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THE DISCRETE CHOICE ANALYSIS AS A VALUABLE TOOL FOR ESTIMATING CONSUMER ATTITUDES TOWARDS GENETICALLY MODIFIED FOOD IN EUROPE

Floriana Marin, Lucia Martinelli
Istituto Agrario di San Michele all'Adige, Italy

Abstract

Previous research has demonstrated that gene transfer techniques are perceived differently by different people and that their acceptability depends considerably on risk-benefit considerations. Despite the prospective benefits claimed by Genetically Modified (GM) food promoters, public acceptance remains low. Individual preferences are affected by many factors, including: personal utility (price, improved nutritional characteristics), risk perception, and beliefs (sustainable development). Consequently, purchase behavior could be a suitable indicator of attitudes in GMP choice. In this respect, Discrete Choice Methodology proves to be a valuable tool for estimating such attitudes. This methodology assumes that people purchase goods by comparing the costs and benefits of each alternative. The final choice is the product that maximizes the consumer's utility and the one for which she or he is most willing to pay. The use of Discrete Choice Analysis helps to identify the key variables that affect purchase decisions by providing information on preferences for various aspects of a complex food system. Consequently, the results of our analysis may provide valuable guidelines for scientific research, as well as for defining strategies for GMO management and development.

Keywords: Discrete Choice Methodology, GMO, consumer behavior, risk perception

1. Introduction

Consumer concerns about food safety are an important issue that public authorities and private organizations have to deal with constantly, especially when genetically modified organisms (GMOs) are involved in food processing. Several studies suggest that this specific application of gene technology is still a major topic of debate in the society, even though its first introduction in the global market is dated to the beginning of 1990s.

Moreover, many respected figures and agencies continue to proclaim the prospective benefits of DNA transfer techniques for socio-economic development and production [1]. Moreover, GMO cultivation is rapidly spreading around the world. The International Service for the Acquisition of Agri-Biotech Applications (ISAAA) reports that in their first decade of commercialization (1996-2005), the global area of GM crops has increased more than fifty fold. In 2005, biotech crops covered about 90 million hectares, an increase of 9 million hectares compared to the data available for the year 2000 [2]. Despite their great diffusion and the positive opinion that many influential subjects have about GMOs, European attitudes towards GM crops tends to remain negative, and public acceptance of GM foods remains low [3].

In this context, European Union (EU) chose to adopt a *precautionary approach* for the management of GMOs in scientific research, food processing and market release. Accordingly, whenever there are possible grounds for thinking that a specific action or phenomenon can have serious health consequences, but no complete scientific information is available to ascertain the very implications of the risks in discussion, decision makers can take temporary actions to protect human health from risks until new and more complete knowledge on the facts has been obtained [4]. In this framework, the EU has established specific directives and regulations to make sure that agrobiotech research and GMO circulation around Europe takes place in safety for the citizens and the environment. Consequently, only GMOs that have passed all the requested controls for the risk assessment are allowed to be released in the European markets [5].

Nonetheless, the transfer of agrobiotech research from the laboratory to application and the market still raises a whole range of collective fears and meets with social rejection despite having met the requested controls and having obtained the necessary authorization [6, 7, 8]. Moreover, opposition to GMOs persists even though these technologies were presented as highly promising for improving agro-food production and for treating human diseases and environmental problems.

The research we are carrying out aims to provide more extensive knowledge of how consumers evaluate the benefits and risks associated with genetic modification and to examine the factors that affect final purchase choice when GMOs are used in food processing. Moreover, we are convinced that extensive knowledge of the society's attitudes, priorities and interests with regard to agro-biotechnology applications can play a crucial role in providing accurate and transparent information, and in helping people to respond constructively to technology transfer. Thus, attitude identification could be the starting phase of a strategic risk communication plan, providing insights about public understanding of risks and technologies that, in turn, will help us to bridge the gap between science and society.

In this paper, we describe the methodology chosen for the current study and the preliminary results of the qualitative analysis conducted during the last months of 2005. Section 2 reports on previous studies which estimated attitudes and different perceptions with regards to technology innovations and to GMOs in particular. Section 3 summarizes the principal findings on attitude construction, risk perception and consumer behavior. Section 4 formally discusses the methodology chosen for this study, while Section 5 focuses on the main results we obtained in the first part of this analysis (qualitative focus group study). Finally, Section 6 sketches out future work and outlines the possible policy and research implications of this investigation.

2. Public attitudes towards GM technologies

Public reactions for the supposed GMO "threat" share many similarities with other technology transfers such as nuclear power, electromagnetic fields and waste management [9, 10]. Regarding technologies, individuals' *self-constructed* estimates of the unknown effects of a certain technology on health and the environment seem to play a major role in determining opposition behavior, compared with the scientific evaluations of the same technology [11, 12]. As a consequence, the strong feeling of dread that characterizes society's response to a specific technology application may hamper and eventually stop progress in scientific research, creating an inexorable break between science and society [13].

For a long time, the foremost social research theories have explained such phenomenon by focusing on citizens' supposed lack of familiarity and knowledge of the scientific facts [14]. However, evidence of the latest years proved that the public support of some specific technology applications does not depend on the level of exposure to scientific facts or on the quality of information. Thus, deeper knowledge of a question does not result directly related to a more diffused public approval [15] and this fact seems to be particularly true in the case of nuclear power and GMOs [16]. Moreover, many surveys that have concentrated on the matter of biotechnologies in the public sphere in Europe and in Italy specifically [6, 7, 8, 17, 18, 19, 20] found that people vary in their level of support for different applications of gene technology. In fact, genetically modified (GM) applications in health care receive great support, while GM food and xenotransplants, conversely, are least supported [21, 22, 23]. Moreover, it was found that GM microorganisms and plants are associated with fewer risks to health compared to GM animals [24].

Thus, many factors other than lack of information can be crucial in defining public consensus towards gene technology applications: among them, ethical concern, trust in technology promoters and individual utility perception [16, 25, 26, 27]. Deep understanding of citizen reaction to technology transfer and the ability to properly interpret the motivations behind such responses are crucial for institutions that want to govern innovation democratically and efficiently. Analyzing how positive or negative attitudes translate into actual behavior can make a valuable contribution toward identifying people's needs and priorities with reference to gene technology.

In this framework, we are carrying out research based on an economic approach. This will enable us to understand purchase behavior as tangible expressions of an individual's choice to consume or reject GM food products.

3. Consumer behavior theory

GMO products allowed to circulate in the European Union have to pass through a complex chain of severe institutional safety controls. When released into the European markets, these products are declared safe according to the European Union regulations for GM food and feed [Reg. 2003/1829/CE and Reg. 2003/1830/CE]. Nevertheless, the great majority of European citizens still perceive GM food to be different from conventional non-GM products. In the latest social surveys [6, 7, 8], European consumers were strongly opposed to the "intrusion" of GM foods in their every day lives, claiming that there is still a lack of proof regarding their safety or superior quality compared to conventional food. In particular, people feel that despite to their similar appearance GMOs have different traits and are produced in different ways compared to "traditional" organisms [6, 7, 8].

Several studies have demonstrated that the intent a person declares with regard to a matter often differs from how he or she acts in actual situations because of personal attitudes and social influence [28, 29]. This behavior results because of uncertainty: the combination of emotional, political, cultural and ethical questions influences the construction of individual attitudes and strongly contributes to the final choice [30, 31, 32]. Moreover, individual self-confidence, perceived levels of personal control over choices, and social pressures seem to relate to acceptability or rejection of GM foods [11, 33, 34]. Judgments about GM products, for instance, proved to be formed first by the individual. In a second step, they are made explicit as purchasing decisions that, in turn, can be influenced by additional factors like "other people's behavior", price, or the promised properties of the goods. Because the market system is based on the free circulation of goods and services, consumers can express their preference by their right to choose, thus exerting their purchasing power. Consequently, purchase behavior proves to be a suitable and realistic indicator of an attitude toward GM food choice.

Following this line of reasoning, benefits and costs are defined in terms of individual preferences, but can be affected by many other factors, for example, personal utility (price, improved nutritional characteristics), risk perception, and beliefs (sustainable development). Accordingly, recent social research findings showed that "without the perception of an improvement in the status quo in terms of quality, price or other attributes, there is simply no incentive to deliberate further on the issue" of GM food [17].

The Rational Consumer Theory, one of the milestones of economic science [35], states that consumers are rational agents in their choices because they always pursue their own utility maximization under a budget constraint. The direct

implication of this statement is that an individual always chooses the most efficient good or service bundle in the market, following the rationality condition for which, among similar goods and services, she or he will always choose what is better in terms of price and quality. We can see a discrepancy between what we said before and Consumer Theory: because a consumer could choose to avoid a GM food and not purchase it if she or he thinks that it is not worthwhile, even if the GM food price is lower than the price of another non-GM food with similar characteristics.

As facts seem to demonstrate, many other crucial factors affect individual actual choice. In this context, the use of specific methodologies that are able to deal simultaneously with several different variables is crucial in order to achieve a thorough knowledge of the complex issue of public perception of agrobiotechnology [36, 37, 38, 39].

4. Discrete Choice Methodology

Discrete Choice Methodology proved to be a valuable tool for estimating attitudes towards gene technology products. This methodology was conceived in marketing and transport studies, and was recently applied in environmental economics to estimate the social value of natural resources such as eco-system quality, the costs of air pollution, or of food safety [40]. Due to their nature, such goods do not possess a market price, being characterized by the following attributes: *non-rivality* (the consumption by one person does not reduce the good quantity available to other people), and *non-excludability* (the good is available to everybody and not only to those persons who pay for it). As a consequence, these commodities have a strong social relevance. Thus, every decision concerning their supply, improvement or management has to take into account the value that society is likely to assign to them [41]. For example, what cost would the society be willing to pay for the guaranteed absence of GMO components in food? On the other hand, what kind of benefits would make the consumption of GM food worthwhile? The answer to these questions — that point out the relevance of the individual's money valuations associated to the costs and the benefits of a certain decision—can be provided by various valuation techniques, among them the Discrete Choice Methodology (DCM).

This methodology operates in the theoretical framework of Lancaster Consumer Theory. It assumes that each good can be depicted as a combination of characteristics or *attributes* and that each attribute has a specific role in the definition of the total value of the good [42]. The exemplification by Veeman and Adamowickz [43] is a clear explanation of this aspect: in pursuing the objective of a healthy diet, an individual is likely to purchase low-fat foods. Similarly, when a consumer purchases yoghurt, she or he is looking for a combination of various attributes, such as low-fat ingredients, use of organic production processes, good taste, quantity of fruit content, percentage of GMO presence, price, and so on. So, when considering altogether the different yoghurt options available at the supermarket, a consumer would compare the costs and benefits of each alternative yoghurt on the basis of her/his personal preferences and estimates of utility. The final choice will be the purchase of yoghurt that maximizes his or her utility, and the one for which she or he is most willing to pay. DCM is founded on a basic principle: individuals choose among alternative options characterized by a certain number of attributes (e.g., GMO content, price), which may be present to different degrees in the good (e.g., 0% or 15% GMO content; 40 Eurocent or 35 Eurocent price). Every change in attribute levels results in the production of different goods or services: DCM focuses precisely on the value that people confer on such changes in attributes.

DCM is built on the Random Utility Theory [44, 45], which assumes that, one, among a number of options, individuals select the alternative with the greatest utility; and that, two, the probability of being selected increases with the level of utility promised by the alternative [46].

The utility that individual *q* derives from the consumption of the good *i* can be formulated as

$$U_{iq} = \sum_k \beta_k X_{ki} + e_i \qquad (1)$$

where the X_{ki} are the quantified attributes of the good *i* and þ ix a coefficient that ix known or extimated by the researcher. From the Random Utility Theory, Eq. (1) can also be expressed as

$$U_{iq} = V_{iq} + e_{iq} \qquad (1a)$$

In Eq. (1a), V_{iq} is the systematic component of the utility that is built up by attributes observable by the analyst, while e_{iq} is a random element that the researcher is not able to directly detect, simply because she or he cannot "read the consumer's thoughts". Let us consider, GMO food consumption. As we introduced in Sections 1, 2 and 3, in the great majority of cases, opposition to GMOs persists even though these technologies were presented as highly promising for improving agro-food production, treating human diseases, and resolving environmental problems. Hence, perceived GMO risks are unbalanced with respect to prospective GMO benefits. We cannot establish *a priori* how much a person is a "risk taker", but we can clearly see what her behavior is when purchasing food with various levels of "risky" attributes (pesticides, toxins, etc.). Accordingly, Eq. (1a) enables us to model an individual choice as the effect of the presence and the quantity of specific attributes (systematic component), as well as the outcome of an individual's specific socio-economic environments, summarized by the inclusion of the random term.

Following the assumptions of Random Utility and considering, for the sake of simplicity, only two goods, i and *j*, consumer *q* will choose the good which promises the greatest utility. So *i* will be chosen when:

$$U_i = V_i + e_i > U_j = V_j + e_j \quad iÇj \qquad (2)$$

From Eq. (2), the probability that good *i* will be chosen from *n*=2 possible options, *i* and *j*, can be expressed as follows:

$$n_i = \text{Prob}\{ U_i = V_i + e_i > U_j = V_j + e_j \quad i \neq j\} \qquad (3)$$

Assuming that error terms are independent and identically distributed following a certain probability distribution (Normal, Logistic, Gumbel, etc.) [44], the probability n_i of choosing option *i* from a set of *n* alternatives (namely, *choice set*) can be expressed as follows:

$$n_i = \frac{\exp\left[\sum_{k=1}^{K} \beta_k X_{ki}\right]}{\sum_{n=1}^{N} \exp\left[\sum_{k=1} \beta_k X_{kn}\right]} \qquad (4)$$

Eq. (4) describes the relationship between the alternative *i*'s selection probability and the attributes of the whole *n* alternatives in the choice set for a utility maximizing consumer in the framework of Random Utility Theory. Accordingly, the probability that *i* will be chosen depends upon the comparison between the expected utility of all the attributes that characterize *i*, and the expected utility of the other *n* alternatives faced by consumer *q*.

The formula in Eq. (4) summarizes the basic choice model, called Conditional Logit or Multinomial Logit Model (with more than two alternatives) and it can be estimated using standard econometric packages.

Data for the discrete choice analysis (DCA) can be collected using specifically designed questionnaires in which respondents are faced with different bundles of attributes and levels. Using DCM implies that people interviewed are asked to choose the product with the combination of attributes and levels which provides the higher level of utility. In order to obtain monetary values, different prices for different bundles of attributes are included in the choice sets.

After the survey, individual choices are aggregated and analyzed by means of statistical procedures.

The use of DCA helps to identify the key variables that affect purchase decisions—in this specific case, for GM foods—by providing information on preferences for various aspects of a complex food system.

In comparison to similar methodologies, the great advantage of DCA stems from the fact that it helps predict choices concerning hypothetical products that still have to be released to market. For example, Burton and Pearse [47] estimated the levels of acceptance of different kinds of GM beer with prices and health attributes, finding that consumers would be willing to pay extra money for health characteristics in beer. Baker and Burnham [48] used consumer choice models to identify groups of consumers based on their valuation of GM product attributes and to detect which socio-economic characteristics can be associated to the preference for GM foods. Their results provide evidence that socio-economic variables do not affect GMO preference. However, cognitive factors like risk aversion and opinions regarding GM foods have great influence on the acceptance or rejection of GM products. Burton et al. [49] applied DCM to study consumer willingness to pay to avoid GM products, and to identify the effect this has on purchase-decision attributes such as health, processing techniques, information, and structure of the food system. Specifically, they found that GM applications are perceived differently, depending on whether GMOs are obtained from the DNA transfer from plants or animals. Onyango and Govindasamy [50] adopted a DCM approach to investigate how consumer valuations of particular attributes vary across different product types. Their results suggest that social attitudes are more favorable toward GMOs produced from plants where genes of the same species are transferred. Thus, for these goods, positive reception could be expected in the US market.

5. Field research

Beyond their usefulness in market surveys, the results from DCM can provide valuable guidelines for scientific research itself, as well as for governance and decision-making processes in delicate matters such as the introduction of novel foods [51, 52, 53].

We are carrying out research based on DCM that is aimed at revealing consumer preferences with respect to food products where hypothetical GM ingredients were associated with functional characteristics. Our purpose is to deeply understand how consumer preferences vary according to use and promised effects of different GMOs. Specifically, we want to test and understand: (a) if people are averse to biotechnology *in se* or only to specific applications of biotechnology; (b) if the use of GMOs in food production is always and *a priori* perceived as "risky"; (c) if individuals' attitudes to GMOs reflect their final behavior and choice (i.e., how people behave and choose when particular risks and benefits are associated to GMO presence in food); (d) what are the levels and kinds of benefits for which people accept a given degree of risk, and (d) if demographic or socio-economic factors influence in some way final choice or risk-benefit trade-offs.

We carried out research in the Autonomous Province of Trento (Trentino), in northern Italy, whose economy is mainly based on agricultural activities, environmental services, and tourism. Dairy production is one of the most representative activities in Trentino, so we selected yoghurt as a target product for our study. Yoghurt is very familiar to

Trentino's inhabitants and its consumption is common and generalized. Moreover, yoghurt can be considered a functional food, thanks to its healthy properties [54, 55, 56]. In our simulation, yoghurt was hypothesized to be the product of conventional food processes or, alternatively, produced using GMOs for various aims, namely higher agricultural yields, lower environmental impacts, or the prevention of serious diseases.

DCM results depend greatly on the questionnaire design phase, which should be as realistic and informative as possible for the researcher, while being plausible and meaningful to the respondents. Before starting field research, we carried out two focus groups with local consumers to test our decision to use yoghurt for DCM. This allowed us to gain insight about general attitudes toward GM foods and to identify crucial attributes and levels about yoghurt that we could use in the survey phase. Focus groups represent a kind of social analysis which involves the study of qualitative information rather than quantitative data [57, 58]. Focus-group techniques prove to be a valuable tool in the questionnaire design phase, because they offer the opportunity to get face-to-face with the individuals who are closest to an investigated topic. Therefore, this technique enables us to investigate more aspects compared to the traditional one-on-one interview. Verbal interaction occurs with moderator guidance in order to ensure that only crucial issues are discussed during the meeting. Focus group participants are invited to talk about a number of subjects that are presented in various modalities: videotapes, images, and articles. Literature reports several definitions of the focus group method. Among them, organized discussion [59], collective activity [60], social events [61] and interaction [62] identify the contribution that focus groups give to the social research [63]. According to Powell [60], a focus group is "a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of the research". In this view, this method relies on interactions within a group involved in topics supplied by the researcher [64]. Nevertheless, they have to be considered a preliminary phase of the analysis, and have to be followed by the main survey, which offers more details [41].

In our experience, accordingly, we were able to obtain deep insight and produce valuable data following the interactions among participants. In fact, compared to the individual interviews which aim to obtain individual attitudes, beliefs and feelings, focus groups elicit a multiplicity of views and emotional processes in a group context. This enables the researcher to gain a greater amount of information in a shorter period of time [11, 34].

5.1. Focus group results

We carried out two focus groups to assess attitudes towards genetically modified food and to design the questionnaires and choice sets for the subsequent Discrete Choice Analysis. The first focus group took place in Borgo Valsugana (Trento, Italy) and involved a group of women of different ages, level of education, and occupation, while the second one engaged male and female researchers from a local Information Technology research institute at Povo (Trento, Italy). Both meetings focused on our respondents' household food expenses, family habits and individual perception of nutraceuticals and GMOs.

Results of the meetings proved that yoghurt is consumed by the great majority of the people interviewed. There were, however, a few cases of milk intolerance. Our respondents said that when they purchase yogurt they take extreme care with the specific attributes of taste, quality (in strong association with the place of origin) and, sometimes, price. The stress on the "place of origin" attribute in purchasing decisions can be explained by the context of agricultural and environment-friendly practices and by the presence of several local dairy industries throughout Trentino. Accordingly, Trentino's food products are perceived as more "natural" than other similar products coming from other regions or from abroad, because they are produced in a context of mountains, meadows, and small, family-run farms. In this view, the Autonomous Province of Trento has established specific rules for assigning a non-GMO label to local products where the GMO component thresholds are lower than the GMO percentages admitted by European Regulations 1829/2003 and 1830/2003, with the aim of providing special qualification to local products.

Consumers interviewed in our focus groups paid great attention to the "hedonistic" aspects of yogurt (i.e., taste, smell, consistency, aspect), but an increasing interest was progressively given to the "healthy" attributes of the same product. Many persons revealed that they buy and consume yoghurt because it is a light, easily digested food whose consumption can be beneficial, thanks to a supposed high supply to he human organism of vitamins, calcium and other important nutritional stuffs. Accordingly, the importance of yoghurt for human consumption was unanimously declared. At this point of the discussion, the moderator addressed the discussion to the general perception of the prospective functionalities of yoghurt. Interestingly, the respondents declared that if scientific research ever made it possible, they wished that yoghurt could be improved to deliver further health benefits, like memory aid or sight support.

The second part of the focus groups was specifically directed to assess the level of knowledge and perception on GMOs. A short description on the concept of GMOs was given in order to verify the general knowledge in the on-going debate. This short introduction enabled us to verify that people are interested and approach GMOs issues with high curiosity since many questions were asked on the huge field of agro-biotechnologies and GMOs.

After this introduction, the moderator presented the hypothesis of using GM enzymes in the yoghurt production process to obtain new functionalities and to prevent serious diseases. When faced with the possibility that GMOs could be used to improve health effects of yoghurt, people tended to show a generally positive attitude. However, they firmly required that scientific research be carried out before the market release of these yoghurts and that concrete safety guarantees exist. We noticed an absence of hostility or doubts toward the scientific community; on the contrary, skepticism was shown toward putatively hidden objectives of multinationals and brand companies with regard to GMOs.

When the focus groups took into consideration the use of GMOs for benefits other than health, we saw very different reactions. The moderator pointed out, for instance, that gene technologies are used in agriculture to reduce the

production costs of farmers, since GMOs seem to require less pesticide use and to allow better yields than conventional cultures. Our respondents showed many perplexities and doubts toward these alternative uses of GMOs as well as their consumption as ingredients in yoghurt. Importantly, they did not exhibit a strong opposition, but they tended to treat the issue with caution, revealing that GMOs take a different role in the context of agricultural production improvement compared to medical application. The hypothesis of introducing "higher yield" GMOs in a new type of yoghurt was not welcomed by our respondents with the same openness as the first case, where GMOs were hypothetically used for improving health attributes. Similarly, the potential benefits for the environment that reduced use of pesticides might bring were judged to be insufficient to balance all the perceived incidental risks of GMOs. This behavior is coherent with other research that we conducted in 2004 to evaluate citizen and stakeholder opinions toward the application of the just released EU Regulations on GMO traceability and control of food and feed (1829/2003/CE and 1830/2003/CE) [11, 34].

Nonetheless, in the current focus groups, we noticed that fear and uncertainty were not specifically focused on GMOs, but rather to the overall food safety management system. Accordingly, low levels of trust were addressed to the agents who manage guarantees and controls in food processing, as well as to those institutions who govern the circulation of food from producers to consumers. It seems that when direct and strong benefits are perceived as absent, people feel a greater need to control personally, and in detail, what they consume. Moreover, our respondents admitted that when they are unable to ascertain information on the process or on the origin of food, they are likely to trust familiar or well-known sources of provision, like local producers and small shops "where you can still have contact with a person". Besides, people interviewed felt that neither labels nor certification seem capable of always preventing fraud in food; thus, their presence alone does not increase confidence and trust levels, while better information and *more participated* (i.e. interactive) communication are required.

The final session of the focus groups turned the debate toward the more general topic of technology and risks. People's reactions at this point of the discussion suggested that a sort of trade-off between costs and benefits exists in the individual valuation of a specific innovation. In fact, they stressed the need for tangible advantages as a necessary condition for the acceptance of GMOs in production and markets. Our respondents, accordingly judged nuclear power as dangerous, but at the same time they appeared aware of the need to exploit nuclear energy for the sake of the everyday commodities. In this behavior, we could recognize a subtle pragmatism, in which specific actions or innovations are socially identified as necessary despite their perceived risks. In our simulation, while GMOs without health attributes are considered unnecessary and not worthwhile, other technologies whose supposed benefits balance perceived risks are endured, for instance nuclear power. Worth stressing, by law, Italy does not host nuclear plants. Thus, such apparently favorable attitudes may derive from the consciousness that respondents do not have these structures nearby. This behavior can be depicted as the well known "Not-In-My-Backyard" (NYMBY) syndrome, for which people may approve a certain measure or establishment, but only under the restrictive condition that it does not take place in their community [65, 66].

Finally, in our focus groups we observed that the answers given by the individuals with a lower education level did not differ much from those given by the more educated. However, while the more educated ones tended to evaluate all the costs and benefits as well as the ethical implications of agro-biotechnologies at an international, long-term level, the less educated, conversely, contributed to the discussion more impulsively, taking into special account their personal (or at least familiar) interests and valuations.

6. Conclusion

Our focus group results were a valuable preliminary work on which to build a questionnaire format, where *ad hoc* choice sets were inserted. This questionnaire, being the central part of the Discrete Choice Methodology study, will enable us to investigate the attitudes and purchases of conventional yoghurt and hypothetical GM yoghurt, and the food consumption habits of a sample of Trentino inhabitants. During Spring 2006 we began a phone survey and interviewed randomly sampled people. Collected data will be aggregated and processed in Summer 2006.

Results of the DCM will be useful in assessing public concerns about GMOs in food. Moreover, we will develop a theoretical model of the major risk-benefit perception and information influences on actual purchase behaviors in Trentino. Specifically, this research will enable us to evaluate the non monetary attributes associated with the consumption of GM food (in this example, yoghurt) and to identify or classify consumer preferences. Moreover, we will know which attributes play a crucial role in determining GM food choice.

Our study will provide us with information on the food alternatives that are viable or acceptable for consumers. Thus, it could be considered as valuable starting point to develop further researches by the scientific community, and to be offered to the institutions. More specifically, our research could be useful in assessing the correspondence between research lines in agro-biotech research and institutional decisions on GMO management with regard to the needs and attitudes expressed by consumers.

Finally, our analysis would help to identify the social interests, opinions and doubts that should be taken into account by actors in charge of technology transfer. As a consequence, we would expect to give a contribution to an improved communication of risk management. Transparent information and involvement of the various actors of the debate concerning GMO application, in fact, have to be considered as crucial elements in the decision-making processes [67]. This approach is known as "deliberative democracy", and already resulted a precious tool for legitimating choices that involve a whole range of actors and that -by their nature- may produce social conflict [68, 69]. As the previous experiences proved, in fact, some relevant technological innovations can activate crucial changes in the territory where

they are introduced. For this reason, the preliminary consensus of the population is necessary in order to avoid fatal opposition [70, 71]. The effort of harmonizing the Science with the Society through the deliberative democracy approach is one of the most stimulating and fascinating challenges for modern scientific and institutional communication.

This study is part of research activity that has taken place over a number of years and that concerns the traceability of GMOs in the feed and food chains, and the risk management on plant exogenous gene transfer techniques. Our study is a multidisciplinary approach, involving laboratory research, social sciences, bioethics, and communication.

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