An Empirical Study of Latvian Consumers' Attitudes and Perceptions Towards Genetically Modified Organisms

EIS 10/2016

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Submitted 03/2016

Accepted for publication 09/2016

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http://dx.doi.org/10.5755/j01.eis.0.10.14624

Abstract

Genetic modification and genetically modified organisms (GMO) remains a controversial issue. Latvian consumers' attitude towards genetic modification and GMO have been characterized as negative using Eurobarometer data, but so far no specific investigation of Latvian consumers has been done in this field.

The aim of this study was to analyse Latvian consumers' attitude towards genetic modification and GMO, the subjective and objective knowledge about this questions and acceptability of use of GMO in different application areas.

Main task in frame of this research is to summarize different literature and data available to outline some of factors that influence attitudes towards GMO: mainly public subjective and objective knowledge, perception on risk and benefits, and ethical concerns.

The survey method was chosen as a tool to collect data and elicit Latvian consumers' attitude towards use of GMO in different industries. The survey was composed of 18 questions; seven of them have been structured on one to ten–point scale.

The survey data of Latvia's inhabitants (N = 1184) were collected by the telemarketing company from September 2014 until June 2015. To select the units to be included in the sample systematic sampling was applied – every twentieth inhabitant was approached by phone call and invited to answer on survey questions.

The results of Latvian consumers' survey showed that Latvians' acceptability of genetic modification varies by application area; genetically modified (GM) non–food products are more accepted than GM food and feed products. Ethical and moral aspects play essential role among Latvian consumers. Respondents' subjective and objective knowledge of genetic modification and GMO differs.

The findings would be essential to policy makers when designing risk–communication strategies targeting different consumer segments to ensure proper discussion and addressing potential concerns about genetic modification.

KEYWORDS: attitudes, consumers, genetically modified organism, perception.

European Integration Studies
No. 10/ 2016
pp. 157–168
DOI 10.5755/j01.eis.0.10.14624

Introduction

According the forecast of the population analysts current global population will exceed 9 billion by 2050 with 90% living in developing countries in such poor regions as Asia, Africa and Latin America. Presently 815 million people living in these countries are affected by malnutrition, unhygienic living conditions, poverty and face daily food shortages as a result of environmental impacts or political instability, while in the developed world there is a food surplus (Basu *et. al*., 2010). In developing countries, inadequate and unbalanced nutrition or malnutrition is a cause of premature death or disability for every third inhabitant of the world (Cohen, 1994). For these countries the drive is to develop drought and pest resistant crops which also maximize yield. In developed countries, the food industry is driven by consumer demand which is currently for fresher and healthier foodstuffs (Joseph & Morrison, 2006).

In spite of huge progress in food production processes environmental conditions and cataclysms arouse problems of hunger in many developing countries and it is clear that using of conventional agricultural practices alone will not eliminate these problems; new technologies are necessary to help to feed the world and genetic modification is one of the practices to apply. Genetic modification is relatively new technology which has gained an important place in the food industry. Although the aims of genetic modification and conventional plant breeding are the same, genetic modification is more targeted as it allows to predict the results and to improve the characteristics of the organism, increasing yield and nutritional value, as well as safety.

History of GMO – organisms in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination (European Parliament and the Council Directive 2001/18/EC)) – started in 1973 when the first GMO was obtained – an *Escherichia coli* bacterium. Since that time many food plants and crops are being genetically modified. Rapid development of use of genetic engineering technologies was observed especially in 80ies and 90ies of the last century.

Although question of hunger and malnutrition is not urgent in Latvia and use of GM technologies to increase amount of food is not the topic of the day in Latvia the problem of use of GMO in food, animal feed and other industries becomes topical. As Latvia is the part of the Europe Union (EU) common market products containing consisting or obtained with the help of GMO are entering Latvian market and raise a lot of questions especially regarding safety to human and animal health and environment.

Latvian consumers' attitude towards GMO have been characterized as negative using *Eurobarometer* data (Gaskell *et. al.*, 2006) but so far no specific investigation of Latvian consumers has been done in this field.

Kayabası & Mucan (2011) consider that the attitudes and perceptions of the consumers towards GM food have nine dimensions: the perceived environmental risk, the perceived benefit, long–term effects on human health, risk for the world, attitudes towards labelling, attitudes towards purchase, attitudes in terms of cultural–spiritual and moral values, perception of knowledge level and the perceived risk respectively. The most explanatory factor is the possible risks of GM food on human health in the long term. The least explanatory factor solution is the attitudes towards cultural – spiritual and moral values.

The aim of this study was to analyse the attitude towards genetic modification and GMO, the subjective and objective knowledge on GMO and Latvians' acceptability of use of GMO in different application areas. The outcomes of this research are important as the use of the new technologies in food production has potential benefits for both – food manufactures and consumers. But at the time when the food industry is creating the new products and new ingredients, the farmers are growing the new crops with improved or modified characteristics, the question is open whether

the new technologies and money invested by industries is cost effective, are the new products accepted and assumed by the consumers?

Main task in frame of this research is to summarize different literature and data available to outline some of factors that influence attitudes towards GMO: mainly public subjective and objective knowledge, perception on risk and benefits, and ethical concerns.

Research methods applied: analysis of scientific publications, analysis of research results, analysis of statistical data and Latvian consumers' survey on their attitude to different GMO, level of awareness and knowledge about genetic modification and GMO in Latvia, Latvians' perception on safety of GMO.

Analysis of consumer behaviour and attitude towards use of GMO in agriculture and other industries allows predicting market demand in the future and willingness of the consumers to buy and consumers' expectations from technology which can benefit to many.

Research results and discussion

Consumers' attitudes towards GMO, risk and benefit perception. Attitude is defined as positive or negative behaviour potential of individuals learned about an object. The object could be a specific product, product category, ownerships, use of products, reasons, subjects, people, advertisement, prices, retailers, events and news. Attitudes are one of the basic factors affecting the final decision of consumers and if consumers have positive attitude towards an object, it will get easier to direct them as desired. On the contrary, if consumers have negative attitudes, implementations to overcome these negative attitudes should be focused (Kayabası & Mucan, 2011).

The results of the study performed by Christoph *et. al.* (2008) in Germany revealed that consumers' attitude towards use of GMO in areas other than the food production is much more favourable than the use of GMO in food production. According to the results, it was doubted that future studies about risks and benefits would make consumers change their attitude towards genetic modification. The consumers who opposed genetic modification had lack trust in authorities, industry and scientists. Even if new studies showed the risks of GMOs are non–existent or manageable, these consumers would be unlikely to change their attitudes because they would lack trust in the source of information. It was also found out that education was not cause to support genetic modification, because good knowledge does not automatically imply support as this study showed.

The willingness to buy or to avoid GM products has been studied in a number of research papers. The investigations have identified several factors to explain differences in individual support, including the level of knowledge, socio–demographic variables, the perception of the risks and benefits linked to agricultural biotechnology, trust in regulatory bodies, in the information and /or the actions of certain actors, social and political values, *etc.* (Barnett, 2007; Gaskell, 2004). Among all, the high risk regarding human health and environment associated with GM foods as perceived by the consumers seems to be the main obstacle to the consumer's acceptance of such foods. People weigh risk information as more important than benefit information, thus the difficulty of selling benefits against possible risks (Aleksejeva, 2012).

For example, results obtained in the investigation conducted by Harrison *et. al.* (2004) in Italy and the United States (the US) indicated that consumer' risk perception, knowledge and awareness of GM foods, and trust in government agencies impact willingness to buy GM food. Higher levels of perceived risk decrease the likelihood of purchase in both countries. However, Italian consumers were found to be more sensitive to the potential risks what GM foods may pose to human health and the environment, relative to the US consumer. In general, Italians were also less likely to purchase GM foods relative to the US consumers. It was also found that confidence in competent authorities involved in decision making and control process impact willingness to purchase GM

food. Education, age and gender produced mixed results. It was concluded that beliefs regarding risk perceptions and trust in regulatory agencies played an important role in consumer opinions towards GM foods in both countries.

The findings obtained by Brown and O'Cass (2005) in Australia indicated that consumer risk perceptions act as an antecedent to external information search and willingness to buy. Therefore, the more a consumer sees risk in GM food the more likely they are to search for information. However, risk also acts to diminish the willingness of consumers to by GM food.

Investigation made by Aerni and Bernauer (2006) in the Philippines, Mexico and the South Africa found out that most of the stakeholders believed that agricultural biotechnology had the potential to solve important problems in agriculture (drought, pest infestation, plant disease, high use of pesticides), and did not pose a significant health risk to consumers. Yet, there were also concerns regarding the potential negative impact of such crops on the natural environment and the difficulties of implementing strict regulations well as lack of market access, too little investment in research and development, and infrastructure. The results of the surveys suggested that the differences in risks perception in the Philippines, Mexico, and the South Africa were often related to different historical, political, ecological, and socio–economic conditions.

Consumers' subjective and objective knowledge of GMO. The impact of knowledge on decision–making, and the measurement of this variable, has long been a subject in marketing literature. Park and Lessig (1981) identified two major approaches for measuring product familiarity: one measuring how much a person knows about the product and the other measuring how much a person thinks they know about a product. Similarly, Brucks (1985) described three categories of consumer product class knowledge used in consumer behavior research: subjective knowledge, the individual's perception of how much s/he knows; objective knowledge, a measure what an individual actually knows; and prior experience, the amount of purchasing or usage experience the consumer has with the product. However, according to Brucks (1985) experience–based measures of knowledge are less directly linked to behavior.

The impact of the knowledge on consumer decision and acceptance of GM products is an important issue for different stakeholders: policy makers, agribusinesses, and other parties interested in the acceptance (or rejection) of GM products. When investigating these subjects, it is important to be careful of the differences between objective and subjective knowledge. Both measures may be important factors in willingness to accept new products; however, according to House *et al.* (2004), they may impact acceptance differently.

The level of knowledge of the consumers regarding genetic engineering varies in different parts of the world. For example, according to the investigation of Xiaoyong et.al. (2010) a basic quiz of six questions concerning biotechnologies was given to respondents in China, the US and the EU. By comprising the test results among these consumers it was concluded that there are statistical differences between Chinese consumers and the EU consumers indicating that Chinese consumers are more knowledgeable regarding issues concerning biotechnology than their EU counterparts whilst remaining less knowledgeable about biotechnology issues than consumers in the US. It remains a universal phenomenon that consumers have very limited knowledge regarding biotechnology. This suggested that consumers' attitudes toward GM foods could be influenced by new information supplied and knowledge gained.

It is often argued that consumers' education will improve acceptance of biotechnology (e.g., Hoban and Katic, 1998). For example, according to I. Aleksejeva (2014) the most of the EU experts involved in GMO decision making process are supportive towards use of GMO in food and feed and many of them consider that GM food/feed is as safe as conventional products or more safe than unsafe.

The experts are more concerned about cultivation of GM plants as consider they can cause risk to the environment.

Assumption of the genetic modification proponents is that, if citizens better understand the science and biotechnology underlying GM food benefits, they are more likely to accept GM food research, development, and commercialization (e.g. Allum *et. al.,* 2003). Although other research, especially in Europe (e.g. Gaskell *et. al.*, 2003), has called into question this understandable inference from the knowledge deficit model.

When we consider decision making regarding the purchasing of GM products we can presume that this decision is impacted by the consumers' subjective knowledge about GMO and awareness (labelling) regarding these products.

Previous researchers have asserted that subjective knowledge is a stronger motivator of consumer behavior than objective knowledge.

Park et al. (1994) found that product–related experience is more strongly related to subjective knowledge than objective knowledge.

Raju et al. (1995) found that, of the three types of knowledge (subjective knowledge, objective knowledge, and usage experience), subjective knowledge is the most closely associated with purchase decision satisfaction. This is because those who have greater subjective knowledge are likely to feel less confused and more certain about the quality of their choice, implying that subjective knowledge is an important factor in consumer decision making.

Methodology of the Study

Purpose and Importance: After GMO spread all around the world, it became a requirement to analyze the attitudes and perceptions of the consumers towards these organisms and products containing, consisting or obtained with the help of GMO. Considering this requirement, the analysis of consumer attitude and perception towards GMO constitutes the purpose of this study.

Methodology: This study has been carried out with survey method within the descriptive research method. The survey method has been preferred as a tool to collect data. The survey was composed of 18 questions; seven of them have been structured on ten–point Likert scale. Likert scale is widely used since it allows the consumers to express their attitudes in a regular and meaningful way and it is easy to use for those who conduct market researches (Koç, 2008). The survey used in this study has been prepared so as to measure consumers' risk perception and attitude towards GMO and objective and subjective knowledge of genetic modification and GMO. Additionally, based on the literature on consumer perception of risks and benefits and a review of the various empirical applications mentioned above, a series of questions were developed to measure risk and benefit perception. In line with the purpose of this research, dimensions regarding measurement of attitudes and perceptions consist of the perceived environmental risk, the perceived benefit, its long–term effects on human and animal health, benefits for developing countries, attitudes towards recognizable labels and nutritional value, attitudes in terms of ethical and moral values and importance of price. General sociodemographic variables consist of gender, age, income, education, marital status, occupation, religious affiliation and residence. Respondents' subjective knowledge about biotechnology was assessed using Likert scale, where 1 – no knowledge at all and 10 – have excellent knowledge. Objective knowledge of consumers was assessed by eight true and false questions. The obtained data were analyzed through SPSS programme.

Constraints and Sample: The study was conducted face to face and via Internet between January and April 2015. The resident data base was used in the study, units within the sample were determined randomly; so it is quite decently to generalize the results. 1184 surveys were filled by respondents via Internet and interviewing them face to face.

Analyses of the Collected Data

The survey was developed to elicit Latvian consumers' attitudes towards use of different GMO (using evaluation scale 1 – 10, where 1 – no support at all; 10 – definitely support).

Main statistical indicators of Latvian consumers' attitudes towards use of different GMO are reflected in table 1.

Average evaluations of Latvian consumers were quite low and indicated that Latvians were sceptical towards use of any kind of GMO. The most positive evaluations were expressed towards use of medicines obtained with the help of GMO (arithmetic mean – 4,21), followed by GM plants with improved nutritional value (arithmetic mean – 3,2), GM plants resistant to diseases and viruses (arithmetic mean – 3,18) and GM plants resistant to insects (arithmetic mean – 3,03). The lowest acceptance of respondents was expressed towards use of GM animals (arithmetic mean – 1,97). Most frequently evaluation of use of GMO was 1 (characterised by mode).

When Latvian consumers' perception on benefits was evaluated, it was identified that the respondents had low level of benefit perception with the average value about 3. Main statistical indicators of Latvian consumers' benefit perception towards use of different GMO are reflected in table 2. To elicit consumers' opinion, the question was put "whether you choose GMO if."

Despite the fact that GM products could be beneficial Latvian consumers were quiet sceptical regarding any use of GMO and their benefit perception was low (characterised by arithmetic means). The highest support was expressed regarding GM products if their acquisition is environment friendlier (arithmetic mean – 3,35) and if these products have less pesticides residues (arithmetic mean – 3,3). Other perceived benefits were evaluated lower than 3. As the most unessential perceived benefit from Latvian consumers' point of view was well recognizable label of product (arithmetic mean – 2,27). Most frequently perceived benefits were evaluated with 1 – definitely not choose (characterised by mode).

Main statistical indicators of Latvian consumers' attitude in terms of ethical and moral values are reflected in table 3.

Table 1

Latvian consumers' attitudes towards use of different GMO

GMO	Mean	Standard Error of Mean	Median	Mode	Standard Deviation	Range	Minimum	Maximum
Medicine obtained with the help of GMO	4,21	0,118	4	1	3,191	9	1	10
GM plants with improved nutritional value	3,20	0,107	1	1	2,911	9	1	10
GM animals	1,97	0,077	1	1	2,118	9	1	10
GM feed	2,44	0,091	1	1	2,486	9	1	10
GM plants resistant to insects	3,03	0,103	1	1	2,805	9	1	10
GM plants tolerant to herbicides	2,76	0,096	1	1	2,623	9	1	10
GM plants resistant to diseases and viruses	3,18	0,105	1	1	2,870	9	1	10

Source: author's calculations based on Latvian consumers' survey in 2015, n=1184 (using evaluation scale 1 – 10, where 1 – not support at all; 10 – definitely support)

Table 2

Main statistical indicators of Latvian consumers' benefit perception towards use of different GMO answering the question "Whether you choose GMO if:"

Question	Mean	Standard Error of Mean	Median	Mode	Standard Deviation	Range	Minimum	Maximum
Thereby you contribute to development of national economic	2,64	0,095	1	1	2,525	9	1	10
Thereby you support the developing countries where GM food is obtained	2,71	0,099	1	1	2,618	9	1	10
These products have well recognizable label	2,27	0,087	1	1	2,310	9	1	10
These products have higher nutritional value	2,75	0,102	1	1	2,713	9	1	10
These products remain fresh longer	2,45	0,095	1	1	2,517	9	1	10
These products cost less than others	2,67	0,100	1	1	2,643	9	1	10
These products have less pesticides residues	3,30	0,114	1	1	3,008	9	1	10
Acquisition of these products is environment friendlier	3,35	0,115	2	1	3,044	9	1	10

Source: author's calculations based on Latvian consumers' survey in 2015, n=1184 (using evaluation scale 1 – 10, where 1 – definitely not choose; 10 – definitely choose)

Table 3

Main statistical indicators of Latvian consumers' attitude in terms of ethical and moral values

Declaration	Mean	Standard Error of Mean	Median	Mode	Standard Deviation	Range	Minimum	Maximum
Genetic modification of plants is more acceptable then genetic modification of animals	3,80	0,117	3	1	3,066	9	1	10
People have the right to interfere with the natural life	3,05	0,109	1	1	2,854	9	1	10
Genetic modification is morally wrong and inadmissible	6,57	0,129	7	10	3,384	9	1	10
GM products are unnatural	6,89	0,133	8	10	3,461	9	1	10
If genetic modification doesn't pose risk to human and animal health, and environment it is acceptable	4,57	0,126	5	1	3,299	9	1	10
If genetic modification contribute to society it is acceptable	3,35	0,113	2	1	2,935	9	1	10

Source: author's calculations based on Latvian consumers' survey in 2015, n=1184 (using evaluation scale 1 – 10, where 1 – completely disagree; 10 – completely agree)

Arithmetic means of Latvian consumers' attitude in terms of ethical and moral values indicated that in general Latvian consumers considered that genetic modification was morally wrong and inadmissible and that GM products were unnatural (respectively – 6,57 and 6,89), most frequently evaluations for both declarations were 10 – completely agree (characterised by mode).

Main statistical indicators of Latvian consumers' perception on safety aspects of GMO (possible impact on human/animal health and environment) are reflected in table 4.

Arithmetic means of Latvian consumers' perception on safety aspects of GMO indicated that in general Latvian consumers considered that GMO was not safe for next generations (arithmetic mean – 2,48), had negative impact on environment (arithmetic mean – 2,5), GM feed was not safe for animal health (arithmetic mean – 2,42) but GM food – for human health (arithmetic mean – 2,44); most frequently evaluations for all declarations were 1 (characterised by mode).

When Latvian consumers' subjective knowledge level was evaluated, it was identified that the respondents were moderately knowledgeable (a 5,11 on a 10–point scale) about genetic modification and GMO.

The respondents were asked to evaluate their knowledge using Liker scale (where 1 – no knowledge at all; 10 – excellent knowledge) by answering the question – how knowledgeable would you say you are about genetic modification and GMO? Main statistical indicators of Latvian consumers' subjective knowledge of genetic modification and GMO are reflected in table 5.

As reflected in Fig most frequently (22.6%) the respondents evaluated their knowledge with 5 (characterised by mode), in addition the half of the respondents evaluated their knowledge lower than 5 and half – higher than 5. 16.4% of the respondents evaluated their knowledge with 3 but 14.5% – with 7.

In a second step, respondents' objective knowledge about genetic modification and GMO was analysed. Respondents were asked eight true/ false questions about genetic modification and GMO and had the opportunity to answer with „do not know"'. Table 6 shows the questions as well as the results.

Table 4
Main statistical indicators of Latvian consumers' perception on safety aspects of GMO

Declaration	Mean	Standard Error of Mean	Median	Mode	Standard Deviation	Range	Minimum	Maximum
GMO is safe for next generations	2,48	0,093	1	1	2,427	9	1	10
GMO is safe for environment	2,50	0,089	1	1	2,336	9	1	10
GM feed is safe for animal health	2,42	0,090	1	1	2,355	9	1	10
GM food is safe for human health	2,44	0,093	1	1	2,448	9	1	10

Source: author's calculations based on Latvian consumers' survey in 2015, n=1184 (using evaluation scale 1 – 10, where 1 – completely disagree; 10 – completely agree)

The most widely known fact was that „toxic and allergic reaction can be caused by GM food and ordinary food" (60.68% correct answers), while the question that „ GM food genes may enter the human germ cells and can be passed to future generations" received the lowest share of correct answers (22.58%).

More than half of the respondents gave correct answers to questions that "every day a man by the consumption of food consume a lot of different foreign genes" (60.68%), "genetically modified tomatoes contain genes but ordinary tomatoes do not" (56.12%) and that "tomatoes genetically modified with a help of fish gene taste fishy" (respectively 56.44% of respondents).

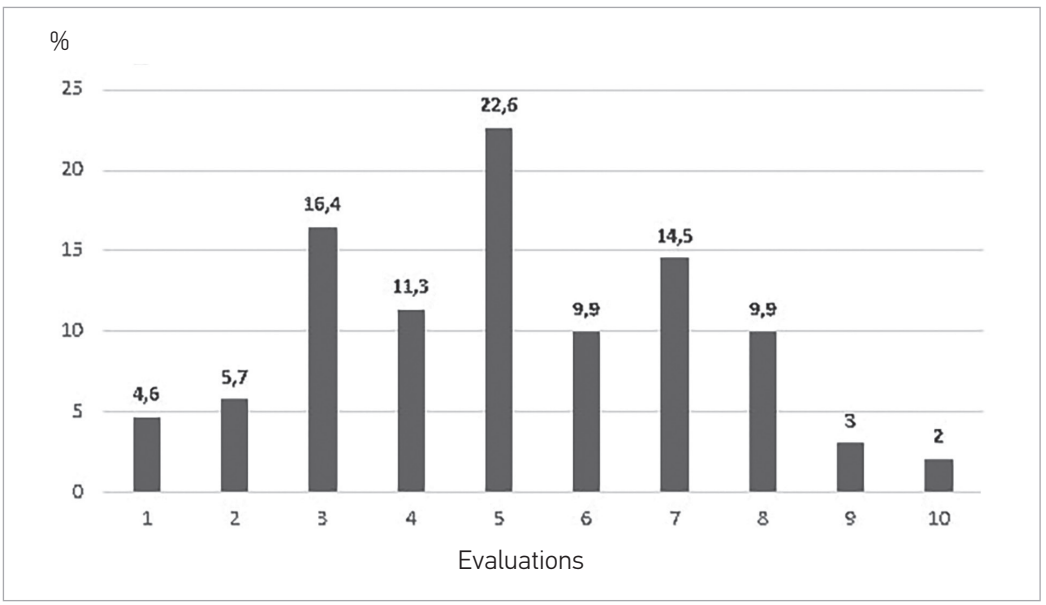
Main statistical indicators	Values
Mean	5,11
Standard Error of Mean	0,082
Median	5
Mode	5
Standard Deviation	2,140
Range	9
Minimum	1
Maximum	10

Source: author's calculations based on Latvian consumers' survey in 2015, n=1184 (using evaluation scale 1 – 10, where 1 – no knowledge at all; 10 – excellent knowledge)

Table 5
Main statistical indicators of Latvian consumers' subjective knowledge of genetic modification and GMO

Some of the items are disappointing in terms of the knowledge exhibited. For example, a near one–third, or 31.24% of the respondents believed that "by eating genetically modified tomatoes, a person's genes could also be changed" but almost half of respondents (43.47%) were convinced that "GM food genes may enter the human germ cells and can be passed to future generations".

It should be noted that although most often the respondents evaluated their knowledge of genetic modification and GMO with 5 (22.6% of respondents) and in addition the half of the respondents evaluated their knowledge higher than 5, aggregated results in table 6 indicate that near one third of the respondents (can be concluded from the last column of table 6) did not know the correct answers to questions (except for the question that "toxic and allergic reaction can be caused by GM food and ordinary food").



Source: author's calculations based on Latvian consumers' survey in 2015, n=1184 (using evaluation scale 1 – 10, where 1 – no knowledge at all; 10 – excellent knowledge)

Figure 1
Latvian consumers' subjective knowledge of genetic modification and GMO

Table 6
Latvian consumers' objective knowledge of genetic modification and GMO (%)

Question	Correct	Wrong	Do not know
Genetically modified tomatoes contain genes but ordinary tomatoes do not	56.12	16.21	27.68
By eating genetically modified tomatoes, a person's genes could also be changed	42.27	31.24	26.49
GM food genes may enter the human germ cells and can be passed to future generations	22.58	43.47	33.95
Toxic and allergic reaction can be caused by GM food and ordinary food	83.28	5.52	11.2
Genetically modified animals are always larger than their conventional counterparts	49.62	23.2	27.19
Tomatoes genetically modified with a help of fish gene taste fishy	56.44	9.82	33.74
Every day a man by the consumption of food consume a lot of different foreign genes	60.68	12.44	26.88
It is impossible to transfer animal genes to plants	42.99	9.4	47.61

Source: author's calculations based on Latvian consumers' survey in 2015, n=1184

Conclusions

- The review of the literature regarding relationship between knowledge and acceptance of genetically modified products shows that consumers are particularly conservative when it comes to acceptance of GMO and their choice is based more on their presumed risk/benefit evaluation than knowledge.
- Latvian consumers are quite sceptical regarding any use of GMO. The highest level of support was for use of GMO for medicines but the lowest – for GM animals.
- In spite of the potential GMO benefits Latvian consumers in general were quite sceptical regarding any use of GM products. The highest support was expressed regarding GMO if their acquisition was environment friendlier. As the most inconsequential aspect marked by respondents was well recognizable label.
- Ethical and moral aspects were essential for Latvian consumers and influenced their attitudes towards GMO. Latvian consumers believed that genetic modification was morally wrong and unacceptable and that GM products were unnatural.
- Latvian consumers believed that GMO was not safe for next generations, causes harmful effects on the environment, GM food was not safe for animal health, but GM food – for human health.
- Latvian consumers evaluated themselves as moderately knowledgeable about genetic modification and GMO. Analysis of consumers' objective knowledge indicated that respondents' knowledge depended on the particular issue; although a few of the answers given by respondents purported that they had lack of even a rudimentary knowledge in biology.

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The paper was supported by the National Research Program 5.2. EKOSOC–LV

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