

Public knowledge and perceptions of biotechnology and genetically modified organisms in Iran

Mohammad Hasan Sheikhha^{1,2†}, Seyed Mehdi Kalantar^{1,2*}, Ali Reza Vahidi³,
Maria Faghihi⁴

¹Research & Clinical Center for Infertility Reproductive & Genetics Unit, Shahid Sadoughi Medical University, P.O. Box 89195-999, Yazd, I.R. Iran ²Yazd Medical Biotechnology & Genetic Engineering, P.O. Box 89165-1734, Yazd, I.R. Iran ³Department of Pharmacology, Shahid Sadoughi Medical University, P.O. Box 89195-999, Yazd, I.R. Iran ⁴Department of Computer, Yazd Islamic Azad University, Ashkezar, P.O. Box 89415-138, Yazd, I.R. Iran

Abstract

Biotechnology offers a variety of potential environmental, social and economic benefits but, it is the center of extreme public and political debate at present. A major field of discussion in biotechnology are genetically modified (GM) organisms. New medical, political, ethical and religious discussions arise over the production and consumption of these organisms. Many surveys have been conducted in industrialized countries to investigate the public perceptions regarding the risks and benefits of biotechnology, while in developing countries hardly any studies have been done so far. The present descriptive study intends to contribute to a better understanding of public attitudes toward biotechnology and GM foods in Iran. To assess the public's knowledge and opinions on the dangers or opportunities of genetic modification, 300 university students as a sample of educated community and 300 individuals with no university's education as a sample of ordinary people were asked to complete a specially designed questionnaire on the risks and benefits of biotechnology and GM foods. This article summarizes the current situation with regard to biotechnology, with a particular focus on GM foods and discusses the results of the survey. Our results indicated that public's knowledge about biotechnology is low in Iran and more efforts are needed to improve their understanding of different aspects of biotechnology.

Keywords: Biotechnology; Genetically Modified Organisms; Ethics; Public's knowledge; Public's perception.

INTRODUCTION

Genetic experiments have been done by human for centuries in the forms of crossing plants and animals

with the purpose of making them better for use and consume. At the present time, the genetic modifications are being done in a scientific way, by the use of more developed techniques capable of permitting the identification, manipulation and multiplication of genes in organisms, regardless of species borders. This new branch of science is known as biotechnology. One of the strongest performances of biotechnology is found in agriculture where the transgenic foods are produced. These genetically modified (GM) products are making many controversies among scientists.

In 1973, genes were transferred for the first time from one bacterium to another and later on, in 1977 the soil bacterium *Agrobacterium tumefaciens* was used to transfer alien genes into the plant cells. Large scale farming in USA starts in 1986 with soy bean, maize, rapeseed and cotton. The large numbers of GM plants which have been grown so far and the lack of any reported side effect indicate that biotechnology cause no immediate or significant risks (Stewart *et al.*, 2000). The symbolic situation for genetic engineering was changed by the imports of GM soya into Europe in 1996-97 (Bauer, 2002). After Chernobyl nuclear accident which caused a drop in the public trust of science, the founders of biotechnology recognized the strategic importance of risk assessment (Fleising, 2002).

Based on the scientific reports, biotechnology techniques can solve a potential problem with food supply by producing new plants, which are resistant to dry or excessive wet weather or can reduce the need for pesticides and herbicides. But what is the opinion of ordinary people about these types of changes? The awareness of biotechnology was very low a decade ago in most countries. For example, surveys indicated

*Correspondence to: Seyed Mehdi Kalantar, Ph.D.
Tel: +98 351 8247085 Fax: +98 351 8247087
E-mail: kalantarsm@ystp.ac.ir

†The 1st and 2nd authors have the equal contribution in this article.

that only about one-third of consumers in the USA have heard or read much about biotechnology. Similar results obtained from Japan, France and the United Kingdom in 1995 (Hoban, 1997). During recent years, increased media coverage lead to a rise in public awareness but not public knowledge. Media coverage is the main source of people's information on biotechnology and has significant influence on consumer attitudes. Therefore the media must be used by scientific community to reach the public with accurate information about biotechnology. The positive media coverage in the USA helps the relatively high levels of acceptance of biotechnology in there (Gaskell *et al.*, 1999). In America and Australia, GM foods are adopted in their agriculture policy while in almost all the European countries public attitudes toward biotechnology have been regarded as negative (Pardo *et al.*, 2002). The ambition across Europe to avoid GM foods has lead to an increase of demand for organic and GM-free foods. Meanwhile some companies announces that they are going to produce GM free because they do not want to lose their market due to the negative opinion of their consumers about the GM food.

The other important contributor of misinformation on biotechnology is the low knowledge about it in most countries. Different studies showed that Canada, the Netherlands, Sweden, and the USA are the countries with the highest levels of knowledge while Austria, Greece, Ireland, Portugal, and Spain are the countries with the least knowledge (Wagner *et al.*, 2002).

In Iran, this subject has not been a hot discussion. There are some groups that are against many new technologies including GM foods, pleading that these foods are dangerous to environment. On the other hand the other groups are in favor of GM foods which say that there is not any evidence of damage to health and environment. The risks of using these technologies against their benefits must be weighted either by society as a whole or by the scientific community. There are worldwide discussions on how to assess and to manage possible risks of GM foods and on the potential of biotechnology to improve global food security (McCullum *et al.*, 2003). An increasing number of consumers expect food producers and retailers to assume a major role in providing safe food (Bruhn, 1999). The important factor for risk assessment and management is obtaining a basic knowledge on GM food production, consumption and interaction with humans and environment. In addition, it needs availability of clear data that results from careful researches (Paparini and Romano-Spica, 2004).

Many surveys have been conducted in industrial-

ized countries to investigate the public perceptions regarding the risks and benefits of biotechnology, while in developing countries hardly any studies have been done so far. The present study intends to contribute to a better understanding of public attitudes toward biotechnology and GM foods in Iran. For this purpose, 300 university students as a sample of educated community in Iran and 300 people with no university education as a sample of ordinary people (known in this paper as non-students) were asked to complete a specially designed questionnaire on the risks and benefits of biotechnology and GM foods. A comparison of attitudes of ordinary people with the students was done to show how the different educational backgrounds influence public perceptions.

MATERIALS AND METHODS

A total of 300 students (166 female and 134 male) and 300 non-students (154 female and 146 male) contributed to this survey. The students were randomly chosen from Shahid Sadoughi Medical University, Yazd University and Yazd Islamic Azad University and the non-students were chosen in a variety of locations like shops, factories, banks and shopping centres by simple random method, regarding to the gender, job, etc. The students were originally from different parts of country coming to Yazd for continuing their higher education. The median age of the students was 20 years (range 17-27 years) and of non-students was 36 years (range 21-54 years).

A questionnaire was designed to evaluate their knowledge and perceptions about biotechnology and GM foods. The questionnaire was developed by expert opinions and was validated on a focus group. It starts with a brief statement about the nature of biotechnology to give elementary information to the participants follows by 15 multiple choice questions. Recently, scientists have made GM rice in Iran. The first part of the questionnaire was questioning their opinion about this rice. The second part was about the most important benefit and risk of biotechnology in agriculture. Followed by their overall idea about GM foods? In the next part their possible concerns about biotechnology were asked and finally their knowledge was assessed. The study was approved by the Research Ethics Board of Yazd University of Medical Sciences and informed consent was provided to the participants. The data were compared by ANOVA using SPSS version 11.0 for windows. The level of *p-value* <0.05 was considered as significant.

RESULTS

Regarding the GM rice, our survey showed that only 13% of the participants would like to eat this new rice, while 60.5% do not like to eat it and 26.5% are not sure. In addition, 95% believe that the rice should be clearly labelled as GM, and if so, 58.1% agree with the production of this new rice. Ninety seven percent of the participants did not know if this rice is in market or not and in response to their reaction if they realize that this new rice is in the market and they unintentionally used it, 25.9% said they would be extremely angry, 53.9% would be angry, 15.2% have less concern and only 5.2% said it has no importance.

The present survey showed that the public's concern toward biotechnology is different by the type of changes made; genetic modification on plants is more acceptable than this modification on animal or human. There was less concern for the application involved crops or for producing new medicines than there was for meat production.

Furthermore, 39.8% of participants said that they would eat GM foods if they were nutritious but only 19.8% would eat them if the only advantage was that the food is cheap. The percentage of non-students who would eat the cheaper GM foods was significantly higher than students (24.7% vs. 14.5%, $p=0.04$). Similarly, this rate was significantly higher in men than women (30% vs. 10.3%, $p=0.002$).

The results indicated that 79% of students and only 18% of non-students have read or heard something about GM foods before participating in our survey. Furthermore, 95.2% of the participants demand more information related to GM food or biotechnology.

When the participants were asked about the expected benefits of biotechnology, 27% believed it is the foods with better quality, 18.5% chose profits for farmers, 16.5% higher production of agricultural products and 14.5% said that using less pesticide is the supposed benefit. Twenty two percent believed that biotechnology can bring all of these benefits, while 16% said it has no benefit at all. Differences were detected between students and non-students with regards to their believes that biotechnology can bring all of these benefits, where 36% of students but only 8% of non-students had this belief ($p=0.001$). On the other hand, 28% of non-students think that biotechnology has no advantages at all while this rate was only 4% among students. Overall, our data showed that only 12.2% of participants, considering the benefits of biotechnology, are ready to accept unintentional risks of it, while the majority of them (78.3%) are not ready to accept these risks and 9.5% are not sure about this.

In total, 60% of students have negative view about GM foods while this rate was 87.3% for non-students. There was a gender gap in feelings toward genetic engineering in our study. It was found that men were more likely than females to believe that the benefits outweighed the risks (19.3% vs. 10.6%) ($p=0.035$). Overall 40.7% of men had a positive view about GM foods compared with 30.3% of females ($p<0.05$).

When the participants were asked about the expected risks of biotechnology, 37% believed it is the unknown impacts of experiments using in biotechnology, 32% chose ethical problems, 22% risks of food and allergies, 14% producing viruses with new mutations, 11% environmental risks and 8% said that this will make the quality of food worse. Twenty eight percent believed that biotechnology can bring all of these risks, while only 2% said it has no risks at all.

This survey has also showed that 69% of the students and 41% of non-students have trust in information regarding GM organisms published by ministry of health and educational sciences.

DISCUSSION

Modern biotechnology with its progressing scientific breakthroughs has been under public inspection and political discussion around the world for over 30 years (Cantley, 2004). In modern societies, acceptance of new technologies is highly related to the public perceptions. Therefore, Public perceptions of biotechnology have received extensive consideration in recent years in most countries and several surveys have been done in this regards (Hoban, 1997; Angus Reid, 2000; IFIC, 2000; Morris and Adley, 2001). These surveys have shown that people's attitude toward biotechnology is different and a number of inter-related factors have major influences on consumer acceptance or rejection of the technology. Overall the people's knowledge levels, awareness of benefits, confidence and trust have an important effect on acceptance of biotechnology, while, more negative media coverage and activist opposition have negative effect on it (Hoban, 1997). The type of information provided by media is very important factor in consumer perceptions and understanding of biotechnology. Some believe that the preferred source of information on GM food is balanced argument (Wilson *et al.*, 2004). The present survey showed that 79% of students and only 18% of non-students have read or heard something about GM foods before participating in the survey. We compared this result with a survey performed in 8 countries (Australia, Brazil, Canada, France, Germany,

Japan, United Kingdom and the USA) which examined public knowledge and perceptions regarding GM foods (Angus Reid, 2000) (Fig. 1).

Trust in information sources, and regulators are likely to play a major role in determination of people reactions to GM products (Frewer *et al.*, 1995). Differences between reactions to biotechnology in Europe and USA seem to be a result of different trust, rather than differences in knowledge or education (Priest *et al.*, 2003). According to a survey in Canada, people only trust independent regulators, academics, and health professionals to provide information about GM foods (Pollara and Earncliffe, 1999). The present survey showed that our people have more trust on the articles published by the ministry of health and educational sciences. Regarding gender differences, females in our study demonstrated less acceptance than did males. This was similar to results of the other studies (Siegrist, 2000).

The other factors such as a country's culture and history and economic conditions are important in people support for biotechnology. A similar survey in the Philippines and Mexico shows that public attitudes in both countries are fairly similar, while there were some significant differences in perception often related to cultural and political aspects. However, people in both countries were concerned about the potential impact of transgenic crops on their countries' rich biological variety (Aerni, 2002). One of the fundamental concerns about GM food is the view that GM is unnatural (Verhoog, 2003). Only 12% of the students in the presents study consider ethical problems, while 52% of non-students consider the ethical problems as the main disadvantage of GM foods. A recent survey in UK on 126 adults (mostly from a student population) showed that, when rated in the context of other concerns such

as human cloning, there was less concern about GM food than might have been anticipated. GM food was not viewed as unethical, was judged as controllable, and was viewed as a hot topic (Townsend *et al.*, 2004). It seems that the public's objections are not for all the aspects of biotechnology but it focus on specific applications of it, such as applications involving animals or human genetic material (Frewer *et al.*, 1997). The present survey supports these facts that people are more likely to support biotechnology involved in crop improvement, compared to applications with animals. Overall, the data in the present study indicates that 74% of our people (60% of students and 87% of non-students) have negative view about GM foods which is comparable to the results from an international survey on the eight countries (Angus Reid, 2000) (Fig. 2). In USA, between two-thirds and three-quarters of consumers are positive about biotechnology while only 26% of participants in the present study were positive about GM foods. In a recent survey in UK on 100 individuals, 93% willingly tasted and ate what they believed to be GM food, and 48% said they would buy GM food in the future (Townsend and Campbell, 2004). In contrast, only 13% of participants in the present survey said that they would like to try new GM rice. We compare the public's opinion in the present study about possible benefits and risks of biotechnology with the data obtained from the other surveys done in different countries (Angus Reid, 2000) which is shown in Table 1 and Table 2. The percentage of students (37%) in our survey which believe that better quality of food is the main benefit of GM foods is significantly higher than the other countries. In addition 53% students in our survey believe that unknown impact of experiments is the main risk of GM foods (compared with 21% of non-students).

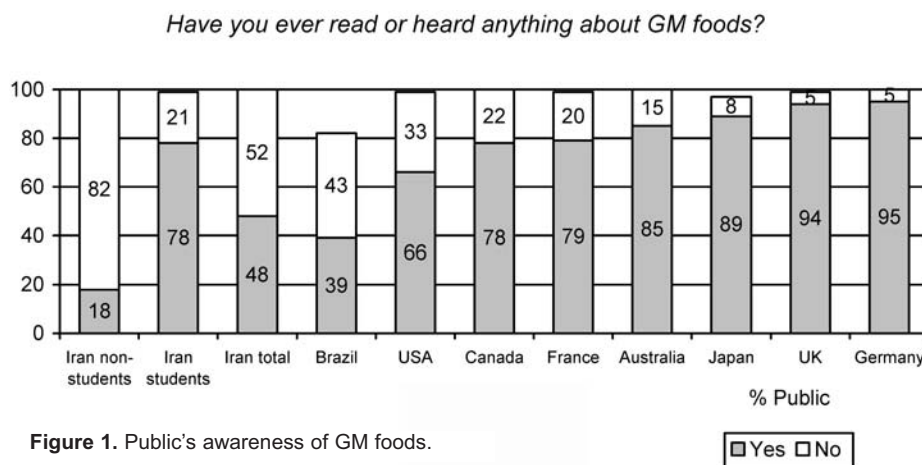


Figure 1. Public's awareness of GM foods.

See the trends towards GM foods as ...

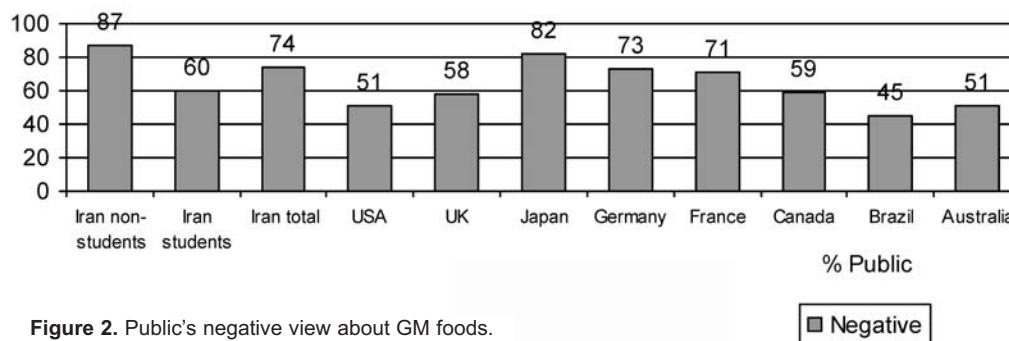


Figure 2. Public's negative view about GM foods.

The labelling of GM food is the most challenging issues about agricultural biotechnology. Most of the societies believe that all the GM foods must be labelled to give the information to the people so they can exercise a choice between consuming GM foods or not. On the other hand, the food industries worry that consumers will perceive a “GM label” as a negative signal. For this reason, some agricultural economists suggested that foods that do not contain any GM ingredients be labelled “GM-free.”, rather than the other

way around. Regarding labelling the GM foods, 95% of our respondents wanted the GM rice be clearly labelled which is similar to the 93% showed by Pollara and Earncliffe (1999).

Most scientists describe risks in relatively narrow, quantitative terms, while the consumers view risk very differently from scientists (Groth, 1991). Therefore, to communicate effectively with ordinary people about GM food, scientists need to understand how they understand risks. In a survey in Italy two groups of

Table 1. The percentage of respondents answering to this question: Overall, what would you say are the main benefits or advantages of GM foods?

Total Mention	Iran	Australia	Brazil	Canada	France	Germany	Japan	UK	US
Productivity / higher yields	16	24	20	29	20	22	50	21	31
Quality of food – better	27	12	16	17	8	14	19	10	16
Less pesticides required	14	15	12	18	12	17	17	15	15
Profits for agriculture industry	18	4	9	6	9	7	20	7	3
Overall good/many benefits	22	4	14	2	1	3	4	2	2
None/No advantages	16	21	27	24	45	32	13	34	20

Table 2. The percentage of respondents answering to this question: Overall, what would you say are the main risks or disadvantages of GM foods?

Total Mention	Iran	Australia	Brazil	Canada	France	Germany	Japan	UK	US
Food safety/health concerns/allergies	22	23	20	32	37	35	37	18	28
Impact unknown / experimental	37	28	18	29	26	25	41	38	25
Virus / Mutations	14	11	18	11	15	13	50	14	10
Environment / Ecology	11	7	8	4	10	8	16	11	4
Ethics / "Playing God"	32	10	8	5	9	2	17	8	6
Quality of food – worse	8	8	7	5	6	7	3	3	3
Overall bad / Many risks	28	8	12	4	13	10	9	15	5
None / No disadvantages	2	5	9	9	5	9	2	12	15

non-experts and experts were asked about the risk perceptions of a series of biotechnology applications. Compared with the experts, the public perceived all biotechnology applications as more risky. Food-related applications were perceived to be riskier than medical applications by both groups (Savadori *et al.*, 2004). Public opposition to GM food is generally clarified as the result of the public's misperception of the risks (Gaskell *et al.*, 2004). An open dialogue between science and society and a better understanding between scientists and media experts is needed to bring public perception of the biotechnology closer to the reality (Braun and Moses, 2004). Industry and government should recognize that spending huge amount of money to do research into GM foods mean nothing without consumer acceptance. Public acceptance in addition to scientific progress is the key factor for continuing progress in biotechnology. Better collaborations among scientists, policymakers, community leaders and consumers are needed to achieve public confidence (Underwood, 2003).

Biotechnology in Iran is at a critical point in terms of public acceptance. The results of the present survey showed that 95.2% of the people want to learn more about GM foods and demand more information about biotechnology. Actions and statements by industry, government, and scientists will have a major influence on this issue. There must be a major obligation to provide relevant education and information to people. We can not employ the same approaches used by the other countries as; different parts of the world with essential cultural differences clearly require different approaches.

In conclusion, there should be a long-term partnership between the government, industry, and universities for the education of people before any GM food reach the market. The existing risks and benefits of biotechnology such as the hope that biotechnology brings for feeding the world, protecting the environment and fighting disease should be shown to people and it is also very important that people trust the source of their information. The goal of these actions should be an informed public (about both risks and benefits) so they can make informed decisions.

References

- Aerni P (2002). Stakeholder attitudes toward the risks and benefits of agricultural biotechnology in developing countries: a comparison between Mexico and the Philippines. *Risk Anal.* 22: 1123-1137.
- Angus Reid Group Inc. (2000). Significant Knowledge Gap In: *Debate Over Modified Foods* (Available: <http://www.angus-reid.com/MEDIA/CONTENT/>)
- Bauer MW (2002). Controversial medical and agri-food biotechnology: a cultivation analysis. *Public Underst Sci.* 11: 93-111.
- Braun R, Moses V (2004). A public policy on biotechnology education: what might be relevant and effective? *Curr Opin Biotechnol.* 15: 246-249.
- Bruhn CM (1999). Consumer perceptions and concerns about food contaminants. *Adv Exp Med Biol.* 459: 1-7.
- Cantley M (2004). How should public policy respond to the challenges of modern biotechnology? *Curr Opin Biotechnol.* 15: 258-263.
- Fleising U (2002). The legacy of nuclear risk and the founder effect in biotechnology organizations. *Trends Biotechnol.* 20: 156-159.
- Frewer L, Hedderley C, Howard C, Shepherd R (1997). Objection" mapping in determining group and individual concerns regarding genetic engineering. *Agri Hum Values.* 14:67-79.
- Frewer L, Howard C, Shepherd R (1995). Genetic Engineering and Food: What determines consumer acceptance? *British Food J.* 97: 31-36.
- Gaskell G, Bauer MW, Durant J, Allum NC (1999) Worlds apart? The reception of genetically modified foods in Europe and the U.S. *Science* 16:285: 384-387.
- Gaskell G, Allum N, Wagner W, Kronberger N, Torgersen H, Hampel J, Bardes J (2004). GM foods and the misperception of risk perception. *Risk Anal.* 24: 185-194.
- Groth E (1991). Communicating with Consumers about Food Safety and Risk Issues. *Food Technol.* 248-253.
- Hoban TJ (1997). Consumer Acceptance of biotechnology: An International Perspective. *Nat Biotechnol.* 15: 232-234.
- McCullum C, Benbrook C, Knowles L, Roberts S, Schryver T (2003). Application of modern biotechnology to food and agriculture: food systems perspective. *J Nutr Educ Behav.* 35: 319-332.
- Morris SH, Adley CC (2001). Irish public perceptions and attitudes to modern biotechnology: an overview with a focus on GM foods. *Trends Biotechnol.* 19: 43-48.
- Paparini A, Romano-Spica V (2004) Public health issues related with the consumption of food obtained from genetically modified organisms. *Biotechnol Annu Rev.* 10: 85-122.
- Pardo R, Midden C, Miller JD (2002). Attitudes toward biotechnology in the European Union. *J Biotechnol.* 11;98: 9-24.
- Pollara and Earnsccliffe (1999). Majority immune to biotech health scare: Willing to take risks. Kathryn May, National Post, July 24, 2000. (Available: <http://www.nationalpost.com/scripts/printer/printer.asp?f=/stories/20000724/352505.html>)
- Priest SH, Bonfadelli H, Rusanen M (2003). The "trust gap" hypothesis: predicting support for biotechnology across national cultures as a function of trust in actors. *Risk Anal.* 23: 751-766.
- Savadori L, Savio S, Nicotra E, Rumiati R, Finucane M, Slovic P (2004). Expert and public perception of risk from biotechnology. *Risk Anal.* 24: 1289-1299.
- Siegrist M (2000). The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk Anal.* 20: 195-203.
- Stewart CN Jr, Richards HA 4th, Halfhill MD (2000). Transgenic plants and biosafety: science, misconceptions and public perceptions. *Biotechniques* 29: 838-843.
- Townsend E, Campbell S (2004). Psychological Determinants of Willingness to Taste and Purchase Genetically Modified Food. *Risk Anal.* 24: 1385-1393.
- Townsend E, Clarke DD, Travis B (2004). Effects of Context and Feelings on Perceptions of Genetically Modified Food. *Risk*

Archive of SID

- Anal.* 24: 1369-1384.
- Underwood BA (2003). Scientific research: essential, but is it enough to combat world food insecurities? *J Nutr.* 133: 1434S-1437S.
- Verhoog H (2003). Naturalness and the genetic modification of animals. *Trends Biotechnol.* 21: 294-297.
- Wagner W, Kronberger N, Seifert F (2002). Collective symbolic coping with new technology: Knowledge, images and public discourse. *Br J Soc Psychol.* 41: 323-343.
- Wilson C, Evans G, Leppard P, Syrette J (2004). Reactions to Genetically Modified Food Crops and How Perception of Risks and Benefits Influences Consumers' Information Gathering. *Risk Anal.* 24: 1311-1321.