



# Consumer Perception of Gm Foods. Profiles of Potential Consumers and Non-Consumers in Spain

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## Abstract

The new production techniques to produce novel food have generated satisfaction among producers, but also a degree of uncertainty among consumers concerned particularly about effects on their health. The purpose of this paper is to study the perception and acceptance of genetically modified food by consumers in Spain. The objectives are summarized as follows

- (i) to discover the knowledge that Spanish consumers possess about such food and the information relating to,
- (ii) to identify the factors that influence its acceptance. The population was segmented by using different descriptive and functional variables to determine potential future consumers with the aim of establishing strategies to improve consumer acceptance of this food.

To improve acceptance and induce willingness to consume GM food, revision of the information offered is advisable so that knowledge of the benefits from production and consumption would reach the consumer, and not only the disadvantages. That way the consumer could make a consistent, responsible choice about consumption.

**Keywords:** Genetically modified food, consumers' acceptance, factorial analysis, segmentation, Spain.

## Introduction

Agriculture is in constant transformation and requires new techniques to progress (Pomar, 2003). One of these new techniques, biotechnology, applied to the agricultural sector, has given rise to genetically modified crops. The consequence of their use in the food sector has resulted in genetically modified food (GM food). Compared to its conventional homologous counterparts, GM food normally presents improvements in production, but also in organoleptic and nutritional characteristics. Therefore this technological innovation is expected to become a social and economic asset for farmers as well as for consumers. The increase in crops for GM food production, as well as the effort undertaken by several GM food producing countries to support commercialization, reflects its benefits for farmers and seed companies, but unless new crops and products are seen to have consumer benefits, the public will continue to be sceptical European Commission [1]. Some authors emphasize several positive characteristics in GM food. According to Sanz-Magallon [2], the majority of genetically modified (GM) products present the consumer with characteristics

(flavour, form, nutritive quality, etc.) similar to conventional products. For other authors, the modified genetic structure even improves the quality and safety of this food Dunwell [3], Baker and Burnham [4]; Gonzalez et al. [5], Mucci and Hough [6] Rodriguez et al. [7]; Moon and Balasubramanian [8]; Rowe [9]. Another potential advantage of this technology is lengthening product life to achieve greater commercial life Rodriguez et al. [7]; Rowe [9]. This benefits both producer and consumer. In spite of this, one of the biggest controversies about this new food is consumer acceptance. A loss of trust in the production chain, lack of knowledge about the new technology and the potential effect of these foods on health increase the risk associated with biotechnology Frewer et al. [10]; Grunert et al. [11]; Townsend and Campbell [12]; Mireaux et al. [13]. Whether the risk is acceptable or not probably hinges on the perception of benefits European Commission [1].

Regarding the effects of GM food on health, it is important to take into account that several years must elapse for establishing possible effects. Some consumers think that production companies

are in too much of a hurry to launch it onto the market, and that their main interest is to obtain huge economic benefits in a short while. The opinions of researchers about the effects on health are not unanimous. Some authors such as Moses [14], Perdakis et al. [15], Hernando [16], Moon and Balasubramanian [8] and Sánchez and Barrena [17] advise the possibility of health risks from these products in the long term, although for Arribas [18], Lamo de Espinosa [19], and Ramon [20], sufficient experimental evidence is beginning to be available nowadays to address such risks and potential danger in accordance with safe strategies. These authors state that GM food is the most tested food in the entire history of nourishment. Other researchers go one step further and even consider that this food, when conveniently “designed,” can produce health benefits for certain individuals Perdakis et al. [15]; Mucci and Hough [6]; FAO [21]. In any case, GM food is a reality that is beginning to appear in consumer markets. Governments are preparing specific legislation to regulate its production and commercialization. At this point it seems important to discover consumer attitudes and behaviour towards such products. Several papers address these aspects.

Baker and Burnham [22], and Scully [23] state that consumer acceptance of GM food is directly related to the level of previous knowledge about genetic engineering, its applications and consumer attitude towards biotechnology. Powell et al. [24] set out that consumers were more concerned about pesticides than genetic engineering. Bredahl et al. [25] go further to make the distinction between GM food from plants or animals, and conclude that greater acceptance exists when dealing with GM fruit and vegetables than genetically modified eggs and meat. Similarly, the study by James and Burton [26] reveals that technology used for obtaining food from plants is more widely accepted than technology for obtaining food from animals. Mucci and Hough [27] think that acceptance depends on the place where the modification originates (in microorganisms, plants or animals) and on the reason for this modification (nutritional, sensorial or economic). Acceptance of this food also differs depending on consumer geographical origin. Thus, research by Noomene and Gil [28] on GM food acceptance in Spain reveals that the degree of knowledge about this type of food is much lower than in other European countries or in the United States. They came to the conclusion that acceptance is good among producers but that consumers are opposed to such food. Han and Harrison [29] found that GM food acceptance in the US is greater due to the population’s greater knowledge about this new food. This knowledge depends directly on the provided information, which can influence consumer attitudes towards these new foods. The specific mention of risk and benefits by different sources of information can change consumer perceptions Costa-Font and Mossialos [30]; Dean and Shepherd [31]. Several authors have noticed that providing positive information about benefits of genetically modified food production could reduce the level of monetary compensation demanded to consume the genetically modified food. Jaeger et al. [32].

On the other hand, other research sought to establish a socioeconomic profile of consumers willing to accept these new products, although uniform results were not found. In work

carried out in Argentina in the year 2003, Mucci and Hough [27] found no differences between men and women in accepting GM food. Nevertheless, a subsequent paper by Mucci et al. [33], also undertaken among the population of Argentina, stated that a more positive perception exists towards GM food among men than among women. On the contrary, James and Burton [26] found greater GM food acceptance among women than men and moreover, that this acceptance is greater in the elderly population group. In the study by Huffman [34] sociodemographic characteristics did not affect willingness to pay for GM food. Finally a European study by the European Commission shows that more than 50% of the sample would be willing to taste or buy GM food if it were healthier and environmental friendly. The study shows that even Spain is the most tolerant country with the risk that this could mean. Only about 20% of Spanish consumers rejected all reasons for buying GM food European Commission [1]. More recently the latest study by Knight et al. [35] shows that the results imply that GM food may prove much more acceptable than has been previously and widely stated, provided that full information and clear statements of consumer benefits are available. These papers reflect the main consumer concerns.

This paper also pursues knowledge of GM food acceptance, delving more deeply into potential influencing aspects. It also aims to determine the profile of consumers willing to eat this type of food, as well as those consumers who are not, in order to identify indirectly the possible causes of transgenic food acceptance and non-acceptance. To determine consumer profile, an analysis was made of various consumer attitudes and opinions about GM food. Based on these variables, the following hypotheses are expressed. Motivation statements shown in the hypotheses are not exclusive to GM food. They may be true or not, but they reflect current consumer knowledge and information concerning these foods. H1: The consumer who is interested in consuming GM food perceives the beneficial aspects of these products. H2: The consumer interested in consuming GM food perceives these foods as similar to conventional products. H3: The consumer interested in consuming GM food is concerned about the effect that these foods may have on one’s health. H4: The consumer interested in consuming GM food is interested in knowing more about these products and values the information received about these foods.

## Methodology

Data for this research was obtained from a survey of the adult population in the province of Alicante (Spain). We only interviewed the Spanish population in spite of the foreign population being high in this province. This large number of foreigners, the majority of whom are from the EU, live in their own residential tourist nuclei, without interacting very much with the autochthonous population. There were 465 valid surveys taken with a 4.6% maximum error and a 95.5% level of confidence for an infinite population (>100,000). Technical facts of the survey are shown on Table 1. Data was collected between the months of April and June 2004. The sample was selected through stratified random sampling with proportional affixation to sex, age and habitat (urban or rural). Sex and age have already been used as selection criteria in research on GM food by Bredahl [36], Cámara et al. [37] and James and Burton [26], among

others. Habitat type, although less frequent, has also been utilized in research on GM food by Koivisto et al. [38] and Renko et al. [39]. Socioeconomic characteristics of the sample are shown on Table 2. The questionnaire was structured in several blocks with details as follows. The first block included questions directed at determining the level of consumer knowledge about GM products. The second part centred on GM food and analyzed consumer knowledge and opinions about this new food and about existing information on the subject. Lastly a series of questions were asked relative to lifestyle and sociodemographic characteristics, permitting consumer segmentation and characterization. In each block, interviewees

rated the various sections of the survey by means of a 5-point Likert scale, with 5 representing the greatest importance in each and every case. The results from analysing the survey were grouped into percentages and averages. SPSS version 13.0 was used for data processing. First a descriptive statistical analysis was made of the entire population. It was aimed at characterising the sample surveyed with regard to sociodemographic characteristics as well as in relation to knowledge and opinions about GM food and about various related issues such as the attributes they value the most in these foods, the information they receive, the trust such sources of information transmit, etc (Table 2).

**Table 1:** Technical facts of the survey.

Population	Adults
Location	Province of Alicante
Sample size	465
Type of survey	Stratified random sampling with affixation proportional to sex, age and habitat
Maximum permissible error	4.6% (for a 95.5% confidence level)
Pre-test	10% of the sample
Dates of field work	April-June, 2004
Control	10% of the sample by telephone

**Table 2:** Sample distribution by socioeconomic variables (Spaniards in Alicante)/(Spaniards in Spain).

		Sample	Population
Sex (%)	Men	40.9	(48.8)/(48.5)
	Women	59.1	(51.2)/(53.2)
Age (%)	18-24 years old	28.2	(12.0)/(11.2)
	25-34 years old	21.9	(20.6)/(19.8)
	35-49 years old	20	(27.8)/(27.2)
	50-64 years old	19.4	(19.7)/(20.2)
	> 64 years old	10.5	(19.9)/(21.6)
Habitat type (%)	Rural	43.9	47.6*
	Urban	56.1	52.4*
Average monthly family income (%)	< 600 €	8.4	
	600-900 €	11.8	
	900-1500 €	38.3	
	1500-3000 €	31.4	
	> 3000 €	10.1	
Occupation (%)	Housewife	17.2	
	Employer	7.7	
	Employee	32.3	
	Retiree	7.5	
	Student	33.5	
	Other	1.7	
Educational level (%)	No schooling	3.2	
	Elementary	29	
	High school	26.9	
	Higher education	40.9	

\*General population in the province of Alicante since data is not available reflecting the number of Spaniards in Alicante versus Spaniards in Spain.

Afterwards, factorial analysis was made to obtain optimum dimensions for summarizing the information from interviewees regarding their knowledge of GM characteristics, opinions about GM food, trust inspired by the available information and interviewee lifestyles. This technical multivariate analysis allows possible variables to be analyzed in a smaller set of interrelated variables. Yet it is simultaneously capable of explaining the common variability found in a group of individuals where a wide set of variables was observed Levy and Varela [40]. This type of analysis has already been used in several studies on GM food such as those by Verdurme et al. [41] and Sanchez and Barrena [17]. Principal Components Analysis was the extraction method in all cases, and the rotation method was Varimax with Kaiser-Meyer-Olkin (KMO) normalization. The statistic used to verify sampling adequacy, the KMO coefficient, contrasts whether partial correlations among variables are small, which should be over 0.5 to be considered adequate. Barlett's sphericity test was also conducted to contrast whether the correlation matrix was an identity matrix, which would indicate that the factorial model was inadequate. Lastly, the population was segmented depending on probable GM food consumption. Consumers were requested to indicate their intention to buy. This intention usually differs from the act of finally purchasing, as is demonstrated by work on purchasing conducted by Knight et al. [19,35]. The profile of each segment was analyzed according to sociodemographic and functional variables to identify indirectly the causes for acceptance / non-acceptance of these products.

### Results and Discussion

Results unfolded starting from the general knowledge of GM products to the opinion that GM food is deserving. Consumer knowledge and opinion about the information received regarding these foods were analyzed as objectively as possible. According to consumer judgment, an important percentage possesses some knowledge about these products and is interested in them, since they pay attention to the information they receive. But when attempting to measure their knowledge about this food, this knowledge is not observed as very objective since consumers are not very sure of their answers, especially those relating to food safety for consumer health. They generally think that such new products should be treated very prudently, especially in reference to the effects their consumption could produce. In regard to the information existing on these products, consumers think that it is limited and manipulated. Consumer characterization was also carried out by lifestyle, due to the peculiarity of these products related to nourishment as well as environmental safety issues. Lastly the sample was segmented dividing interviewees into two population groups, those who would not consume GM food and those who would. The group unwilling to consume GM food positively valued the information received but mistrust this new food, being concerned about the effects that consumption could entail. The segment that would consume GM food is smaller. They perceive this new food as safe for consumption since they consider it very similar to conventional food.

## Characterization of the Total Population

### Knowledge about GM food

Before centring on GM food itself, the level of knowledge about GM products in general was evaluated, based on subjective consumer responses to this direct question. The answer scale was divided into 5 levels from "I have no knowledge" (1) to "I am very knowledgeable" (5). Consumers who had heard of GM products but recognized that they knew nothing about the subject represented 13.5%; 44.3% of the consumers surveyed thought they had little knowledge of the subject; 35.1% had some knowledge; 4.9% stated they had much knowledge, while only 2.2% recognized that their knowledge about GM products was high. Consumer attention to and active search for information is a factor to be taken into account when analyzing the population's attitude towards these new products. To discover this situation, consumers were asked to choose between the following options: (1) I do not hear or read information about this topic; (2) I pay no attention to it; (3) I pay attention to it; and (4) I look for information. The percentages for each of these categories were: 14.2%, 23.9%, 57.4% and 4.5%, respectively. Centring on GM food, a more objective measurement of the population's knowledge was sought. Therefore, on a 5-level scale consumers were asked to indicate with certainty their level of knowledge concerning a series of statements relative to the most frequent advantages and disadvantages in existing literature about GM food: (1) No, for sure; (2) I think not; (3) I don't know; (4) I believe so; and (5) Yes, for sure (Table 3). Conviction of the truth of their statements is generally not very strong, since the average score given by interviewees was found at the halfway mark. Statements with which consumers were most in agreement are that GM food is economically advantageous to producers and that it can be kept for a longer time. Statements indicating less certainty were those related to health.

**Table 3:** Indicators and codes for various potential aspects of GM food.

Indicator	Code
GM food can signify economic advantages for producers.	EAP
Some GM food can be kept longer.	CKL
Some GM food may have better flavour and/or aroma than conventional food.	BFC
GM production will allow the eradication of harmful pests in crops.	EPC
GM food production has more negative effects on the environment than conventional production.	NEE
GM food could reduce the world's hunger problem.	RWH
GM food can produce allergies.	CPA
GM food can include properties that improve human health.	PIH
GM food can include properties that will improve my health or that of my family.	PHF

A factorial analysis was made with the aim of summarizing information on consumer knowledge about GM food. Four factors were obtained that explain a total variance of 65.23% (Table 4).

The first factor, called health, explains a variance of 19.39%. This factor is clearly identified with the beneficial aspects for health from GM food. The second factor, social awareness, explains 15.64% of the variance and is correlated to various aspects related to the production of this new food that concern society. The third factor, negative aspects, explains 15.64% of the variance and identifies potential negative characteristics of GM food. This factor

is also correlated with the statement “GM food can mean economic advantages for producers” included in factor 2, which are direct economic advantages for the producer. The consumer, who does not enjoy them, may therefore see them as a negative aspect of GM food. The fourth factor, positive aspects, explains 14.56% of the variance and is correlated with some positive aspects or improvements that GM food may incorporate.

**Table 4:** Average score and factorial analysis of Alicante consumer knowledge about GM food.

	Average	Standard deviation	Factor 1 Health	Factor 2 Social awareness	Factor 3 Negative aspects	Factor 4 Positive aspects
PHF	2.81	1.08	0.918	-0.021	-0.067	0.064
PIH	2.9	1.07	0.888	0.185	-0.107	0.057
RWH	3.12	1.21	0.259	0.725	-0.013	-0.022
EPC	3.3	1.12	-0.04	0.65	-0.312	0.236
EAP	3.9	1.11	-0.118	0.539	0.507	-0.028
CPA	2.93	0.97	-0.034	0.002	0.712	-0.021
NEE	3.23	1.11	-0.144	-0.312	0.637	0.173
BFC	3.31	1.15	0.063	-0.04	-0.138	0.852
CKL	3.74	0.93	0.062	0.187	0.325	0.7
Variance explained			19.39%	15.64%	15.64%	14.56%

KMO: 0.576

**Consumer Opinions about GM Food characteristics**

Various statements relating to GM food characteristics were proposed to consumers to find out their opinions about GM food. Interviewees were to indicate their level of agreement or disagreement on a 5-level scale (1: completely disagreed, 5 completely agreed) (Table 5). It must be emphasized that in all cases the consumer was in agreement or disagreement but very few showed indifference to the statements. Sentences with which consumers agreed the most are that new food should be treated prudently and be strictly legislated since the effect of its consumption

concerns them greatly. They think that this food is already being consumed and that the main beneficiaries are producers and industry. They are quite in agreement with statements indicating that this food is not very natural and therefore can be harmful to health, in spite of believing that it undergoes greater control than conventional food. They also think that it should be lower priced. Options that consumers disagree with relate to the similarity between GM and conventional food. That is, the statements hardly scored were “Conventional products can be just as detrimental to health as GM food” and “Differences are few between GM and conventional foods.”

**Table 5:** Indicators and codes for consumer opinions on various aspects of GM food.

Indicator	Code
GM food, like other scientific advances, should be treated cautiously.	ATC
Legislation on GM food should be very strict since its effects are unknown.	LSE
Businesses have other interests in genetic engineering besides social welfare.	IGE
I am concerned about the effect of GM food consumption on my family’s health.	EFH
I think we consume GM food without realizing it.	CWR
I am concerned about the effect of GM food on human health.	EHH
The principal beneficiaries of GM products are producers and industry.	PBP
GM food is not very natural.	NVN
GM food should be lower priced than conventional food.	LPC
GM food consumption can be harmful to health.	CHH
GM food is a scientific advance for the benefit of mankind.	SAM
Health security controls are greater for GM food than for conventional food.	GSC
GM food is highly regulated by legislation.	HRL
Conventional products can be as detrimental to health as GM food.	ADH
There are few differences between GM and conventional food.	FDB

The factorial analysis of variables related to consumer opinions about several aspects of GM food allowed the reduction of the high number of variables under consideration and the determination of optimum dimensions. Five factors were obtained that explain a total variance of 54.46%. The first factor, "of interest to businesses," explains 13.03% of the variance and is associated with those variables which cause distrust in consumers, which refer to who the main beneficiaries of GM food are, what their interest is and how these products should be treated. The second factor, "effects on health," explains 12.21% of the variance. Its variables relate to GM

food consumption and effects on health. The third factor explains 11.12% of the variance and is designated "similar to conventional food" since it is basically related to indicators comparing conventional to GM food. The fourth factor, which explains 9.23% of the variance, is called "strict controls" because its indicators relate to security controls and how this food, including its price, should be regulated. The fifth factor, "underhanded / not very natural," explains 8.87% of the variance and correlates with consumer uncertainty about whether they already consume GM food or not and the opinion that these products are not very natural (Table 6).

**Table 6:** Average score and factorial analysis of consumer opinion on various aspects of GM food.

	Average	Standard deviation	Factor 1 Of interest to businesses	Factor 2 Effects on health	Factor 3 Similar to conventional food	Factor 4 Strict controls	Factor 5 Underhanded/ not very natural
MBP	4.13	1.12	0.689	0.124	-0.19	0.018	-0.17
ATC	4.53	0.77	0.688	0.078	0.051	0.013	0.176
IGE	4.38	0.98	0.656	0.058	0.16	-0.062	0.049
SLE	4.47	0.86	0.592	0.117	-0.066	0.048	0.103
EFH	4.32	0.96	0.088	0.871	0.057	0.001	0.15
EHH	4.18	1.01	0.173	0.849	-0.024	-0.02	0.048
CHH	3.55	1.1	0.273	0.52	-0.415	-0.115	0.237
ADH	2.65	1.28	0.004	0.002	0.741	-0.005	0.054
SAM	3.38	1.25	0.138	-0.041	0.673	0.262	0.012
FDB	2.41	1.18	-0.112	-0.013	0.517	0.077	-0.267
GSC	3.24	1.21	0.116	-0.065	0.229	0.711	-0.042
HRL	2.69	1.13	-0.225	-0.036	0.227	0.644	-0.173
LPC	3.63	1.17	0.098	0.07	-0.196	0.568	0.394
CWR	4.2	1.04	0.061	0.056	0.033	-0.182	0.851
NVN	3.67	1.21	0.052	0.168	-0.096	0.107	0.437
Variance explained			13.03%	12.21%	11.12%	9.23%	8.87%

**Consumer opinion about existing information on GM food**

As for existing information about GM food, consumers basically think that it is limited and manipulated by commercial business and national interests. These opinions were also evaluated on a 5-level scale from complete disagreement (1) to complete agreement (5). Table 7 shows indicators and codes for several statements about existing information. Consumers agreed more with aspects relating to the quantity and clarity of information since they thought that the limited existing information is difficult to understand besides being conditioned and even manipulated by various institutions related to this new food (businesses, countries, etc.). Up to a point they considered the information too scientific, which does not inspire them with very much trust. In spite of deeming that the information could be manipulated, they did not regard such manipulation as done by ecologist groups since they disagreed with this statement. Finally, the indicators they disagree with the most are that existing information clearly shows the advantages and disadvantages of such food and that information about GM food appears on the labels of these products. The latter corresponds to their previous opinion that GM food consumption is a reality although we are unaware of it (Table 7).

**Table 7:** Indicators and codes for existing information about GM food.

Indicador	Code
It is limited.	LMT
It is conditioned by commercial business and national interests.	CCI
It is unclear.	UNC
It is manipulated by businesses.	MBB
It inspires me with very little trust.	ILT
It is too scientific.	TSC
It is manipulated by ecologist groups.	MEG
It appears on product labels.	APL
It clearly shows the advantages and disadvantages of these products.	SAD

Three factors, which explain a variance of 55.83%, were obtained from a factorial analysis of consumer opinion about existing information on GM food. The factor called "insufficient and biased" explained 27.74% of the variance and is correlated with variables indicating that the information is unclear, limited, manipulated by businesses, etc. The second factor, "objective information," explains

16.51% of the variance and is related to information variables directly connected with aspects appearing on the label. The last factor in this analysis is designated "manipulated by ecologists." It

explains 11.58% of the variance and is highly correlated with the statement "Information about GM food is manipulated by ecologist groups (Table 8).

**Table 8:** Average scores and factorial analysis of Alicante consumer opinion about existing information on GM food.

	Average	Standard deviation	Factor 1 Insufficient and biased	Factor 2 Objective information	Factor 3 Manipulated by ecologists
ILT	3.91	1.1	0.758	-0.002	-0.184
UNC	4.25	1.01	0.72	0.011	-0.207
MBB	4	0.97	0.675	-0.239	0.186
CCI	4.28	0.96	0.642	-0.236	0.234
LMT	4.33	1	0.56	-0.095	-0.031
TSC	3.58	1.17	0.46	0.18	0.167
SAD	1.87	1.07	-0.079	0.834	-0.021
APL	2.25	1.24	-0.059	0.787	0.167
MEG	2.95	1.25	-0.011	0.128	0.905
Variance explained			27.74%	16.51%	11.58%

KMO: 0.731

**Surveyed Consumer Lifestyles**

Product perception and acceptance is connected to individual lifestyles. Surveyee characterization is all the more necessary since this study deals with food in relation to such different fields as consumer safety, environmental aspects in the production of raw materials, and also socioeconomic and political aspects. Therefore, several statements were used which surveyees evaluated on a 5-level scale (1: complete disagreement, 5: complete agreement) (Table 9). The sample was more in agreement with items referring to the environment and health. Consumers are concerned about the type of foods they eat, and also about how new products might affect environmental deterioration. The item obtaining the lowest score was "I collaborate financially with associations in defence of

nature." The factorial analysis of statements referring to lifestyles yielded three factors that explained a total variance of 61.69% (Table 10). The first factor, "health / food," explains 24.96% of the variance and is associated with consumer concern about their health and related aspects, sports, regular check-ups, healthy and appropriate food, etc. The second factor, "concern about the environment," explains 22.72% of the variance and is related to concern about consumer surroundings. Besides their interest in scientific advances, consumers are concerned about healthy foods and leading a life that respects the environment. The third factor, "information and science," explains 14.01% of the variance and is basically correlated with the concern to be informed and knowledgeable about scientific advances (Table 10).

**Table 9:** Indicators and codes for surveyee lifestyles.

Indicator	Code
I am concerned about environmental deterioration.	CED
I am concerned whether my food is healthy.	CFH
I recycle my garbage regularly or would like to.	RGR
Fruit and vegetables are very important in my meals.	FVI
I am interested in scientific advances.	ISA
I am concerned about my figure.	CMF
I participate in sports regularly.	PSR
I read the newspaper.	RNP
I voluntarily get periodic health check-ups.	VHC
I collaborate financially with associations that defend nature.	CAN

**Table 10:** Average scores and factorial analysis of Alicante consumer opinion about existing information on GM food.

	Average	Standard deviation	Factor 1 Health / food	Factor 2 Concern about the environment	Factor 3 Information and science
CMF	3.62	1.12	0.745	0.194	-0.131
PSR	3.56	1.29	0.744	-0.017	0.122
VHC	3.22	1.27	0.696	0.059	0.171

FVI	4.14	1.05	0.582	0.397	0.213
CED	4.55	0.76	0.112	0.815	0.002
RGR	4.33	1.02	0.057	0.71	0.112
CFH	4.34	0.86	0.525	0.598	0.024
ISA	3.68	1.13	0.079	0.564	0.55
RNP	3.48	1.31	0.113	0.04	0.916
Variance explained			24.96%	22.72%	14.01%

### Characterization of Consumer Segments Depending on the Probability of GM Food Consumption or Non-Consumption

The population was divided into two segments according to the probability of consuming GM food or not. The first segment included consumers who indicated in the survey that they would never consume GM food, those who stated that they would do so only if there was no other possibility and those who said they were almost sure they would not consume. The second segment included consumers who stated they were almost sure they would consume GM food and those who said they would do so without a doubt. The descriptive variables of age, monthly family income, habitat type, and educational level were used to characterize these segments, as well as the factors obtained about their knowledge of

GM food, their opinion of GM food, information about GM food and their lifestyles. The NON-CONSUMING segment comprises 57.8% of the sample (Table 11). By using socioeconomic variables to analyze this segment, it was observed that for variables where differences exist (age, income, habitat and education), the maximum percent of difference is close to 10%. Data analysis shows that age distribution in this segment is similar to distribution in the population, with slight differences in the 18 to 24 year old group and the group over 64. On the other hand, the consumer group with an income over 1500 € is smaller than that of the population. It is the segment with the largest population in rural areas and the least in urban centres. With regard to distribution by educational level, the percentage of the higher education group that was lower than the population is noteworthy. No significant differences were found between segments according to sex or employment.

**Table 11:** Alicante consumer segments according to probable GM food consumption. Characterization according to descriptive and functional variables.

Variables	Segment 1 Non-Consuming (57.8%) <sup>1</sup>	Segment 2 Consuming (42.2%) <sup>1</sup>	Total population
<b>Age***</b>			
18-24 years old	24.50%	33.20%	28.20%
25-34 years old	20.40%	24.00%	21.90%
35-49 years old	21.60%	17.90%	20.00%
50-64 years old	20.80%	17.30%	19.40%
> 64 years old	12.60%	7.70%	10.50%
<b>Monthly family income***</b>			
< 600€	9.70%	6.60%	8.40%
600-900 €	13.40%	9.70%	11.80%
900-1500 €	40.90%	3.70%	38.30%
1500-3000 €	28.30%	35.70%	31.40%
> 3000 €	7.80%	13.30%	10.10%
<b>Type of habitat***</b>			
Rural	47.20%	39.30%	43.90%
Urban	52.80%	60.70%	56.10%
<b>Educational level***</b>			
No schooling	4.50%	1.50%	3.20%
Elementary schooling	32.00%	25.00%	29.00%
High school	26.00%	28.10%	26.90%
Higher education	37.50%	45.40%	40.90%
<b>Lifestyles</b>			
Health / food	0.022	-0.031	
Concern for the environment	0.013	-0.018	
Information and science**	0.09	-0.124	



Knowledge about GM food			
Health*	-0.187	0.257	
Social awareness**	-0.117	0.16	
Negative aspects*	0.213	-0.292	
Positive aspects**	-0.108	0.149	
Opinion about GM food			
Business self-interest**	0.086	-0.117	
Effects on health*	0.203	-0.278	
Similar to conventional food*	-0.293	0.402	
Strict regulation**	-0.086	0.119	
Underhanded / not very natural**	0.095	-0.13	
Existing Information about GM food			
Insufficient and biased*	0.228	-0.313	
Objective information	-0.054	0.074	
Manipulated by ecologists**	-0.098	0.134	

According to functional variables this segment is characterized by positive evaluation of information and scientific advances. With regard to their knowledge about GM food, they do not know of any possible advantages for health or any positive aspects, although they do know the negative aspects. This leads us to think that they will not consume these products because they see no advantage in it. They also do not know the possible advantages of GM food to society. They distrust this food, they are concerned about its possible effects on health and about the price, and they do not consider it similar to conventional food. Here is another reason that could explain their refusal to consume it. With regard to information, they declare that insufficient, biased information is offered to them, but they do not consider that it is manipulated. According to this group, information received from official or scientific organisms and health care personnel is not very reliable. The CONSUMING segment comprises 42.2% of the sample. The percentage of young people between 18 and 24 years old in this segment is 5% higher than the population. This segment is characterized as enjoying high monthly incomes and living in urban centres, as well as a larger percentage of its consumers having a higher education. Consumers from this segment do not show concern for information or scientific advances through their lifestyles. They recognize the advantages that these products may have for health as well as their positive aspects and more concretely those referring to society in general. But they do not know the negative aspects and possibly this is the reason why they are willing to consume. GM food is similar to conventional food in the opinion of this segment of consumers and is safe for consumption. It is sufficiently regulated by law and therefore they have no reason for mistrust. They are not concerned about possible effects on health or the price. In regard to the information that reaches them, they think that it is manipulated and they negatively rate aspects related to the factor designated "insufficient, unbiased information." They trust the information offered them by public organisms and businesses, as well as from scientists and health care personnel.

## Conclusion

GM food is proof that using biotechnology in food production is a reality that is gradually prevailing in the marketplace. This has

generated some alarm among consumers due to potential effects on health from consuming such food as well as possible environmental consequences from the introduction of these crops. On the other hand, producers observe a direct economic benefit, which has caused the adoption of this technology without great problems. This bipolarity has led to an economical, political, and social debate in society on this issue. Consumer knowledge and related opinions about GM food were analyzed in this study. It was observed that consumer attitude towards these products is conditioned by level of knowledge and information received. Results indicate that knowledge about GM products in general is not very high, since consumers have heard the term but very few really know what they imply or their actual potential effects. More specifically, consumers do not know what benefits might be contributed by GM food. Nevertheless, they think that the chief beneficiaries are producers and industry, but no one else. They mainly consider this type of food as not very natural, although longer lasting and better in flavour and aroma. Besides, many consumers distrust the productive chain since they believe that these foods actually exist in consumer markets, although this is not reflected on the label. They deem the information they receive, besides being insufficient, is incomprehensible and conditioned by many other interests besides the improvement of food production. The Alicante consumer profile was established for those willing to consume and those who are not. At any rate, what is demonstrated is consumer intention to consume these products, since real products were not presented at any time for the consumer to actually carry out the act of purchasing.

The main differences between these segments were due to functional characteristics such as consumer knowledge and opinions about this new food, especially opinions referring to effects on health or existing information on GM food. Differences were few with regard to socioeconomic characteristics. Depending on the characteristics analyzed, it could be affirmed that one of the possible causes for the non-consumption of GM food is the general lack of consumer knowledge about this type of product. They distrust this food in spite of the information available to them and their positive rating of advances in this science. The reason

for consumption among the segment of the population willing to consume is because they think that these new foods are sufficiently controlled and safe. Therefore, they have no reason to mistrust them. In conclusion, analysis of the information and knowledge about GM food shows a large group of consumers that would be willing to consume GM food that was safe to health, since this is a highly considered factor for accepting the new food. To improve this acceptance and induce willingness to consume, revision of the information offered is advisable so that knowledge of the benefits from production and consumption would reach the consumer, and not only the disadvantages. That way the consumer could make a consistent, responsible choice about consumption.

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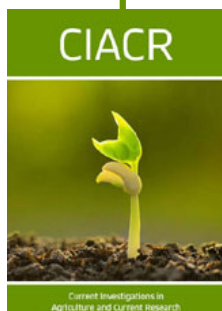


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