

Genetically Modified Products – Contradictions and Challenges

by

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Abstract. This paper aims to identify the perception that consumers have about GM products, also taking into consideration the evolution of consumption and production of products based on genetically modified organisms. Therefore, the paper presents both aspects to clarify the concept of genetically modified organism (GMO issues such as typology, national or international regulations regarding this area) and global market development of genetically modified organisms, evolution which is presented by statistical data concerning the whole global area cultivated with genetically modified organisms. The paper has also managed to demonstrate through an exploratory research concerning consumer's knowledge about GMO products, their attitude about biotechnology applications, the need for GMO-based products for scientific progress, the risks or advantages of genetically modified organisms and the paper has also managed to identify the key GMO-based products and to analyze the GMO Roundup Ready soybean species distribution in supermarkets in Bucharest.

Key words: biotechnology, genetically modified products, quality, market, producer, consumer.

JEL classification: Q10

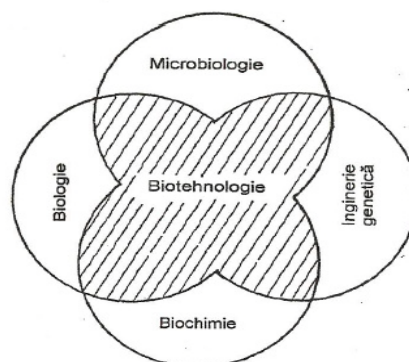
1 Introduction

In spite of a long history of genetic engineering, consumers nowadays are very suspicious concerning the "new technologies" applied to food. The discoveries in genetic engineering have got a high potential for the human health and also for the environment. The development of this field requires adequate safety measures in order to fulfill the fundamental purpose of the World Health Organization (WHO) which is "to lead the nations to the highest level of sanity"¹. (Dima, 2004)

1.1 Notional and conceptual elucidation

In order to describe genetic changes, the most frequently used terms are "modern biotechnologies", "recombined DNA technology" or "genetic engineering". All these notions have approximately the same meaning: the transfer of genes from one place to another. To resume, genetically modified organisms or food are a part of nature, a part determined by spontaneous changes of the genes (mutations). Genetically modified organisms can be plants,

bacteria and animals, all of these being modified with the help of genetic engineering.



Source: Banu, C. – Biotehnologii în industria alimentară, Tehnica Publishing, Bucharest, 2000, pg. 31.

Figure 1. Biotechnology's place in the disciplines of microbiology, biology, biochemistry and genetic engineering.

1.2. National and international regulations on genetically modified organisms

The European Commission has established several laws in order to label and to follow GMO's and to maintain a safe environment. These laws refer to the labeling of the food if more than 0,9% of its ingredients come from GMO's and if genetic changes can be detected

¹ Dima, D., Pamfilie, R., Păunescu, C., Procopie, R. – Merceologia și expertiza mărfurilor alimentare de export-import, Ase Publishing, Bucharest, 2004, pg. 60

in that food. The consumer's trust can be won and encouraged only with such clear and honest labeling. Before creating a new GM culture or GM microorganism the producer must ask for permission from the competent authorities. The producer gives a file to these authorities, consisting of information about genetic changes and the safety of GMO's for the environment, people and animals. The EU procedure concerning these applications consists of different stages along with the involvement of the Member States, the European Commission, the European Council of Ministers and the Permanent EU Committee. The legal problems of approval and labeling of GMO's are initially based on a series of fundamental instructions.

1.3 Pro and counter arguments over the consumption of genetically modified organisms

The understanding of the public's perceptions and attitude concerning genetic changes is important and it must be treated with respect. Only a clear and objective research of genetic changes can offer consumers the possibility of taking decisions when it comes to choosing a certain food product. The researchers come with several pro and counter arguments for the consumption of genetically modified organisms as the following:

Table 1. Pro and counter arguments over the consumption of genetically modified organisms.

Pro Arguments	Counter Arguments
GMO's increase the validity of fruits and vegetables.	In Europe, many consumers believe that these technologies are very dangerous, causing disorders in nature.
GMO's provide enough economic food quantities for the World.	Consumers think that an infinite number of genetic transfers will lead to unpredictable consequences with devastating effects.
The aminoacid content of a product can be increased, this fact leading to a healthier product.	The impact of genetically modified organisms over the environment and the human being isn't fully known and controlled by the specialists.
Changing glucides in a potato can lead to a tastier product when it is being fried.	Creation of biological weapons. ² (Goldsmith, 2005)
The development of functional food or vaccines which bring medical benefits and health.	Decreased action of medical treatment due to the transfer of genes that develop resistance to antibiotics used in human or veterinarian medicine.
Taste and specific food structures can become better, for example: the sweetness of carrots or the fluffy structure of a cake.	Affections of plants and animals including toxic and allergenic effects.

² Goldsmith, E - Consumer economics : issues and behaviors, Pearson Prentice Hall Publishing, Upper Saddle River, 2005 , pg. 217

1.4 World market of genetically modified organisms

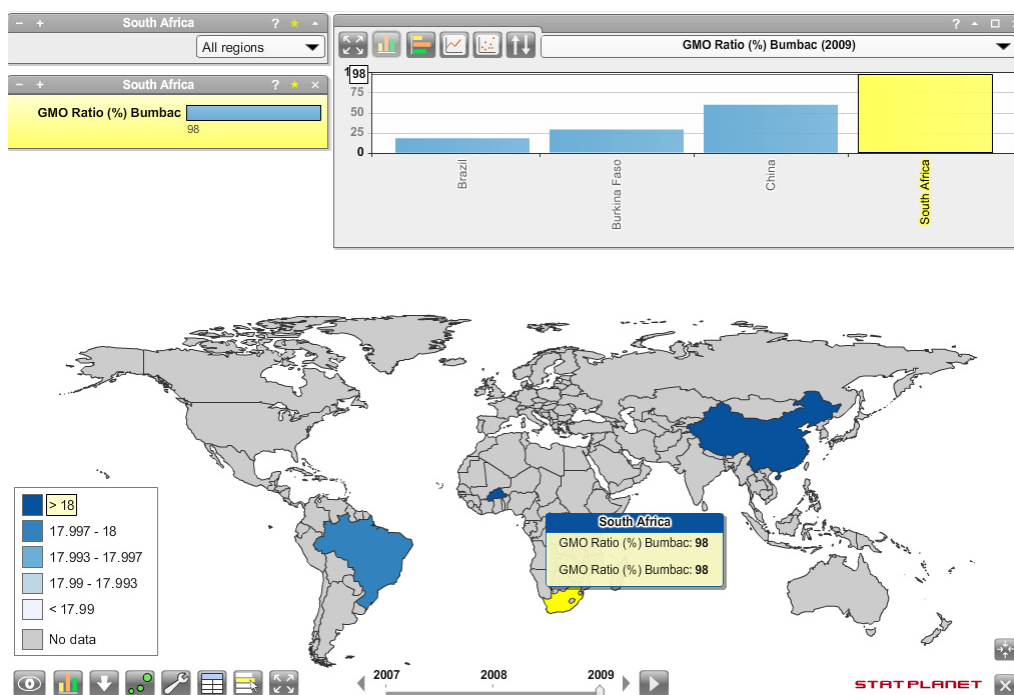
GMO producing countries have to monitor and quantify genetic changes in agricultural cultures and also in the food that comes from these cultures. Also these countries must take all

safety measures based on the tests made before commercializing GM products. The following table presents the evolution stages of the surfaces cultivated with genetically modified organisms in the world.

Table 2. The evolution of the area cultivated with genetically modified organisms.

Year	Are The area cultivated with genetically modified organisms
1995	- Genetically modified plants and products which derive from these are present on the international markets. - USA authorized trade with soybean and genetically modified maize.
1996	- Japan, Australia and Great Britain approve trade with genetically modified organisms. - The cultivated surface of transgenic plants reaches 1.7 million ha.
1997	- Luxemburg, Austria and Italy, forbid the import of transgenic plants. - The cultivated area of genetically modified plants reaches 12,74 million ha. The countries which cultivate transgenic plants are USA (8,13 million ha), China (1,82 million ha), Argentina(1,41 million ha), Canada (1,21 million ha), Australia (40.000 ha) and Mexico (less than 40.000 ha).
1999	The area cultivated with GMO's increased with 44% (12,1 million ha), reaching 39,9 million ha, in comparison with 27,8 billion ha in 1998. The seven types of genetically modified cultures were cultivated in 12 countries. Portugal, Romania and Ukraine have cultivated transgenic plants for the first time.
2003	Worldwide, the GMO cultivated surface is approximately 80 million ha. ³ (Dima, 2006)
2005	During 9 years of transgenic plants cultures, the cultivated area increased from 1,7 million ha in 1996 to 81 million ha in 2005. This is an unprecedented increase in the agricultural technology field.
2006	- Slovakia cultivates Bt maize. - Transgenic cultures can be found on little surfaces in Paraguay, South Africa, Uruguay and Australia. - Spain produces transgenic maize on an area of approximately 60.000 ha.
2007	For the 12th consecutive year, the area cultivated with transgenic plants continued to increase reaching 114 million ha, cultivated in 23 countries.
2008	Worldwide, there are approximately 16 million ha cultivated with genetically modified cotton, 42 million ha cultivated with maize and approximately 70 million ha cultivated with GM soy.
2009	Worldwide, there are 16 million ha cultivated with genetically modified cotton, approximately 45 million ha cultivated with MG maize and approximately 70 million ha cultivated with GM soy.

³ Andrei, V., Bobe, M., Diaconescu, I., Dima, D., Pamfilie, R., Păunescu C., Popescu, D., Procopie, R. – Mărfuri alimentare și securitatea consumatorului, Economic Publishing, Bucharest, 2004, pg 321



Source: GMO Compass, www.gmo-compass.org (accessed at 23.03.2011) and StatPlanet-Map-Maker, <http://www.sacmeq.org/statplanet/StatPlanet-Map-Maker.html> (accessed at 23.03.2011)

Figure 2. Cultivation area of genetically modified cotton in the world.

Figure 2 points out that in 2009 the cotton share of total genetically modified organisms from South Africa is 98%, followed by other countries in which genetically modified cotton cultures are made, such as China (approximately 75%), Burkina Faso (25%) and Brazil (approximately 25%) also in 2009.

2 Identifying the main GMO-based products and offer analysis. Case Study: Analysis of Roundup Ready soy species distribution in Bucharest supermarkets

The objective of this study was the analysis and evaluation of soybean samples, fresh or processed, randomly chosen from the supermarkets of Bucharest. Vegetal food (soy) and also food products of animal origin which contain vegetal protein (soy) have been analyzed. The method used in the Microbiology Laboratory – ELISA of ABI Bucharest for the extraction of the nucleic acids was recommended by the Roche producer – High Pure GMO Sample Preparation Kit.

The analyzed samples have included a wide range of soy products, from the less processed ones such as

flour, to the highly processed ones such as tofu, soy milk, soy drinks and sweets. Out of the total samples, 24 samples have been identified with genetically modified soy content, from 0,2 to 100% and 56 samples which do not contain genetically modified soy.

2.1 Exploratory study on a sample of availability concerning genetically modified organisms

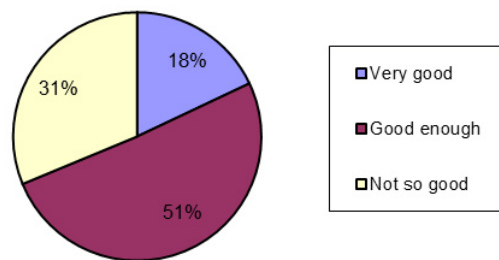
The central objective of the research has been to identify the perception that consumers have about the “new technologies” applied to food, especially the contradictions and challenges that genetically modified organisms can bring.

The secondary objectives of the research consist in the consumer’s attitude concerning genetically modified organisms, their knowledge concerning these products based on GMO’s, the level of satisfaction obtained by consuming a GM organism based product, the consumption of certain food identified with genetically modified soy content put on sale in the supermarkets from Bucharest, the safety problems concerning GM food, the advantages

and also the characteristics of GMO products which mostly influence consumers.

The primary source of the research has been the questionnaire based quest developed among persons beyond 18 years old which were familiarized with the genetically modified organism notion. After finishing the questionnaires the following stages took place:

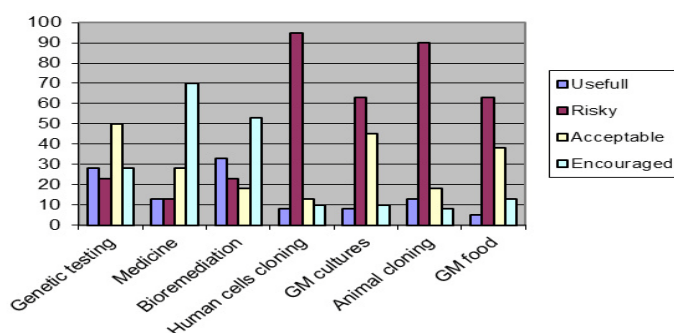
- **Taking the information** – The questionnaires have been distributed, recovered, took over, sort, classified and prepared for processing.
- **Processing the information** – The information has been processed on basis of the correlations established by the central and secondary objective of the research.
- **Analysis and interpretation** – The results of the correlation graphics obtained by the processing of the validated questionnaires have been interpreted.
- **The method of gathering information. The investigated collectivity** – The questionnaires have been randomly distributed to the persons that corresponded to the criteria's of the primary and secondary research objectives.
- **The obtained results** – The questionnaire assigned for the consumers included 23 questions. Those questions were made in order to point out the objectives which were established by the research program. Introductory, closed, open, mix, control questions have been made, and also questions which regard opinions and explanations.
- **The sample** – The sample consisted out of 50 persons aged above 18 years old which were familiarized with the genetically modified organism notion.
- **The period in which the quest took place** – The questionnaires have been administrated in the following period: 1.03.2011 – 1.04.2011.
- **The data analysis** - Concerning the 50 consumers that were questioned I chose to describe in detail their responses to the following questions:



Source: based on the information obtained under questionnaire centralization.

Figure 3. Consumer knowledge about GMO - based products.

According to the graph presented above, more than half of the survey respondents consider that their knowledge about genetically modified organisms is good enough. This fact demonstrates the increased interest of the consumers for the products made through modern biotechnology.

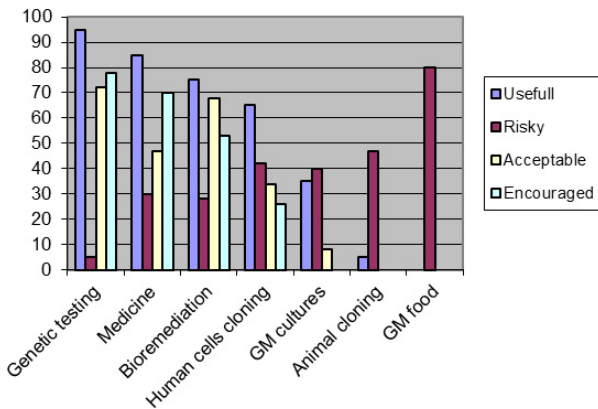


Source: based on the information obtained under questionnaire centralization

Figure 4. Romanian consumers' attitude about biotechnology applications.

The comparison between the next two graphs points out the attitude of Romanian consumers versus the attitude of European consumers concerning a series of important applications of biotechnology such as: genetic testing, medicine, bioremediation, human cells cloning, GM cultures, animal cloning and GM food. Concerning the Romanian attitude about biotechnology applications, the majority didn't agree with GM food thinking that human cells cloning, GM cultures, animal and food cloning are risky. On the other hand, bioremediation,

medicine and genetic testing are encouraged.
(figure 4)

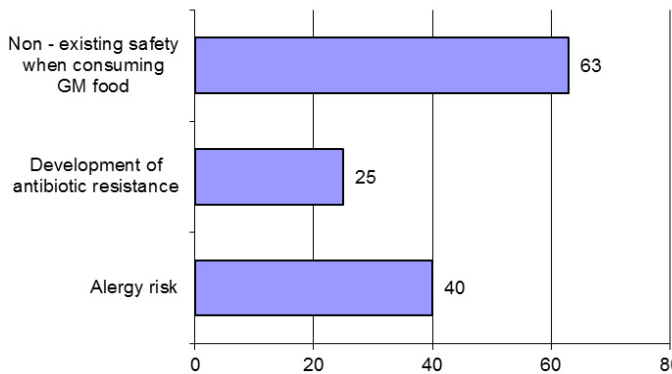


Source: Holm, Finn - Alimente modificate genetic, Profesioniștii Sănătății, Nr. 2, Anima Publishing, June 2002, pg.13

Figure 5. European consumers' attitude about biotechnology applications.

Comparing the attitude of the European consumers with the attitude of the Romanian consumers concerning biotechnology applications it is clear that European consumers are more permissive compared with Romanian consumers. They didn't oppose to animal cloning, GM crops, cloning human cells or GM foods, considering them less risky than the Romanians.

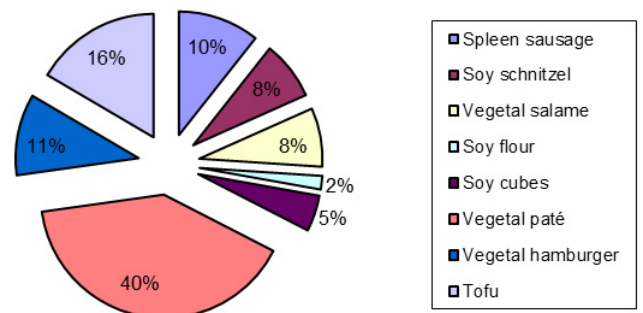
Interestingly, some applications of biotechnology are more easily accepted than others, depending on the benefits perceived by consumers according to the available information.



Source: based on the information obtained under questionnaire centralization

Figure 6. Safety issues related to GM food.

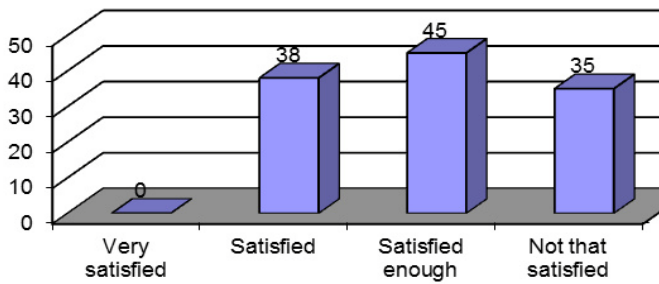
According to figure 6, non - existing short or long term safety of genetically modified food consumption is the main problem of those who were questioned. Another safety issue worthy of consideration is the risk of allergies and later, the development of antibiotic resistance. Safety measures against developing resistance to antibiotics, the risk of allergies and the non-existent safety of genetically modified food consumption, along with other safety issues related to genetically modified foods are widely covered in research projects funded by the European Union, in which the consumer is the center of attention of the competent authorities.



Source: based on the information obtained under questionnaire centralization

Figure 7. Food types with genetically modified soy content.

Figure 7 describes the answers given by consumers when asked about the type of food containing genetically modified soybean, being previously informed on the label that the product contains genetically modified soybean. All products mentioned in the above figure can be purchased from supermarkets in Bucharest. According to Fig.7, 39% of the respondents consume vegetal pate. The difference is noticeable compared to the 16% who consume tofu. 11% of the questioned consume spleen sausage and vegetal hamburger. Schnitzel and vegetal salami are consumed equally by 8% of those surveyed, soy cubes is consumed by 5% of the respondents, and soy flour is consumed by very few respondents (2%).



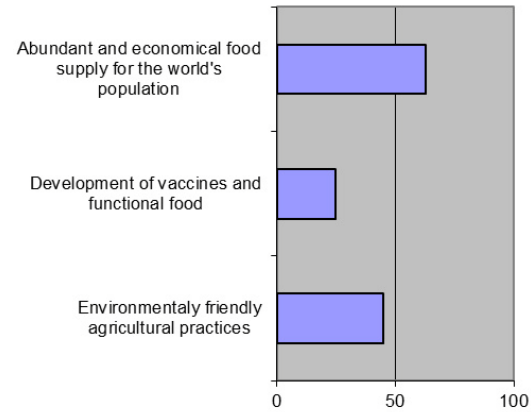
Source: based on the information obtained under questionnaire centralization

Figure 8. The level of satisfaction obtained from consumption of products containing genetically modified soy.

Figure 8 points out we that no customer was very satisfied from consumption of products containing genetically modified soy, which leads to the following conclusion: the assortment of such products should be improved in the future.

In order to achieve this goal, manufacturers of food containing genetically modified soy will have to take more account of consumer preferences, the need for such products, as well as the constant comparison that consumers make in the supermarkets over food of the same type that doesn't contain genetically modified soy.

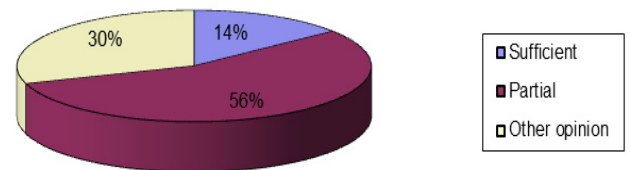
Products such as schnitzel, spleen sausage, salami, hamburger, flour, etc.



Source: based on the information obtained under questionnaire centralization.

Figure 9. The advantages of genetically modified organisms based products.

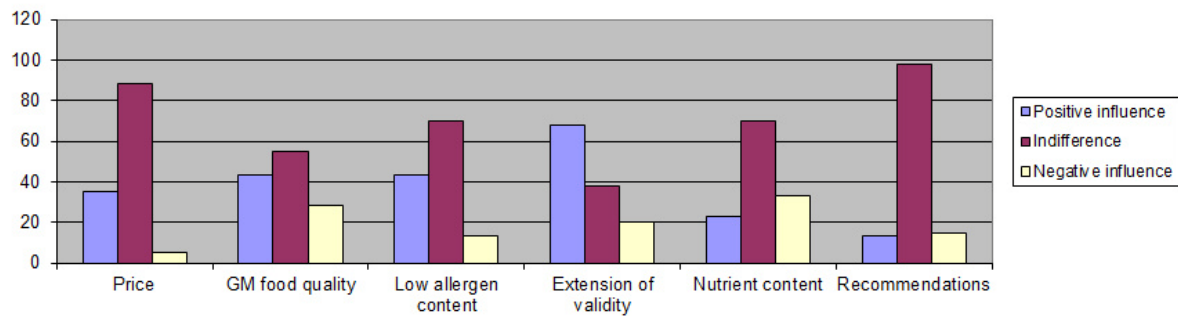
Those surveyed believe that more abundant and economic supply of food for the world population is the most important advantage of GMO - based products. This advantage is followed according to those surveyed by the environmental friendly agricultural practices and only 20% of consumers think of the development of vaccines and functional food as one of the advantages of genetically modified organisms in order to maintain an optimal health status.



Source: based on the information obtained under questionnaire centralization

Figure 10. Informing consumers about GMOs.

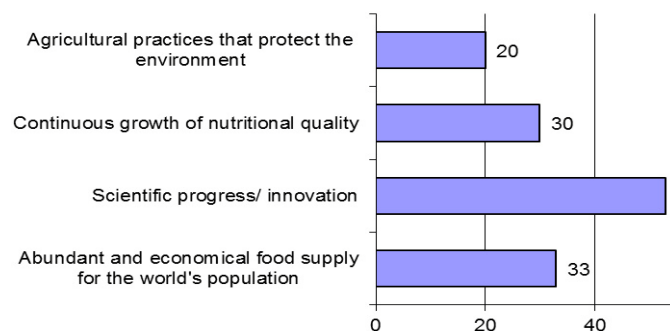
When referring to consumers' information on genetically modified organisms (Fig. 10), 56% of the respondents are partially informed, 14% believe they are sufficiently informed, but a significant 30% believe that media on GMOs should be improved through clear labeling of these types of products or advertising campaigns in the media. Therefore, being better informed, consumers may choose between GM food and non – GM food.



Source: based on the information obtained under questionnaire centralization

Figure 11. The influence of GMO based products features on consumers.

Figure 11 describes to what extent consumers are influenced by the most representative features of GMO-based products. The validity extension of GMO-based products positively influences consumers when they want to buy such products, followed by GM product quality. Most consumers express their indifference to money. Recommendations and price of GMO - based products do not affect all consumers as they remain indifferent to these two features.



Source: based on the information obtained under questionnaire centralization

Figure 12. The need for GMO – based products.

According to figure 12, the majority of those questioned believe that we need GMO-based products for scientific progress and innovation, a significantly lower percentage, 33% say that it takes GMO-based products for a more abundant and economic food supply for the entire population and the minority of respondents (20%) believe that we need these products due to agricultural practices that involve the protection of the environment

3 Conclusions

Several important conclusions have resulted from the present research concerning consumers' option for genetically modified organisms. This paper aimed and managed to show the situation in which genetically modified organisms find themselves on the world market.

Consumer information, their knowledge about GMO products, their attitude concerning biotechnology applications, the development of GM cultures, the need of GM products for scientific progress, innovation and also the eventual risks or advantages that may appear from GMO products, all of these prove the real progress in this field, favoring the consumer's perception over the contradictions and challenges caused by the appearance of genetically modified organisms.

- Genetically modification was studied for decades. In Europe, the research concerning genetically changes is under development. For an even more thorough research contradictive subjects concerning GM food need to be clarified.
- In order to straighten the trust of consumers in genetic engineering the following aspects are important: high quality results and objective scientific studies. The consumers aren't totally prepared for a market of genetically modified food.
- The European Commission highly supports biotechnological research concerning genetic technologies in the food industry. It focuses over the consumer's problems and

many tests are made in order to capture their reactions and preoccupations and it also focuses over the new initiatives concerning legal aspects.

- GMO's contribute to high progress in the increase of the competition in agriculture and in business, also contributing to the food quality with benefits for the consumers.
- The surveillance of the quality of food products with the purpose of preventing affections over the health and even the life of the consumers must be treated with high responsibility.
- In opinion of those who were questioned the problems concerning the safety of GM food are: allergy risk, development of antibiotics resistance at animals and humans, the non – existence of long term or short term safety in GM products consumption. They also think that on the long term the consumption of GM products can affect health.
- The organizations involved in the food field should apply modern management systems of food safety (HACCP, ISO 22000). Thus only this way they can demonstrate their ability to control of food safety dangers in order to supply secure final products and their continuous capacity of improving customer satisfaction.
- The majority of respondents ranged from 20 to 30 years. The next age group being between 30 and 50 years. Among these, most are students, economists and

engineers. Regarding the gender structure of the respondents, the majority were women.

- The consumer should remain in the center of attention to the certified authorities.

References

Andrei, V., Bobe, M., Diaconescu, I., Dima, D., Pamfilie, R., Păunescu C., Popescu, D., Procopie, R. (2004), *Mărfuri alimentare și securitatea consumatorului*, Economic Publishing, Bucharest, 2004, pg 321.

Banu, C. (2000), *Biotehnologii în industria alimentară*, Tehnica Publishing, Bucharest, 2000, pg. 31.

Dima, D., Pamfilie, R., Păunescu, C., Procopie, R. (2004), *Merceologia și expertiza mărfurilor alimentare de export- import*, Ase Publishing, Bucharest, 2004, pg. 28, pg.60.

Goldsmith, E. (2005), *Consumer economics: issues and behaviors*, Pearson Prentice Hall Publishing, Upper Saddle River, 2005 , pg. 217.

Holm, F. (2002), *Alimente modificate genetic*, Profesioniștii Sănătății, No. 2, Anima Publishing, June 2002, pg. 7, pg.11 - 14.

***GMO Compass, www.gmo-compass.org (accessed at 23.03.2011).

***StatPlanet-Map-Maker, <http://www.sacmeq.org/statplanet/StatPlanet-Map-Maker.html>(accessed at 23.03.2011).

***The European Consumers' Organization, BEUC; www.beuc.org (accessed at 14.12.2010).