



Received November 22, 2006/ Accepted December 11, 2006

GMO TECHNOLOGY. VENEZUELAN'S CONSUMERS PERCEPTIONS: SITUATION IN CARACAS.

D. A. Pereira de Abreu^{1*}; K. Villalba Rodriguez²; M. Schroeder³; M. B. de Mosqueda⁴ and E. Pérez⁴
e-mail: dpereira@usc.es*

¹Dep. of Analytical Chemistry, Nutrition and Bromatology, Faculty of Pharmacy,
University of Santiago de Compostela, 15782-Santiago de Compostela. Spain.

²Dep. of Organic Chemistry, Faculty of Pharmacy, University of Santiago de Compostela, 15782-Santiago de
Compostela. Spain.

³Behavioral Science Department Faculty Member, University of Phoenix, Yuma Arizona, USA.

⁴Institute of Science and Food Technology, Faculty of Sciences of the Central University of Venezuela, Paseo
Los Ilustres Urb. Valle Abajo, Apartado Postal 20513, 1020-A Caracas. Venezuela.

Abstract

The main benefits generated by the genetically modified organisms (GMO's) include greater yields harvested, foods with greater content of nutrients, vaccines, resistant plants to virus or plagues and resistant plant to high levels of salts in ground. However, there is a controversial discussion regarding its acceptance and welcoming and is missing information in regard the topic especially in developing countries. The purpose of this study is to measure the level of knowledge or acceptance towards GMO's and biotechnology by consumer from Caracas, Venezuela. The researchers will use a survey that was previously applied to consumers from USA, Japan and some other South American countries. The results of the study demonstrated that Venezuelan' consumers are misinformed about this topic; however, they are more informed about microbial contamination and pesticides than other topics.

Keywords: Consumers Perceptions, Biotechnology, Survey, Genetically Modified Organisms, Transgenic Food, Acceptance, GMO's.

Introduction

Commonly, biotechnology and genetic modification (GM) are used interchangeably. GM is a special set of technologies that alter the genetic makeup of such living organisms as animals, plants, or bacteria. On the other hand, biotechnology is a more general term that refers to using living organisms or their components, such as enzymes, to make products that include wine, cheese, beer, and yogurt (HGP, 2004).

Plants are considered modified genetically when the genetic material from other organism is introduced in its DNA sequence. In the majority of the cases, the series of pairs of bases that are inserted in the natural DNA sequence has some common elements. Each inserted external gene, or

transgenic, has a promoter, a protein that codifies the site and a terminator. The starting point of the transcription of the DNA, inserted in the ARN, is when the promoter acting as a "switch" alerts to the cell to begin to produce the new protein. The terminator marks full stop for this procedure of transcription of the gene (Spiegelhalter et al., 2001).

Ever since the biotechnology arose in the nineteen eighties the vegetal production has increased dramatically the extension of harvested acres of organisms modified genetically. Only in the U.S.A. these cultures increased from approximately 3.6 million acres in 1996 to 51.3 million acres in 1998 (Liu, 1999). In 1999, the U.S.A., reached 85 million acres that represented 72% of the global

area harvested with transgenic cultures (cultures that has been modified genetically). Argentina and Canada cover the rest to reach the 99% of the global (Hübner, 2001).

In the year 2003, about 167 million acres (67.7 million hectares) planted with transgenic crops were grown by 7 million farmers of 18 countries. The main crops were herbicide- and insecticide-resistant soybeans, corn, cotton and canola. In addition, other crops grown commercially or field-tested were sweet potato, rice and a variety of plants that are able to survive extreme weather condition. Also, it is important to mention that the sweet potato is resistant to a virus that could decimate most of the African' harvest. In addition, the rice with increased iron and vitamins may alleviate chronic malnutrition in Asian countries. On the horizon are bananas that produce human vaccines against infectious diseases such as hepatitis B; fish that mature more quickly; fruit and nut trees that yield years earlier, and plants that produce new plastics with unique properties. Moreover, in 2003, countries that grew 99% of the global transgenic crops incorporated the United States (63%), Argentina (21%), Canada (6%), Brazil (4%), China (4%), and South Africa (1%). It is relevant to notice that although growth is expected to plateau in industrialized countries it is rapidly increasing in developing countries. The next decade we will see exponential progress in GM product development as researchers gain increasing and unprecedented access to genomic resources that are applicable to organisms beyond the scope of individual projects. (HGP, 2004)

Technologies for genetically modifying (GM) foods or transgenic foods offer dramatic promises to fulfil the great challenges of the 21st century. Like all new technologies, there are possible known and unknown risks. These risks raise controversies. Some of the controversies surrounding GM foods and crops commonly focus on human and environmental safety, labelling and consumer choice, intellectual property rights, ethics, food security, poverty reduction, and environmental conservation (HGP, 2004).

The transgenic foods production raises two concerns with respect to potential human safety or regards to health impact (the allergens) (Gendel, 1998). The first concern is in regard the fact that transferred genes should codify proteins, that are not commonly present in the original food and they could be allergens (Lehrer et al., 1996). Inasmuch arise always, the question: if the protein will continue being

allergenic in the new food? (Gendel, 1998). The second concern is in regards the possibility that a previously non-allergenic protein present in the food will be transformed into an allergen. In this case, due to the serum from this allergenic condition is not available, there is no appropriate immunological test designed to determine its potential allergenicity (Gendel, 1998). Moreover, the effect of the possible allergen is difficult to test because the vulnerable population is unknown and will not develop tolerance to the new product (Lehrer et al., 1996).

Despite, the knowledge most of the population from industrialized countries such as the USA and countries from Europe has about biotechnology technique, GMO's and its terminologies; they are concerned with the elaboration of foods using GMO's products. The acceptance of transgenic foods by the consumers of industrialized countries has been controversial as well as concerns for its security (Hernandez et al., 2001). These consumers need to be sure and confident that the regulating authorities have studied the risks for health (Peacock, 2000). In contrast, consumers from developing countries are lacking the information on techniques and terminologies used, because the biotechnology techniques are not common yet in there countries.

In a study conducted in Argentina in 1995, the 95.0% of the interviewed people agreed on the benefits of the biotechnology techniques. These participants considered that the most important areas of applications of this technique are medicine (94.0%) and agriculture and foods (82.0%). A study conducted in Brazil in 1998, showed that 47.0% of the interviewed people had never heard the term biotechnology and 53.0% approved of its uses for cultures resistant to insecticides. In a study performed in Chile in 2001, the 97.0% of the interviewed people ask for information on the quality of foods and 69.0% of the consumers are reading the labelled before to buy the product. Also, 65.3% of the people interviewed did not to know the term biotechnology and 73.0% rejected the use of the biotechnology. In Mexico in 1997, the survey shown that 54.8% of the people interviewed were misinformed on the subject of biotechnology and GMO's (Carullo, 2002).

The goal of this study was to measure the Venezuelan consumer's level of knowledge and perceptions of the terminologies and concepts of GMO's, and the feelings that were generated by this type of foods using a survey.

Materials and methods

Description of the Population. The population of the study encompassed the consumers of Caracas, Venezuela.
Description of the Sample. The participants of this study were 200 consumers from the city of Caracas, Venezuela. They were invited to answer a questionnaire. The questionnaire application was managed with instruction by trained crew in different zones of the Gran Caracas, Distrito Capital, Venezuela.

Instruments

A questionnaire previously used with other consumers from different countries (Hoban, 1999) was modified to be used in this study. A questionnaire of twelve questions was applied to consumers in order to measure their perception of the biotechnology and GMO's. The questionnaire was elaborated using an answering system of yes, not, and I don't know and also a grading scale from the 1 to the 10, where 1 is unacceptable and 10 are acceptable.

Table I. Consumers' perceptions of food safety risks

| Risk | (%) |
|----------------------------|------|
| Pesticide residues | 13.0 |
| Additives or preservatives | 8.8 |
| Microbial contamination | 37.8 |
| Antibiotics or hormones | 4.7 |
| Irradiated foods | 6.7 |
| Biotechnology | 0.0 |
| None | 11.9 |
| Other | 17.1 |

As it can be seen in Table I, none of the participants indicated that the biotechnology concerned them, being the

Statically Analysis. All the statistical analyses were made by means of program STATGRAPHICS (Statistical Graphics Educational System, version 6,0, 1992, Manugistics, Inc. and Statistical Graphics Corp, the USA).

Results and discussion

Perceptions of Food Safety: Two questions were asked to participants in regards to their knowledge on food safety.

•First question: What of the following items concerns you the most after you ingest food?

- Pesticides residues
- Additives or preservatives
- Microbial contamination
- Antibiotic or hormones
- Irradiated foods
- Biotechnology
- None
- Other.

microbial contamination (37.8%) the most important factor. Also, it could be notice that consumers who answered "others" were referring to the food prices being the factor that they worried about the most. In contrast, results reported by Hoban in 1999, shown that the microbial contamination was the most important event that North Americans consumers worried about (69%) and Japanese worries highlighted the pesticide residues (45%). These results are superior from the results reported in this study (using the same events or items).

•Second question: Could you please classify the following items using the following scale: serious hazard, slight hazard, It is not hazard and I do not know?

- Pesticide residues
- Additives or preservatives
- Microbial contamination
- Antibiotics or hormones
- Irradiated foods
- Biotechnology

Table II. Consumers' perceptions of food safety hazards

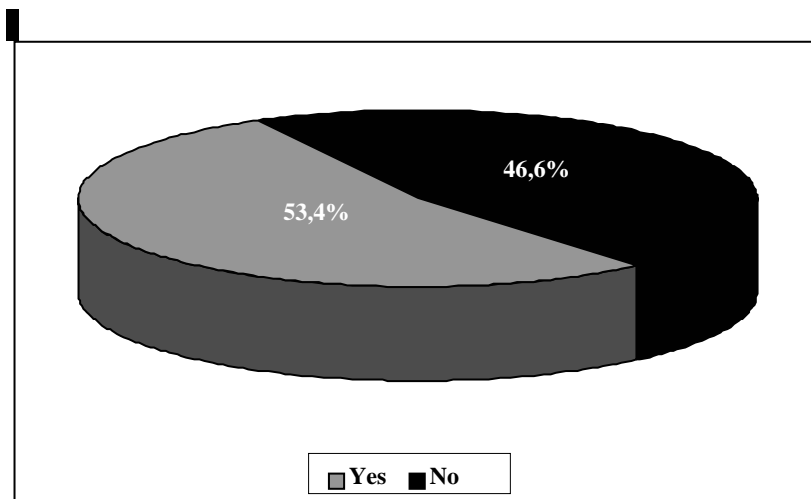
| | Serious Hazard | Slight Hazard | It is not a risk | Don't Know |
|----------------------------|----------------|---------------|------------------|------------|
| Pesticide residues | 76,2% | 16,6% | 2,1% | 5,1% |
| Additives or preservatives | 44,0% | 40,9% | 4,7% | 10,4% |
| Microbial contamination | 51,8% | 16,1% | 11,4% | 20,7% |
| Antibiotics or hormones | 22,8% | 48,2% | 20,2% | 8,8% |
| Irradiated foods | 75,7% | 14,5% | 1,0% | 8,8% |
| Biotechnology | 13,4% | 19,7% | 25,4% | 41,5% |

As is shown in Table II, the great knowledge of the consumers was on the health risks that represented the pesticide residues, irradiated food and the microbial contamination. A great percentage of consumers recognized them as a serious hazard for their health 72.6, 75.7 and 51.8 % respectively. In addition, consumers were aware that they are misinformed about techniques such as biotechnologies, irradiated foods, and a great percentage communicated being misinformed about the hazard this represents for their health.

Knowledge of biotechnology: Five questions were asked to participants in regards to their knowledge about biotechnology:

- Do you know what a genetically modified food (transgenic food) is?
- Are there foods produced through biotechnology in supermarkets?
- Are there foods produced through biotechnology in grocery stores?
- Are there foods produced through biotechnology in restaurants?
- Are there foods produced through biotechnology in the premises fast foods?

Figure 1. Public perception to the question: Do you know what is a genetically modified food or a transgenic food?



When consumers were asked about the meaning of genetically modify foods, or a transgenic food, as it is appraised in Figure 1, a 53.4% responded affirmatively. But, when consulting to their following question: -Do you know if there are foods produced through the biotechnology in the supermarket, in stores, restaurants or in the premises of fast food? A mean of 67.4% indicated that they did not

know, demonstrating the lack of information on the commercialization of these foods in Caracas, Venezuela. In order to know what biotechnology represents for these individuals consumers were asked: Before today, had you ever talked about biotechnology with someone? A 43.5% responded affirmatively, whereas a 56.5% responded negatively. Asking to the 43.5% of consumers that

responded affirmatively in regard the frequency of talking about biotechnology a 51.2 % responded that they has talked one or twice time, while a 41.7% responded that they has talked only one time and only a 7.1% responded that they has talked frequently.

Acceptance of biotechnology: Five questions were asked to the participants in regards to their acceptance of biotechnology.

•Would you support the use of the biotechnology in the field of medicine?

•Would you support the use of the biotechnology in the field of agriculture?

•Could you please rank from (1-10) the following items: Think about what is your acceptance of the applications of biotechnology?

- Crop breeding
- Foods with lower fat or more vitamins
- Crop plants that reduce the need for pesticides
- Human insulin or other medicines
- Farm animals that resist disease need for pesticides
- Human insulin or other medicines

• Food ingredients

•Plants or parts of plants exist that are used in the food elaboration, for example edible oils, into which biotechnology has been applied to protect the plants from pests or improve the yield. Do you believe that the use of biotechnology into theses plants has on effect on the purchase of its products?

•Would you agree, for this type of products, the application of a law that forced to indicate in the label that this food has been genetically modified or contains a genetically modified ingredient?

When consumers were asked: A) would you support the use of the biotechnology in the medicine field? B) would you support the use of the biotechnology applied to agriculture?, the results of the study indicated that 11.9% agreed to the use applied to medicine and 19.2% agreed to the use applied to agriculture. It is relevant to observe that approximately 70% of responses answered -I do not know- This proportion could be due to the lack of trustworthy information on these products.

Table III. Consumers' acceptance of various applications of biotechnology

| Application | Mean score ^a |
|---|-------------------------|
| Crop breeding | 6.40 |
| Foods with lower fat or more vitamins | 6.86 |
| Crop plants that reduce the need for pesticides | 7.06 |
| Human insulin or other medicines | 6.40 |
| Farm animals that resist disease | 6.38 |
| Food ingredients | 5.03 |

^aOn a scale of 1 = unacceptable to 10 = acceptable

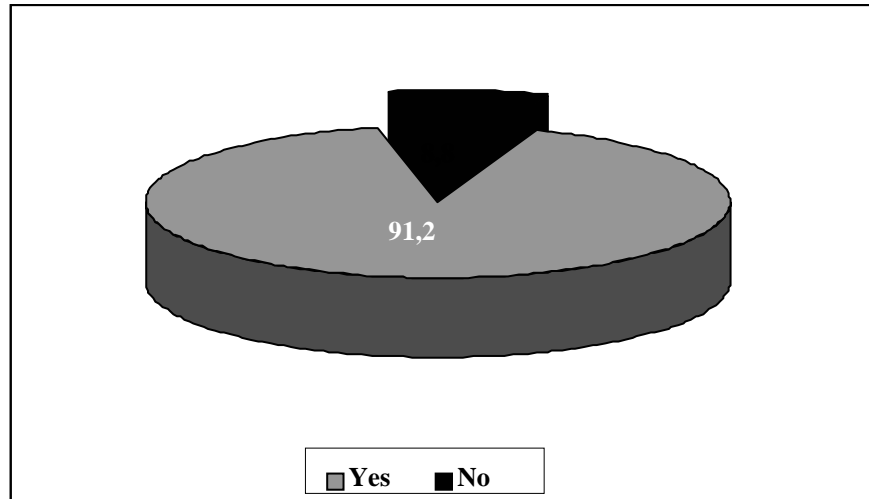
In order to discern consumers acceptance of the applications of biotechnology on specific uses, a scale from the 1 to the 10 (where 1 is unacceptable and 10 are acceptable) to describe what do they thought on the use of this technology was used (Table III). The item “crops plants that reduce the need for pesticides” that profited the greatest acceptance with 7.06 points. On the other hand, values close to 5 indicate the lack of knowledge on the subject from the Venezuelan consumers, which did not generate a rejection or a high acceptance. It was concluded that this lack of knowledge could be used by commercial groups, which should manipulate information move to the affection or rejection of these products to benefit their interests as has happened in other countries.

When consulting the consumers with this statement and question “Plants or parts of plants exist that are used in the food elaboration, for example edible oils, into which biotechnology has been applied to protect the plants from pests or improve the yield. Which effect would have the use of the biotechnology in your selection of purchase edible oil isolated from these plants? ” A 33.2% answered that it would have a positive effect and a 23.3% indicated that this would have a negative effect on its selection of purchase. But, when it was creating the situation "If, the product (edible oil) have a mandatory label, where it is certify security for the health, would you acquire it", It was observed a great increase of selection of purchase, increasing acceptance at 71.0% and diminishing the

rejection to 15,5%.

Figure 2. Public perception to the question: “Would you agree, for this type of products, the application of a law that

forced to indicate in the label that this food has been genetically modified or contains a genetically modified ingredient”



Finally, we asked: “Would you agree, for this type of products, the application of a law that forced to indicate in the label that this food has been genetically modified or contains an genetically modified ingredient? In the Figure 2, we appreciated forceful a 91.2% of affirmative answers.

Conclusions

It can be concluded that consumers from Caracas, Venezuela recognized to the microbial contamination and pesticides as the most important concern in regards to food production (safety risk). When consumers graded the food safety hazard, they scored pesticides as serious hazards followed by irradiated foods and microbial contamination. None of consumers were concerned with biotechnology and it was graded as serious hazard only in a 13.4%. A high proportion of consumers recognized pesticides and microbial contamination as serious hazards for their health. Also, it could be postulated that Venezuelan’ consumers own more information in regards to pesticide and microbial contamination, than in regards to biotechnology. The consumers shown evident lack of information in regards to biotechnology, still more the genetically or transgenic foods and its marketing. A high score for acceptance of biotechnology application was reached for the statement “crops plants that reduce need for pesticides” and the less one was for the use of biotechnology for food ingredients. Consumers from Caracas have shown a high trend to prefer a mandatory label in the product which inform the presence of this technique and certified the product as a safe healthy product.

Acknowledgements

The authors thank for the endorsement granted by Project No.: S1-2000001311 supported by the Fondo Nacional de Ciencia, Tecnología e Innovación, Ministerio de Ciencia y Tecnología.

References

- Carullo J (2002) La Percepción Pública de la Ciencia: El Caso de la Biotecnología. Instituto de Estudios Sociales de la Ciencia y la Tecnología. Universidad Nacional de Quilmas. Argentina.
- Gendel SM (1998) Sequence Databases for Assessing the Potential allergenicity of Proteins used in Transgenic Foods. *Advances in Food and Nutrition Research*. 42: 63-92.
- Hernández M, Río A, Esteve T, Prat S, Pla M (2001) A Rapeseed-Specific Gene, Acetyl-CoA Carboxylase, Can Be Used as a Reference for Qualitative and Real-Time Quantitative PCR Detection of Transgenes from Mixed Food Samples. *J. Agric. Food Chem*, 49: 3622-3627.
- Hoban TJ. (1999) Consumer Acceptance of Biotechnology in the United States and Japan. *Food Technoogy*, 53(5): 50-53.
- Hübner P (2001) Validation of PCR methods for Quantization of Genetically Modified Plants in Food. *Journal of AOAC International*. 84(6): 1855-1864.

HGP.Human Genome Project, 2004. Genetically Modified Foods and Organisms. What are Genetically Modified (GM) Foods? In:
http://www.ornl.gov/sci/techresources/Human_Genome/elsi/gmfood.shtml

Lehrer SB, Horner WE, Reese G (1996) Why are Some Proteins allergenic? Implications for Biotechnology. *Critical Reviews in Food Science and Nutrition*. 36(6): 553-564.

Liu K (1999) Biotech Crops: Products, Properties, and Prospects. *Food Technology* 53(5): 42-48.

Peacock WJ (2000) The role of gene technology in food agribusiness systems. *Food Australia*. 52(8): 367-370.

Spiegelhalter F, Lauter FR, Russell JM (2001) Detection of Genetically Modified Food Products in a Commercial Laboratory. *Journal. of Food Science*. 66(5): 634-640.

About the authors:

David A. Pereira de A. Farmacéutico de la Universidad Central de Venezuela (UCV). y M.Sc. Ciencias Mención Ciencia y Tecnología de los Alimentos, Universidad Central de Venezuela (UCV). Cursante del Doctorado en Alimentos: Valor Nutritivo, Tecnología y Seguridad Alimentaria en la Facultad de Farmacia de la Universidad de Santiago de Compostela, España. e-mail: dpereira@usc.es

Karen Villalba R. Farmacéutica y Bombero, Universidad Central de Venezuela (UCV). Cursante del Doctorado en Química de Medicamentos en la Facultad de Farmacia de la Universidad Central de Venezuela y como Investigadora invitada en la Facultad de Farmacia de la Universidad de Santiago de Compostela, España. e-mail: karenvr@usc.es

Mileibys Schroeder. B.S in Psychology, University of Wisconsin-Stout (USA). M.S. Counseling Mental Health (Psychotherapy), University of Wisconsin-Stout (USA). Doctor in Education Candidate, St Mary's University of Minnesota (USA). Behavioral Science Department Faculty Member, University of Phoenix, Yuma Arizona E-mail: Mschroeder@phoenix.edu

Mercedes B. de Mosqueda. Biólogo, Doctora en Ciencia y Tecnología de Alimentos, Facultad de Ciencias Universidad Central de Venezuela. Profesora Titular del Instituto de Ciencia y Tecnología de Alimentos, Facultad de Ciencias de la Universidad Central de Venezuela.

Elevina Pérez S. Biólogo, M.Sc. Ciencias Mención Ciencia y Tecnología de los Alimentos, Universidad Central de Venezuela. M.Sc. in Science, major in Food Science and Nutrition University of Wisconsin-Stout. Doctora en Ciencia y Tecnología de Alimentos, Facultad de Ciencias Universidad Central de Venezuela. Profesora Titular del Instituto de Ciencia y Tecnología de Alimentos, Facultad de Ciencias de la Universidad Central de Venezuela