with gene transfer?

Source: Authors' calculation based on survey data.

The younger generation is more interested in technological and scientific developments and is more inclined to accept GM technology accordingly. Therefore, they are expected to positively affect the purchase intention of GM foods. According to regression results, increasing age has a negative effect as predicted. The results also reveal that being married negatively affects the purchase intention of GM foods. The coefficient estimate on whether there is a minor in the household is negative and statistically significant. Similarly, Delmond et al. (2018) [11] showed the negative impact of having a child in the household on Russian consumers' willingness to pay for GM foods in their research. Furthermore, consumers with high levels of education are anticipated to have a high awareness of GMOs. The coefficient estimate on education levels is positive according to our results—the intention to buy GMOs increases when the education level increases. Participants with a higher education are nearly five times more likely to purchase GM foods than the reference group of participants with a low education level. This beneficial effect of education on purchase intention was supported by Loureiro and Hine (2004) [26] and Tas et al. (2015) [39]. In Mehmetoglu's (2007) [28] study, which used a sample of the population of Turkey, found that young people with higher levels of education or income were more aware of GM foods than older consumers with lower levels of education or income. Moreover, the coefficient of the number of family members is negative, and it implies that the intention to purchase GM foods decreases as the number of households increases. This result is consistent with the education and income variables because crowded families generally have low income and education levels in Turkey.

On the other hand, gender and the primary household food buyer do not have a statistically significant effect on purchasing GM foods. Interestingly, monthly income is also statistically insignificant. However, the estimated coefficient of monthly income carries a positive sign as predicted. The positive sign shows that participants with

higher income levels are more likely to purchase GM foods. It may be said that a low level of education is positively related to a low level of income, although the monthly income is statistically insignificant.

Trust

Trust is an essential variable in accepting GM foods. However, scientific researchers are not able to agree on this issue. Some empirical studies have suggested that trust does not directly affect the consumer's intention toward GM foods [7, 32]; others [19, 42, 3, 37, 24] have shown that trust is a critical determinant of adoption of GM foods.

Therefore, we aimed to see how the participants' confidence in GM foods affects their intention to purchase the products. For this purpose, five questions (B section in Table 1) were asked of the respondents, and only the expression B4 was found statistically significant at the 5% level. In Question B4, it was asked whether they have confidence that there is sufficient control of GM foods in Turkey. According to this result, it is observed that the participants who trust that the GM foods are adequately controlled intend to purchase GM foods 3.12 times less compared to the participants who do not trust, contrary to our expectation. When looking at other explanatory variables examining the trust, it is seen that they are statistically insignificant. Regarding the signs of the coefficients, respondents who stated GM foods are safe for human health and improve quality of life intend to purchase GM foods more. However, those who trust in government policy implementations related to GM foods intend to buy less. In line with the results obtained, this situation can be explained as follows. It is thought that the higher the education level, the less confidence in the government's practices. At the same time, it is a fact that individuals with a high level of education also follow scientific developments more. Thus, trust in the health and safety of GM foods may be a sufficient factor to increase the purchase intention even if there is distrust in the government. According to Kaya et al. (2013) [22], in their study of Turkey in general, it was seen that the sense of trust in the

institution related to the control of GM foods was at a very low level (8.9%).

Perceived benefit

Several previous studies have posited that perceived benefits are significantly correlated with purchase intention [19, 14, 7, 10, 33]. Therefore, eight questions were asked about the perceived benefit to identify the affecting factors of respondents' purchase intention for GM foods, such as the benefits to human and animal health, positive effects on agriculture, and hunger problems. Only C1 was statistically significant.

The variable C1 was found to be statistically significant at a 5% level. According to the results, the respondents who think that GM products should not be consumed at an early age tend to buy 4.81 times more GM foods. This situation shows that individuals think GM foods may be harmful to children instead of themselves. It is also a sign that individuals are trying to be more careful and attentive to their children's health. Similarly, Kaya et al. (2013) [22] stated that the rate of those who think that consuming GM products is inconvenient for children was quite high for the sample of the Turkish population.

Although other variables employed in examining the perceived benefit are not statistically significant, their signs of the coefficients are mostly as a priori predicted. The participants, who think GM foods are beneficial for human health, tend to purchase 1.8 times more than those who do not think so. In C3, participants who think that foods will become better quality thanks to GMOs intend to purchase 0.39 times fewer GM foods. For variable C5, the participants were asked the question, "Do you think that products resistant to some agricultural diseases have been obtained thanks to GMOs?". Thus, it was determined that the participants who said yes to this question intended to buy 2.27 times more GM foods. For variable C4, respondents who think that GMOs cause increases in food production are inclined to buy 1.2 times less. Also, the opinion that GM products are rich in nutritional structures and fight hunger does not have a positive effect on consumers'

intention to buy GM foods. This finding is in line with that of Canavari and Nayga (2009) [5] and Bawa and Anilakumar (2013) [2]. Finally, participants who think the storage and shelf life of GM foods become longer have an intention to purchase 1.14 times more. This result shows us that benefits such as storage and long shelf life are easily perceived by individuals. This favorable effect is supported by [1].

In a nutshell, the results cannot provide strong evidence for the presence of perceived benefits in GM foods purchase intention. However, it is seen that benefits such as finding foods beneficial for human health, obtaining products resistant to agricultural diseases, and increasing the storage and shelf life of foods lead the consumer to buy GM foods.

Perceived risk

Studies such as Grunert et al. (2001) [16], Rousu et al. (2004) [34], Chen (2008) [8], and Zhang et al. (2018) [50] have shown that GM foods are refused when the risks perceived by consumers are greater than the risks associated with traditional foods. According to Veeman and Adamowicz (2004) [45], large numbers of consumers perceive a greater risk associated with transgenic food due to the ambiguity of possibly hidden impacts generated by these products. Based on these findings, five questions about the perceived risk that may determine the affecting factors of respondents' purchase intention for GM foods were analyzed in the research.

According to the results, the variables D1 and D5 were statistically significant at the 5% level. The result of the D5 variable in this section shows that the participants who do not think that GMOs cause a loss of biodiversity in plants are 4.1 times more likely to buy GM foods. However, individuals who think that GM plants harm living things in the soil are more likely to purchase GM foods. Similarly, the participants who believe that GM foods have harmful side effects such as toxic, allergic, and teratogenic (structural anomalies in the unborn baby) have more intention to buy.

Table 2. Descriptive analysis of the variables

Variable name	Number/percentage
A	Individual Characteristics
A1	Male 132/50%, Female 132/50%
A2	18-25 74/28%, 26-33 76/28.8%, 34-41 61/23.1%, 42-49 61/23.1%, 50 ≥ 32/12.1%
A3	Single 105/39.8%, Married 134/50.8%, Divorced 25/9.5%
A4	Primary School 2/0.8%, Secondary School 13/4.9%, High School 120/45.5%, Associate Degree 56/21.2%, Bachelor's Degree 68/25.8%, Master's Degree 4/1.5%, Doctorate (PhD)1/0.4%
A5	Managers 7/2.7%, Professionals 57/21.6%, Technicians and Associate Professionals 21/8%, Clerical Support Workers 3/1.1%, Services and Sales Workers 30/11.4%, Craft and Related Trades Workers 12/4.5%, Plant and Machine Operators, and Assemblers 2/0.8%, Elementary Occupations 17/6.4%, Retired 31/11.7%, Unemployed 34/12.9%, Student 50/18.9%
A6	1,500 TL ≤ 12/4.5%, 1,501 – 4,500 TL 55/20.8%, 4,501 – 7,500 TL 124/47%, 7,501– 10,499 TL 53/20.1%, 10,500 TL ≥ 20/7.6%
A7	1 person 3/1,1%, 2 persons 25/9.5%, 3 persons 83/31.4%, 4 persons 90/34.1%, 5 persons ≥ 63/23.9%
A8	Yes 151/57.2%, No 113/42.8%
A9	Myself 75/28.4%, Mother and father 55/20.8%, Partner 37/14%, My partner and I 64/24.2%, Whole family 33/12.5%
B	Trust
B1	Definitely yes 7/2.7%, Yes 9/3.4%, No opinion 44/16.7%, No 108/40.9%, Definitely no 96/36.4%
B2	Yes 68/25.8%, No opinion 58/22%, No 138/52.3%
B3	Definitely yes 11/4.2%, Yes 52/19.7%, No opinion 59/22.3%, No 90/34.1%, Definitely no 52/19.7%
B4	Definitely yes 12/4.5%, Yes 44/16.7%, No opinion 74/28%, No 90/34.1%, Definitely no 44/16.7%
B5	Definitely yes 0/0%, Yes 0/0%, No opinion 53/20.1%, No 119/45.1%, Definitely no 92/34.8%
C	Perceived Benefit
C1	Definitely yes 0/0%, Yes 0/0%, No opinion 22/8.3%, No 97/36.7%, Definitely no 145/54.9%
C2	Definitely yes 0/0%, Yes 2/0.8%, No opinion 47/17.8%, No 98/37.1%, Definitely no 117/44.3%
C3	Definitely yes 0/0%, Yes 1/0.4%, No opinion 90/34.1%, No 106/40.2%, Definitely no 67/25.4%
C4	Definitely yes 1/0.4%, Yes 38/14.4%, No opinion 104/39.4%, No 75/28.4%, Definitely no 46/17.4%
C5	Definitely yes 2/0.8%, Yes 37/14%, No opinion 107/40.5%, No 75/28.4%, Definitely no 43/16.3%
C6	Definitely yes 2/0.8%, Yes 16/6.1%, No opinion 68/25.8%, No 106/40.2%, Definitely no 72/27.3%
C7	Definitely yes 0/0%, Yes 15/5.7%, No opinion 91/34.5%, No 107/40.5%, Definitely no 51/19.3%
C8	Definitely yes 7/2.7%, Yes 75/28.4%, No opinion 92/34.8%, No 61/23.1%, Definitely no 29/11%
D	Perceived Risk
D1	Definitely yes 102/38.6%, Yes 126/47.7%, No opinion 36/13.6%, No 0/0%, Definitely no 0/0%
D2	Definitely yes 90/34.1%, Yes 132/50%, No opinion 40/15.2, No 2/0.2%, Definitely no 0/0%
D3	Definitely yes 113/42.8%, Yes 106/40.2%, No opinion 45/17%, No 0/0%, Definitely no 0/0%
D4	Definitely yes 115/43.6%, Yes 105/39.8%, No opinion 44/16.7%, No 0/0%, Definitely no 0/0%
D5	Definitely yes 95/36%, Yes 107/40.5, No opinion 62/23.5%, No 0/0%, Definitely no 0/0%
E	Attitude towards buying
E1	Definitely yes 0/0%, Yes 4/1.5%, No opinion 44/16.7%, No 110/41.7, Definitely no 106/40.2%
E2	Definitely yes 0/0%, Yes 2/0.8%, No opinion 56/21.2%, No 112/42.4%, Definitely no 94/35.6%
E3	Definitely yes 0/0%, Yes 8/3%, No opinion 45/27%, No 121/45.8%, Definitely no 90/34.1%
E4	Definitely yes 0/0%, Yes 6/2.3%, No opinion 68/25.8%, No 103/39, Definitely no 87/33%
E5	Definitely yes 24/9.1%, Yes 90/34.1%, No opinion 101/38.3%, No 27/10.2%, Definitely no 22/8.3%
E6	Definitely yes 0/0%, Yes 7/2.7%, No opinion 75/28.4%, No 107/40.5%, Definitely no 75/28.4%
E7	Definitely yes 0/0%, Yes 6/2.3%, No opinion 58/22%, No 101/38.3%, Definitely no 99/37.5%
E8	Definitely yes 0/0%, Yes 1/0.4%, No opinion 42/15.9%, No 103/39%, Definitely no 118/44.7%
E9	Definitely yes 0/0%, Yes 1/0.4%, No opinion 39/14.8%, No 113/42.8%, Definitely no 111/42%

Source: Authors' calculation based on survey data.

Table 3. Logistic regression results

Factors	β	Wald	Sig	Exp(β)
A1	-.975	1.446	.229	.377
A2	-1.232	3.397	.065	.292
A3		11.529	.003***	
Single	1.041	.240	.624	2.832
Married	-4.407	8.066	.005***	.012
A4	1.578	6.274	.012**	4.846
A5		9.702	.467	
Managers	-21.929	.000	.998	.000
Professionals	-2.690	2.862	.091	.068
Technicians and Associate Professionals	-3.590	2.994	.084	.028
Clerical Support Workers	-.494	.051	.822	.610
Services and Sales Workers	-2.198	1.601	.206	.111
Craft and Related Trades Workers	-2.156	.674	.412	.116
Plant and Machine Operators, and Assemblers	-17.774	.000	.999	.000
Elementary Occupations	-3.680	2.303	.129	.025
Retired	2.388	1.041	.308	10.888
Unemployed	-.793	.340	.560	.453
A6	.084	.039	.843	1.087
A7	-1.076	5.184	.023**	.341
A8	-6.524	8.614	.003***	.001
A9		3.462	.484	
Mother and father	-2.250	3.286	.070	.105
Partner	-.631	.263	.608	.532
My partner and I	-2.192	1.172	.279	.112
Whole family	-1.012	.525	.469	.364
B1	-.026	.005	.944	.974
B2	.069	.013	.908	1.071
B3	-.475	1.152	.283	.622
B4	1.142	5.960	.015**	3.133
B5	-.075	.025	.876	.928
C1	1.570	4.379	.036**	4.806
C2	-.589	1.326	.249	.555
C3	-.933	2.803	.094	.393
C4	.145	.083	.773	1.156
C5	.819	2.798	.094	2.269
C6	.386	.840	.359	1.472
C7	.743	2.348	.125	2.103
C8	-.136	.120	.729	.873
D1	-1.466	5.080	.024**	.231
D2	.256	.186	.666	1.292
D3	-.004	.000	.995	.996
D4	-.952	3.336	.068	.386
D5	1.410	5.846	.016**	4.098
E1	.121	.057	.811	1.128
E2	.258	.244	.621	1.294
E3	-.140	.104	.747	.869
E4	-1.359	5.154	.023**	.257
E5	-.455	1.205	.272	.635
E6	1.132	5.737	.017**	3.103
E7	-.655	2.006	.157	.519
E8	.633	1.615	.204	1.883
E9	-2.422	11.936	.001***	.089

Chi-square: 81.048 (0.004)

Log likelihood: 93.217, Nagelkerke R Square: 0.547

Hosmer and Lemeshow Test: 26.451 (0.001)

Note: Statistically significant at the level of $p < 0.01$ (***), and $p < 0.05$ (**), respectively.

Source: Authors' calculation based on survey data.

On the other hand, the respondents, who do not think that GM animal feeds negatively affect the health of animals and/or cause organ problems, intend to buy GM foods 1.29 times more. Although this variable is not

statistically significant, its sign is as expected. Furthermore, those who think GM foods are not nutritious enough tend to buy more. In line with the results obtained, perceived risks do not have a considerable effect on

purchase intention for GM foods. Hence, the perceived risks do not significantly affect consumers' purchase intention for GM foods even if they perceive their possible risks. According to the findings, perceived risks have no significant effect on purchase intention for GM foods. In a study conducted throughout Turkey by Oguz (2009) [31], it was determined that the perceived risk of GMOs for consumers and environmental safety increased with the improvement in education level. However, it was concluded that they believed that these effects could be partially brought under control by government control. Therefore, it can be stated that benefit perception is more effective than risk perception in our case. This result is supported by several studies [36, 43, 15] on the perception and purchase intention of GM foods.

Attitude toward buying

Kraus's 1995 study (as quoted in Zhang et al., 2018 [50]) defined "attitude" as a significant psychological structure influencing and predicting consumer behavior. According to some studies [33, 15, 50], attitudes toward GM food and its technology are significant determinants of whether people purchase GM foods. In this regard, the attitude was examined to explain whether it influences consumers' purchase intention toward GM foods. For this aim, all participants in the research were asked a range of questions about their attitudes toward buying these foods. From the results of the logistic regression model in Table 3, it was seen that the three variables (E4, E6, and E9) reached a significance level of 5%.

In E4, the respondents who state that they will buy GM foods if they are cheaper than non-GM foods have more intention of buying GM foods, as expected. Our result is consistent with that of López et al. (2016) [25], which obtained the result that consumers preferred cheaper products. In contrast, Yang, Ames, and Berning (2015) [48] argued that Taiwanese consumers tended to buy non-GM foods even if they were more expensive. Regarding E9, participants who display a less positive attitude towards foods such as carp, catfish, salmon, and tilefish that are made

resistant to cold conditions by gene transfer have less purchasing intention, as hypothesized. However, another statistically significant variable, E6, shows that the respondents who express they will not buy GM foods even if they are better in terms of nutritional properties than non-GM foods, tend to buy the GM foods 3.1 times more. Similarly, although consumers who declare their refusal to buy GM fruits and vegetables with an extended shelf life and transgenic chickens (from different animal species) with less fat, they finally tend to buy more GM foods. The result is also propounded in López et al. (2016) [25].

Nevertheless, participants' tendency to purchase GM foods is consistent with their answers for variables E3, E5, and E7. Respondents who say that they will buy GM foods if their quality is better than the quality of non-GM foods are willing to pay 0.87 times more. Furthermore, respondents who state that they will buy GM foods from a well-known and reliable brand instead of non-GM foods from an unrecognized brand have the intention of buying GM foods 1.57 times more. Finally, it can be seen from the results that people will prefer to buy GM foods if they are better than non-GM foods in terms of color, taste, aroma, and size. Overall, the results indicate that consumers' attitudes toward buying GM foods affect their purchase intention.

CONCLUSIONS

GM products are a difficult and important topic due to their controversial nature. Therefore, attitudes and behavior toward GM foods have been theoretically investigated from several different perspectives. As far as it is known, it has not been handled that an issue of consumers' perception and purchase intention for GM foods in Isparta, Turkey. Therefore, the paper explores econometrically the consumers' perception and the factors affecting the purchase intention of GM foods in Isparta province, Turkey. Following this purpose, the Logistic regression model is estimated with the primary data on demographic and cognitive factors collected

through a survey. These factors are individual characteristics, trust, perceived benefit, perceived risk, and attitude to buying. The survey was conducted with 264 consumers located in the city center of Isparta, Turkey.

Empirical results indicate that consumers' perception and intention of purchasing GM foods are driven by demographic and cognitive characteristics. In terms of demographic characteristics, decreasing age positively affects the purchase intention of GM foods, while being married has a negative effect on it. Similarly, having a minor in the household also has a negative effect. On the other hand, consumers with higher education have nearly five times more intention to purchase GM foods. Furthermore, it is seen from the results that the intention to purchase GM foods decreases as the number of households increases.

Regarding cognitive characteristics, the results show that trust does not directly affect the consumer's intention toward GM foods. However, in line with the results obtained, it is observed that trust in the health and safety of GM foods may be a sufficient factor to increase purchase intention even if there is distrust of the government.

The research also established that the perception of risk and benefit does not provide strong evidence of purchasing intention toward GM foods. According to the results, those who think that GM foods are beneficial for human health and the storage and shelf life of GM foods have become longer intend to buy more GM foods. Also, consumers who think that products resistant to some agricultural diseases have been obtained thanks to GMOs intend to buy more GM foods. The participants who think that GMOs cause a loss of biodiversity in plants are less likely to buy GM foods. At the same time, the respondents, who think that GM animal feeds negatively affect the health of animals, intend to buy fewer GM foods. However, it is found that individuals who think GM plants harm living things in the soil and that GM foods have harmful side effects such as being toxic, allergic, or teratogenic are more likely to purchase GM foods. As a result, it is revealed that perceived risk does not significantly

affect consumers' intention to buy GM foods, even if consumers perceive their potential risks. Hence, it can be said that benefit perception is more effective than risk perception.

Furthermore, the empirical outcomes confirm the critical role of attitude on consumers' intention to purchase GM foods. When we look at its effect on purchasing, consumer attitudes appear to positively affect purchasing intentions if GM foods are cheaper, of better quality, from a well-known and reliable brand, and of better color, taste, aroma, and size than non-GM foods. Furthermore, the participants, who display a less positive attitude toward foods such as carp, catfish, salmon, and tilefish that are made resistant to cold conditions by gene transfer, have less purchasing intention. As a result of the analyses, in general, the findings show that the attitudes of consumers toward purchasing GM foods determine their purchase intentions.

In light of the regression results, some changes may positively contribute to the production and consumption levels of GM foods. To achieve this purpose, it is necessary to raise the consumers' awareness about how healthy GM foods are. In other words, there is a need for comprehensive education using accurate and well-regulated informative materials. Following that aim, the information should be provided via the internet and public media sources such as TVs and radios. These sources are quite important due to their ability to inform directly and serve as primary sources for consumers. Hard and soft-copy materials such as brochures, social media posts, and public service announcements should also be provided. Grasping GMOs thoroughly will help to trust them and to better understand the level of risk and benefit perceptions. It is difficult and time-consuming to build confidence in emerging countries like Turkey. Therefore, policymakers could try to increase consumers' trust in these foods by strengthening relationships among consumers, producers, and the government. From this viewpoint, the research can lead to developing new guidelines and policies to produce and trade more comprehensively. Furthermore, it

provides an extensive foundation that can create awareness, support consumers in areas where they feel lacking, and guide food producers and local authorities on practical implications.

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