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ANALYSIS OF POLISH CONSUMERS AWARENESS AND ATTITUDES TOWARDS GMO IN LIGHT OF THE SURVEY

Summary

The aim of the study was to determine the awareness and attitudes of Polish consumers towards GMO. The study was conducted among 202 respondents living in big cities and smaller towns and villages, using a survey questionnaire, made available online and in paper from. Analysis of the results showed that all respondents knew the term of "genetically modified organisms", but their level of awareness about GMOs was rather limited. Despite knowledge of the risks of genetic engineering threats, respondents declared that they not look for GMO-free products on the market and are willing to believe in producers' ensuring of the safety of GMOs for health. In addition, available studies on the negative impact on laboratory animals and the environment of transgenic organisms do not affect their decision of food choices. Consequently, in order to raise consumer awareness of GMOs, it is necessary to broaden and intensify educational activities on the impact of transgenic organisms on health and the environment as well as on healthy nutrition, free from GMO-containing products.
Key words: *genetic engineering, consumer, genetically modified organism, awareness, attitude*

ANALIZA ŚWIADOMOŚCI I POSTAW POLSKICH KONSUMENTÓW WOBEC GMO W ŚWIETLE BADAŃ ANKIETOWYCH

Streszczenie

Celem badania było określenie świadomości i postaw polskich konsumentów dotyczących GMO. Badanie przeprowadzono wśród 202 respondentów mieszkających w dużych miastach i mniejszych miejscowościach oraz na wsi, przy użyciu kwestionariusza ankiety, udostępnionego w formie internetowej oraz papierowej. Analiza uzyskanych wyników pozwoliła na stwierdzenie, że wszyscy respondenci znali pojęcie „organizmy modyfikowane genetycznie", jednak ich poziom świadomości dotyczący GMO był dość ograniczony. Pomimo wiedzy na temat ryzyka zagrożeń ze strony inżynierii genetycznej, respondenci deklarowali, że nie szukają na rynku produktów bez GMO i są gotowi wierzyć w zapewnienia producentów o nieszkodliwości GMO dla zdrowia. Ponadto dostępne wyniki badań dotyczące negatywnego oddziaływania na zwierzęta laboratoryjne i środowisko organizmów transgenicznych nie wywierają wpływu na ich decyzje dotyczące wyboru żywności. Dlatego w celu podniesienia poziomu świadomości konsumentów w zakresie GMO należy poszerzać i intensyfikować działania edukacyjne dotyczące wpływu organizmów transgenicznych na zdrowie i środowisko, jak również na temat zdrowego żywienia, wolnego od produktów zawierających GMO.
Słowa kluczowe: *inżynieria genetyczna, konsument, organizm zmodyfikowany genetycznie, świadomość, postawa*

1. Introduction

Biotechnology and genetic engineering methods are one of the most important present issues of contemporary science as well as business interests. At the base of the development of molecular transformation of living organisms are: the state regulations, the dynamic progress of experimental research and, above all, public opinion which is largely shaped by the mass media [1]. Today's techniques of genetic modification used in order to obtain a new variability and improve plants, are based on genetic engineering. It uses methods to achieve effects that are difficult or impossible to obtain using traditional methods of plant breeding [2]. There are vector methods that use transgenic organisms to carry transgene to recipient cells, and novector, direct methods, where different techniques are used to facilitate the transgene to overcome the recipient's cell membrane [3, 4, 5]. Transgenesis products have become the subject of numerous controversies, causing the division of society into supporters and opponents of genetic modification. Discussions which take place mainly in the use of genetically modified organisms (GMOs) as raw materials, considered by many researchers as not indifferent to the life and health of consumers [6, 7].

Common understanding of the problems of GMOs by the public is very intuitive, because the understanding of the methods used in biotechnology requires specialized knowledge inaccessible to most people. Therefore, the most important research from this area aims at identifying consumer awareness of GMOs, including information on their level of knowledge, sources and availability of information, and the general attitude of the respondents to the use of GMOs in food production [8]. Public opinion, seen as the main tool for determining the behavior of consumers towards genetically modified products, is considered as an important factor to assess the acceptance of products transgenesis [9, 10].

In order to assess the level of knowledge and awareness and attitudes of different population groups in relation to transgenic organisms and food produced with their participation, Polish consumers were surveyed in large cities and smaller towns and villages.

2. Materials and methods

The questionnaire survey, based on a 20-question survey, was made available online and in paper form for the purpose of evaluating consumer awareness of GMO and food produced with their participation. The online form of the questionnaire was developed using Google Forms. The study was attended by 202 people aged 20-35 years, living in large cities (> 30,000 inhabitants) and smaller towns (cities <30,000 inhabitants and villages). There were 60.1% and 39.9% men in the study group. 57.9% of respondents had higher level of education, 38.6% secondary level of education, and 3.5% vocational or primary level of education. The survey was local and covered the inhabitants of the Podlaskie voivodship. Completion of the survey was voluntary and anonymous. The questionnaire design allowed respondents to select responses from the list of indicated answers (closed questions).

Statistical evaluation was conducted using Statgraphics Centurion 15.2.11.0 and Microsoft Office 2013. In order to establish the interrelationship between the analyzed variables, the analysis of the diversity of respondents' answers was made separated according to the place of their residence. For this purpose, the nonparametric rank-sum test U Mann-Whitney was used (significance level $p<0.05$). *P-value* is given in the tables, if the result of the analysis was not statistically significant was determined as NS (not statistically significant). The results were also presented as a percentage of the value of the studied subgroup.

3. Results and discussion

202 respondents participated in the study. There were 123 women (60.1%) and 79 men (39.9%) in the study group. More than half of the respondents were residents of small towns (<30,000 inhabitants) and rural areas (57%), while the rest (47%) were residents of cities with a population of> 30,000 residents. Higher education had 57.9% of the respondents, secondary 38.6% of the respondents, while only 3.5% of the respondents were professional or basic. Both in the case of the surveyed residents of large cities and small towns, almost everyone met the concept of GMOs (97.7% and 97.4%, respectively). However, only 32.2% of respondents from large cities and about 20% from small towns rated their knowledge in this area as high and very high. Approximately one third of the respondents described it as mediocre. The differences between the groups of respondents were statistically significant in this respect. As a source of information on GMOs, the respondents most frequently referred to the Internet (56.3% of respondents from large cities and 61.7% from small towns), while about 20% declared that they did not seek information on GMOs at all (Table 1). Only a few years ago, Pentor's research showed that half of Poles never met the concept of GMO. On the other hand, only 2% of those who claimed knowledge of the subject rated it as high [11]. In Michota-Katulska et al. survey [12] conducted among medical students, stated that 91.5% of Polish students and 96.2% of Finnish students heard about GMO. At the same time, the majority of the respondents in both groups defined their level of GMO knowledge as small. As the source of his knowledge of the surveyed students indicated most studies and family and friends, the Internet and the least [12]. Other studies of agricultural students have shown that about 90% of them knew the concept of GMOs, and their knowledge was derived mainly from online sources (78%) and then from television and scientific publications [8]. As pointed out Lisowska and Cortez [13], the public is not able to independently analyze the literature in the field of GMOs due to the lack of necessary very specialized knowledge.

Table 1. Percentage of responses to the questions of the survey on knowledge and its sources about genetically modified organisms

Tab. 1. Odsetek odpowiedzi respondentów na pytania ankiety dotyczących wiedzy i jej źródeł na temat organizmów genetycznie modyfikowanych

Question	Citizens of big cities n=87	Citizens of small towns and villages n=115	*p*-value
Have you heard of genetically modified organisms "GMOs" (eg soybeans, maize)?			
– Yes	97.7	97.4	ns
– No	12.3	12.6	
Where do you look for GMO information?			
– TV	1.1	7.8	ns
– Internet	56.3	61.7	
– Radio	1.1	0.9	
– Press	4.6	1.7	
– specialized publications	14.9	6.1	
– family	1.1	0.9	
– friends	1.1	0.9	
– I was not looking for information	19.5	20.0	
How do you rate your level of knowledge about GMOs?			
– lack of knowledge	3.4	3.5	0.0376103
– very low	14.9	20.9	
– small	14.9	23.5	
– average	34.5	32.2	
– high	27.6	15.7	
– very high	4.6	4.3	

Source: own study / Źródło: badania własne

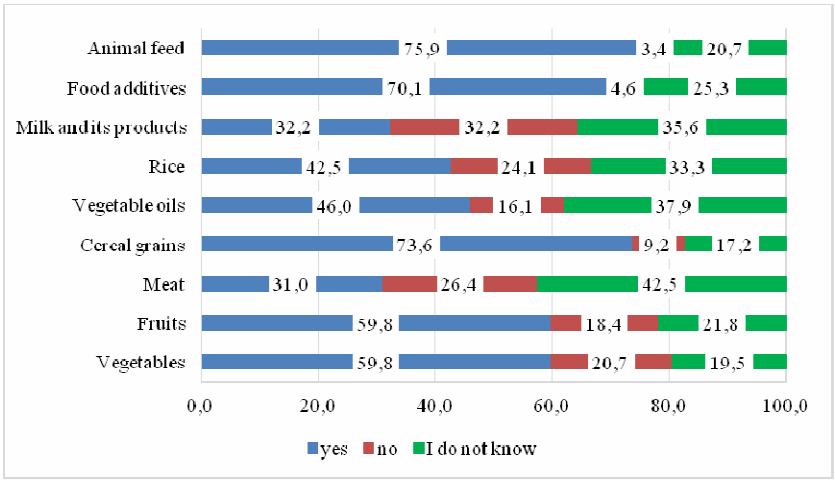
Respondents asked to indicate which foods produced by genetic engineering techniques are present on the Polish market, in the majority were of the opinion that these are the feed, grain and food additives. In the group of residents of large cities such answers indicated respectively 75.9, 73.6 and 70.1%, respondents. In the group of residents of small towns and villages respectively 78.3, 87.0 and 69.6%. This group of respondents also indicated often vegetables (75.7%) and fruits (67.8%) occurring as GM on the Polish market (Fig. 1). It follows that many of the respondents are unaware that only the insect resistant Maize Insecticide MON810 is currently authorized in the European Union [14].

Respondents from both large and small towns questioned about the dangers of genetically modified organisms for human health in more than 65% agreed with this statement. The opposite view represented 18.4% of respondents from large and 20.9% of small towns. Some respondents did not answer clearly on the subject (Table 2). In a study of agricultural students [8], a similar result (60%) was obtained with regard to the belief that GMOs are hazardous to health; In this survey the least (13%) considered the GMO safe and 33% were unable to answer this question. Stępień-Słodkowska et al. [15] found that 69% of respondents indicating a potentially adverse health effects of the GMOs.

Regarding the opinion of respondents on the risks associated with the use of GMO-containing foods, both groups of respondents had similar opinions. 42.5% of respondents from large and 43.5% from small towns believed that the risk was greater than the benefit, while at the same time about 20% of the respondents in both groups were convinced that the risk was smaller than the benefit. Quite a large proportion (20.6% from large and 24.4% from small towns) could not or could not assess it (Table 2). These results indicate that the attitude of limited confidence and uncertainty in GMOs observed across Europe is due to contradictory information on the subject appearing in discussions and media [16].

The issue of the safety of using GMOs in the environment is very important, so the respondents were asked to indicate which threats they think are the greatest. The overwhelming majority (> 70%) of the respondents from both groups indicated that the greatest threat was in the displacement of native species by transgenic plants. More than 64% of respondents in both groups are also at high risk in the absence of control over the crossing of GM plants with conventional plants. Also, a large percentage of respondents from large cities and smaller towns to major hazards included the biodiversity of fields (64.3% and 67.0%, respectively).

A)



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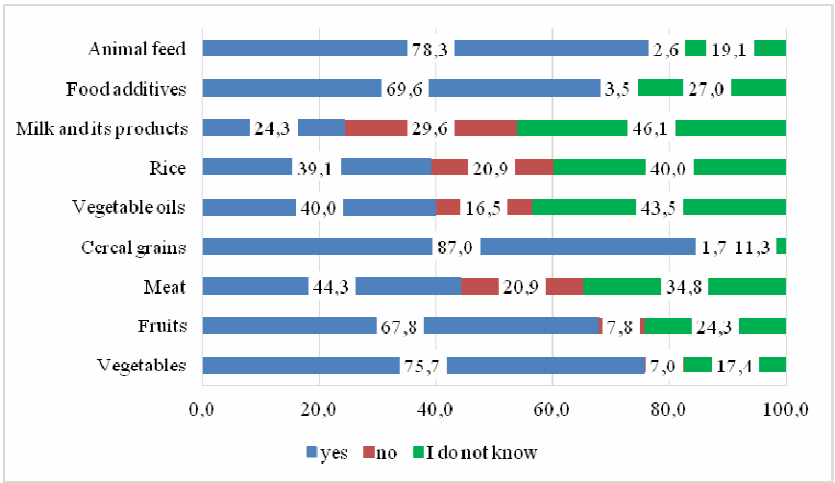


Source: own study / Źródło: badania własne

Fig. 1. Percentage of respondents' responses from big cities (A) (n=87) and small towns (B) (n=115) to the questions of the survey on the presence of food products obtained by genetic engineering techniques on the Polish market
Rys. 1. Odsetek odpowiedzi respondentów z dużych miast (A) (n=87) i małych miejscowości (B) (n=115) na pytanie ankiety o występowanie produktów spożywczych otrzymywanych technikami inżynierii genetycznej na polskim rynku

Table 2. Percentage of respondents' responses to the questions of the survey on awareness of the influence of genetically modified foods on health
Tab. 2. Odsetek odpowiedzi respondentów na pytania ankiety dotyczące świadomości w zakresie wpływu żywności modyfikowanej genetycznie na zdrowie

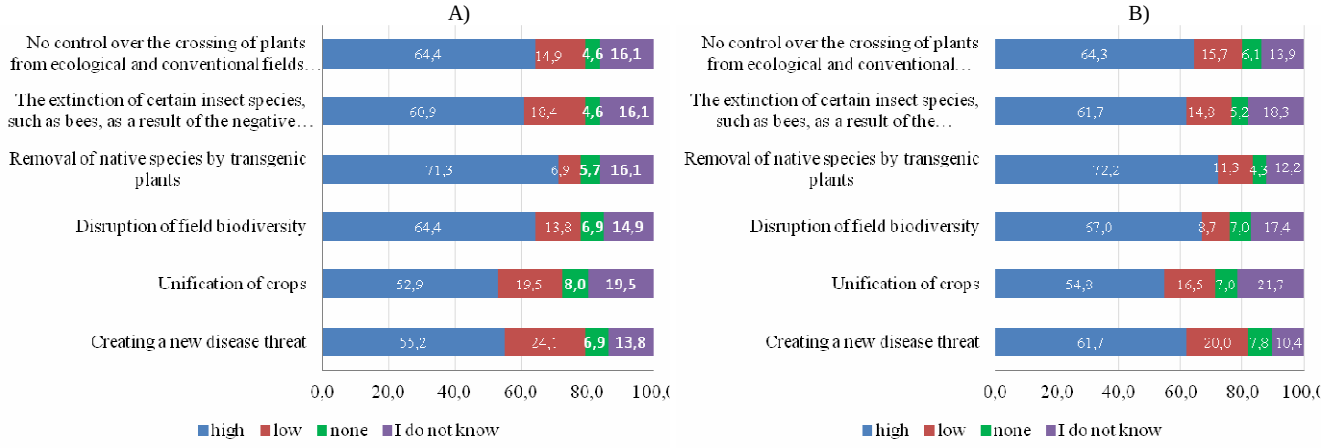
Question	Citizens of big cities n=87	Citizens of small towns and villages n=115	*p*-value
Do you think that consuming genetically modified foods can negatively affect health?			
– yes	65.5	67.0	ns
– no	18.4	20.9	
– I have no opinion / I do not know	16.1	12.2	
What do you think is the risk of using genetically modified foods?			
– greater than benefits	42.5	43.5	ns
– less than benefits	23.0	20.0	
– the risks and benefits are equal	13.8	12.2	
– hard to say	14.9	20.9	
– I have no opinion / I do not know	5.7	3.5	

Source: own study / Źródło: badania własne

Maintaining biodiversity is essential for the proper functioning of agricultural ecosystems and makes farmers' actions and agricultural production more sustainable and cost-effective [17, 18]. Only from 4 to 8% of the respondents indicated the absence of environmental threats from GMOs (Fig. 2). Based on the Eurobarometer surveying social risk in Europe [19], it was found that GMOs are perceived to be unnaturally affecting social life and the environment.

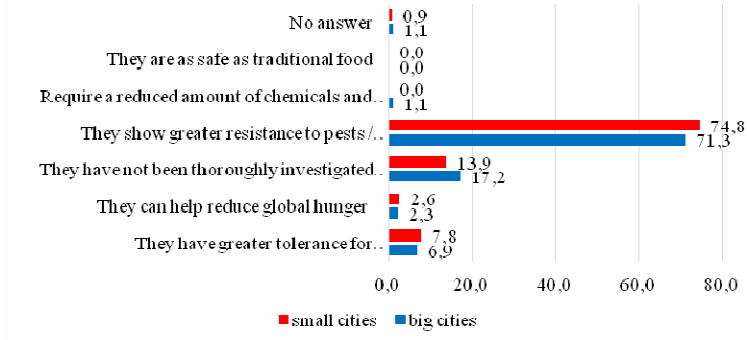
In the next question, the respondents were asked to indicate among the given GMO statements those which they agree. Both groups in more than 70% of the responses indicated that GM plants are more resistant to pests and diseases by introducing genes from other organisms into their DNA. 13.9% of large and 17.2% of the respondents from small towns have chosen to say that GM organisms have not been thoroughly studied by scientists, so the effects and negative impacts that they can have on the environment and human health in the future are unknown (Fig. 3). These both statements confirm that the respondents not only heard, but they have largely correct knowledge about GMOs.

The survey, apart from the knowledge and consumer awareness, aimed at identifying their attitudes toward GMOs. The data presented in Table 3 show that the attitudes of consumers in this respect from both groups were comparable. 88.5% of large cities and 92.2% of small towns people believe that GMO products should be labeled. At the same time, more than 50% of the respondents in both groups assessed that the commercially available GMO food was labeled to a small extent and about 33% that it was not labeled at all. 41.4% of consumers living in big cities and 47% of smaller towns declared that they did not pay attention when buying food on the GMO label. Similar results were obtained by Kramkowska et al. [1] in a study conducted among students, more than half of which stressed that GMO foods were labeled insufficiently. The respondents were asked how much higher price they would be willing to pay for free-GMO food. As many as 41.4% of respondents from large cities and 30.4% from small towns would not pay more for such products. Up to 10% more would pay respectively 23.0 and 30.4% of respondents, and about 11-30%, 28.7 and 24.3% of respondents. On the question whether GM crops and foods should be prohibited affirmatively answered 44.1% of consumers from large cities and 47.3% of the smaller centers, while more than 35% of the respondents were of the opposite opinion. However, when asked whether the manufacturer of a GMO-harmless product would convince them to buy them, the respondents in both groups over 50% responded negatively, and a significant proportion did not answer unequivocally (19.5% of the respondents from large and 29.6% from small towns).



Source: own study / Źródło: badania własne

Fig. 2. Percentage of respondents' responses from big cities (A) (n=87) and small towns (B) (n=115) to the question of the survey on threats for environment and people from GMOs
Rys. 2. Odsetek odpowiedzi respondentów z dużych miast (A) (n=87) i małych miejscowości (B) (n=115) na pytanie ankiety o zagrożenia dla środowiska i człowieka ze strony GMO



Source: own study / Źródło: badania własne

Fig. 3. Percentage of respondents' responses from big cities (n=87) and small towns (n=115) in relation to the selection of statements about GMOs with which respondents agree

Rys. 3. Odsetek odpowiedzi respondentów z dużych miast (n=87) i małych miejscowości (n=115) w odniesieniu do wyboru sformułowań dotyczących GMO, z którymi badani się zgadzają

Table 3. Percentage of respondents' responses to the questions of the survey about their attitudes toward genetically modified organisms

Tab. 3. Odsetek odpowiedzi respondentów na pytania dotyczące ich postaw wobec organizmów modyfikowanych genetycznie

Question	Citizens of big cities n=87	Citizens of small towns and villages n=115	*p*-value
Do you think that GMO products should be properly labeled?			
– yes	88.5	92.2	ns
– no	8.0	6.1	
– I have no opinion / I do not know	3.4	1.7	
To what extent do you think that genetically modified food is labeled?			
– small	51.7	53.0	ns
– average	13.8	12.2	
– large	1.1	0.9	
– no signage	33.3	33.9	
Do you pay attention when buying food whether it contains GMO?			
– yes	41.4	47.0	ns
– no	58.6	53.0	
How much more would you be willing to pay for GMO-free products?			
– <10%	23.0	30.4	ns
– 11-30%	28.7	24.3	
– 31-50%	5.7	5.2	
– >50%	1.1	9.6	
– I would not pay more	41.4	30.4	
Is the manufacturer to ensure the harmlessness of a product of genetically modified convince you to purchase it?			
– yes	25.3	19.1	ns
– no	55.2	51.3	
– hard to say	19.5	29.6	
Do you think that society is open to food and genetically modified organisms?			
– yes	19.5	16.5	ns
– no	80.5	83.5	
Do you think that GMO cultivation and sales of GMO products should be prohibited?			
– yes	47.1	44.3	ns
– no	37.9	35.7	
– I have no opinion	14.9	20.0	
Do you think that genetically modified organisms should be used in medicine and the pharmaceutical industry?			
– yes	42.5	33.0	ns
– no	21.8	38.3	
– I have no opinion	35.6	28.7	

Source: own study / Źródło: badania własne

Regarding the question whether Polish society is ready for GMO, the respondents in both groups had a similar opinion and stated in more than 80% that they were not ready. Acceptance of the use of GMOs in the medical and pharmaceutical industries differed in the unquestioned respondents. 42.5% of respondents from large and 33.0% from small towns accept this possibility. However, quite a large percentage of the respondents were opposed to the contrary claim (21.8 and 38.3%, respectively). Approximately one third of respondents could not give a clear answer to this question. Undecided and often contradictory attitudes of consumers result from contradictory information coming from different sources, which prevents the formation of unambiguous opinions [16].

As Wunderlich and Gatto [20] has reported, consumer knowledge of GMOs is low, according to studies based on direct consumer surveys (in US, Latvia, Turkey, Japan and Italy). The main findings of the review say that US consumers tend to accept GMOs more readily than European counterparts, with Europeans having higher willingness to pay for non-GMO foods than Americans, but meta-analyses of consumer behavior still show that consumers as a whole are willing to pay more for non-GM products than GMO products. It is interesting that whereas European aversion to GM goods is increasing dramatically over time and at a slower but still growing rate in the United States, other parts of the world are becoming less resistant to GM foods. Many consumers report that they receive information about GMO food products from the media, Internet, and other news sources. These sources may be less reliable than scientific experts whom consumers trust more to present the facts. Although many in the United States support mandatory GMO labeling (similar to current European standards), consumer awareness of current GMO labeling is low. A distinction must also be made between GMO familiarity and scientific understanding, because those who are more familiar with it tend to be more resistant to bioengineering, whereas those with higher scientific knowledge scores tend to have less negative attitudes toward GMOs [20].

The study indicates the need to increase consumer access to reliable information about GMOs, based on independent research, which would allow access to reliable knowledge in this field.

4. Conclusions

1. Both consumers in large cities and smaller towns knew the concept of GMOs, but their level of knowledge in this field would usually be assessed as small or average, with consumers in larger cities more likely to consider their level of knowledge to be higher. The Internet was the most common source of knowledge about GMOs for both groups.
2. Respondents mostly identified with the statement that plants are more resistant to pests and diseases, by introducing into their DNA genes from other organisms.
3. Most of the respondents were convinced of the potential negative impact of GMOs on human health and environmental risks, indicating primarily the lack of control over the crossing of GM non-GM species, the threat to field biodiversity, and displacement of native species by transgenic.
4. The vast majority of respondents were of the opinion that Polish society was not ready for GMO and emphasized the need for labeling of products containing GMOs, which are currently not in their opinion, sufficiently marked.
5. It is worth noting that the awareness and attitude of many respondents to GMOs were often undecided and inconsistent, which can come from equivocal media reports and the limited access to reliable information based on reliable scientific research in this field.

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