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Knowledge of adolescents completing secondary schools concerning genetically modified organisms (GMO)

Wiedza maturzystów na temat genetycznie modyfikowanych organizmów (GMO)

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Abstract

The objective of the conducted analyses is the evaluation of the level of knowledge concerning the scope of problems related with genetically modified organism (GMO) amongst adolescents completing secondary schools and the determination of the relationship between the level of this knowledge and the selected demographic traits of the adolescents examined.

The scope of problems undertaken was elaborated based on the survey conducted in a group of 500 adolescents from the Lublin Region completing secondary schools, including 250 adolescents attending General Secondary Schools and 250 adolescents attending Agricultural Secondary Technical Schools. The study was conducted by the method of a diagnostic survey, using a questionnaire.

The study showed that the majority of adolescents completing secondary schools were not interested at all in the scope of problems concerning GMO. A large part of the respondents (more than 2/5) had a very low level of knowledge of this problem. The greatest differences in the level of knowledge about GMO were observed in subgroups divided according to the type of school attended by the adolescents (General or Agricultural Technical). Respondents who attended General Secondary Schools showed a better knowledge of theoretical problems, whereas those who attended Secondary Agricultural Technical Schools were better familiarised with practical issues.

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1. INTRODUCTION

The concept of GMOs (genetically modified organisms) is becoming increasingly better known and used in Polish society. Actions aiming at intentional interference in natural growth and development of organisms evoke much controversy. An insufficient amount of genuine information addressed to the potential consumers of products manufactured based on GMO favours the shaping of extreme attitudes from total acceptance to total rejection of the possibility of any interference in the natural life cycle of organisms.

From the scientific point of view, the progress in molecular biology and a considerable range of possibilities created by genetic

Streszczenie

Celem przeprowadzonych analiz jest ocena poziomu wiedzy młodzieży licealnej na temat zagadnień związanych z GMO oraz określenie związku pomiędzy poziomem wiedzy na temat GMO a wybranymi cechami demograficznymi badanej młodzieży.

Podjętą problematykę opracowano na podstawie badań ankietowych przeprowadzonych w grupie 500 maturzystów z województwa lubelskiego, w tym 250 uczniów Liceów Ogólnokształcących i 250 uczniów Techników Rolniczych. Badania przeprowadzono metodą sondażu diagnostycznego, za pomocą kwestionariusza ankiety.

Z przeprowadzonych badań wynika, że większość maturzystów w ogóle nie interesuje się problematyką GMO. Poziom wiedzy dużej części badanych (ponad 2/5) jest bardzo niski. Poziom wiedzy na temat GMO jest w największym stopniu zróżnicowany w podgrupach wydzielonych ze względu na typ szkoły, do której uczęszcza badana młodzież (LO i Technikum Rolnicze). Licealiści są lepiej poinformowani niż uczniowie technikum w zagadnieniach teoretycznych, a uczniowie Technikum lepiej orientują się w zagadnieniach praktycznych.

engineering are important achievements that have been observed since the second half of the 20th century [Gibson et al., 2008]. At present, genetic engineering has many applications, especially in agriculture, nature protection, medicine and the pharmaceutical industry [Gawęcki 2002]. Amongst the most frequent applications are the modifications of plants and animals in order to improve their properties. Compared to traditional crops, transgenic plants obtained via the route of scientific undertakings and research show a greater resistance to diseases, unfavourable weather conditions, absorption of contaminants from water, soil and so on [Kuiper et al., 2001].

According to GMO supporters, actions within the scope of genetic engineering do not deny natural plant cultivation, but its prolongation. In their opinion, these plants do not genetically differ from those grown naturally, despite the introduction of a foreign gene (genetically modified (GM) transgene) and its protein product. For many years, such a positive approach to new agricultural biotechnologies has been popularised, especially in the United States [Antoniou et al. 2012; Pechlaner 2012].

The belief in the safety of the use of GM crops and their high yield results in a clear increase in interest in these types of crops, which has been observed for more than a dozen years. The data provided by the International Service for the Acquisition of Agri-Biotech Applications ISAAA) show that during the period from 1996 to 2012, the areas under cultivation of GM plants have increased as many as 100 times, from 1.7 million ha up to 170 million ha [Ahmed 2002; Auer 2003].

The above presented approach and actions increasingly more often have not only their supporters but also opponents. Those who have a sceptical attitude towards GMO express their concerns about potential risks resulting from the possibility of uncontrolled penetration of dangerous transgenes into the natural environment, as well as concerns about the effect of GM food on human health [Runge, Jackson 2000; Cook et al. 2002; Crawley et al. 2001; Dąbrowski, Twardowski 2007]. In addition, followers of the traditional model of plant protection consider that the cultivation of GM plants creates a serious risk for the possibilities of development of Polish agriculture and export of the agricultural products [Żarski et al. 2009].

The attitudes towards GMO are the resultant of many factors, including primarily the level of knowledge of this problem, effect of intentional opinion-forming activities of both the supporters and opponents of GMOs as well as common opinions and personal convictions. Despite the fact that the concept of GMO increasingly often functions in the Polish language, more profound knowledge concerning GMOs is not so common, and the main source of this knowledge is the media.

The article presents the results of studies conducted amongst adolescents completing secondary schools from the Lublin Region concerning their knowledge on GMO. The objective of the analyses performed was the evaluation of the level of adolescents' knowledge of the scope of issues related with GMO and the determination of the relationship between the level of this knowledge and the selected demographic characteristics of adolescents in the study. The hypothesis that knowledge concerning the problem of GMO differs according to gender, place of residence and type of family environment, as well as the type of school attend by the examined adolescents, was adopted.

2. MATERIAL AND METHODS

The study covered a group of 500 adolescents completing secondary schools in the Lublin Region, including 250 adolescents attending General Secondary Schools and 250 adolescents attending Agricultural Secondary Technical Schools. Amongst the respondents, girls constituted a slightly larger group than boys (58.4% and 41.6%, respectively). The majority

of the adolescents in the study were rural inhabitants (73.4%), while only 26.6% lived in urban areas. More than a half of the respondents (51.8%) came from agricultural families, whereas the remainder (48.2%) from non-agricultural families.

The study was conducted by the method of a diagnostic survey, using a questionnaire technique. The questionnaire contained items concerning particular components of attitude towards GMO (knowledge, emotional evaluating attitude, behaviours) and questions pertaining to the socio-demographic characteristics of the adolescents in the study.

The collected research material was subjected to statistical analysis. Research hypotheses were verified using the statistical χ^2 test.

3. RESULTS AND DISCUSSION

Analysis of the research material showed that the greatest majority of adolescents completing secondary schools (70.9%) were not interested in the scope of issues concerning genetic modification of organisms, while only less than one-third of them (29.0%) showed any interest in these problems. Boys showed an interest in this problem significantly more frequently than girls – 32.2% and 26.8%, respectively (Table 1).

It should be presumed that the low interest in the scope of problems pertaining to GMO exerted an effect on the low self-reported knowledge of this problem. More than three-fourth of the respondents (78.3%) declared that they had no knowledge about GMO or that their knowledge was rather low, whereas every fifth adolescent evaluated own level of knowledge as rather high, and only 1.6% of respondents as very high (Table 1). A high level of knowledge concerning GMO was declared by a similar percentage of boys and girls, whilst great differences were observed amongst boys and girls who evaluated their knowledge as low. Boys, almost twice as often as girls, admitted that they had no knowledge about GMO. Similarly, adolescents attending General Secondary Schools evaluated their scope of information concerning health effects of consumption of products prepared based on GMOs.

Results of the study did not confirm the presumptions that an interest in the problems of GMO and the level of knowledge of this problems is related with the adolescents' place of residence (rural, urban) and the type of family they came from (agricultural, non-agricultural). At the same time, the analyses performed partially confirmed the hypothesis indicating a relationship between the level of knowledge about GMO and the type of school attended by the adolescents examined. The fact of attending schools of different profiles significantly differentiated the interest in products manufactured based on GMO and self-reported knowledge concerning health effects of consumption of food based on GM products. A considerably greater interest in the scope of problems pertaining to GMO was observed amongst adolescents who attended General Secondary Schools, compared to those from Agricultural Secondary Technical Schools (Table 2). Also, adolescents who attended General Secondary Schools evaluated their scope of knowledge concerning the health effects of consumption of products containing GMOs in more positive terms than those from Agricultural Secondary Technical School.

Table 1. Evaluation of adolescents' knowledge concerning GMO according to gender.

| Aspects of evaluation | Gender | | | | Total | |
|---|-------------|--------------|------------|--------------|------------|--------------|
| | Girls | | Boys | | | |
| | N | % | N | % | N | % |
| Interest in the scope of problems concerning GMO ($c^2 = 10.476$, $p < 0.05$) | | | | | | |
| Definitely No | 45 | 15.5 | 38 | 18.3 | 83 | 16.6 |
| Rather No | 168 | 57.7 | 103 | 49.5 | 271 | 54.3 |
| Rather Yes | 71 | 24.4 | 50 | 24 | 121 | 24.2 |
| Definitely Yes | 7 | 2.4 | 17 | 8.2 | 24 | 4.8 |
| Total | *291 | 100.0 | 208 | 100.0 | 499 | 100.0 |
| Self-reported knowledge concerning GMO ($c^2 = 13.097$, $p < 0.01$) | | | | | | |
| I do not know anything | 42 | 14.4 | 56 | 26.9 | 98 | 19.6 |
| I know rather a little | 186 | 63.9 | 107 | 51.4 | 293 | 58.7 |
| I know rather a lot | 59 | 20.3 | 41 | 19.7 | 100 | 20 |
| I know a great deal | 4 | 1.4 | 4 | 1.9 | 8 | 1.6 |
| Total | *291 | 100.0 | 208 | 100.0 | 499 | 100.0 |
| Evaluation of knowledge concerning health effects | | | | | | |
| I know very little | 81 | 27.7 | 70 | 33.7 | 151 | 30.2 |
| I know rather a little | 154 | 52.7 | 102 | 49 | 256 | 51.2 |
| I know rather a lot | 50 | 17.1 | 34 | 16.3 | 84 | 16.8 |
| I know a great deal | 7 | 2.4 | 2 | 1 | 9 | 1.8 |
| Total | 292 | 100.0 | 208 | 100.0 | 500 | 100.0 |

*Lack of data not considered

Table 2. Interest and self-reported knowledge concerning food produced based on GMOs.

| Aspects of knowledge | | Type of school | | | |
|---|------------------------|--------------------------|-------|---|-------|
| | | General Secondary School | | Agricultural Secondary Technical School | |
| | | N | % | N | % |
| Interest in products manufactured based on GMO ($c^2=52.621$; $p<0.001$) | Definitely No | 35 | 14.0 | 49 | 19.3 |
| | Rather No | 126 | 50.4 | 145 | 58.2 |
| | Rather Yes | 77 | 30.8 | 44 | 17.7 |
| | Definitely Yes | 12 | 4.8 | 13 | 4.8 |
| Total | | 250 | 100.0 | *249 | 100.0 |
| Self-reported knowledge concerning health effects of consumption of GM food ($c^2=21.434$; $p<0.001$) | I now very little | 55 | 22.0 | 96 | 38.4 |
| | I know rather a little | 136 | 54.4 | 120 | 48.0 |
| | I know rather a lot | 51 | 20.4 | 33 | 13.2 |
| | I know a great deal | 8 | 3.2 | 1 | 0.4 |
| Total | | 250 | 100.0 | 250 | 100.0 |

*Lack of data not considered

Nearly one-fifth of respondents from General Secondary Schools reported that they had a high or very high range of information about the problem, whereas a lower level of knowledge was declared by a twice smaller number by adolescents attending Agricultural Secondary Technical School (13.6%).

The adolescents in the study were asked several questions testing their actual state of knowledge concerning GMO. They were asked about the knowledge of the essence of genetic engineering and definition of a transgenic organism, the knowledge of the scale of the phenomenon (in percentages) of the occurrence of

Table 3. Adolescents' knowledge concerning GMOs according to the type of school they attend.

| Knowledge of the problem: | | Type of school | | | | Total | |
|---|-----------------------------------|--------------------------|--------------|---|--------------|------------|--------------|
| | | General Secondary School | | Agricultural Secondary Technical School | | N | % |
| | | N | % | N | % | | |
| Essence of genetic engineering ($\chi^2 = 23.816$; $p < 0,001$) | Does not know or incorrect answer | 69 | 27.8 | 121 | 49.2 | 190 | 38.5 |
| | Correct answer | 179 | 72.2 | 125 | 50.8 | 304 | 61.5 |
| Total | | *248 | 100.0 | *246 | 100.0 | 494 | 100.0 |
| Definition of transgenic organism | Does not know or incorrect answer | 140 | 56.2 | 146 | 59.3 | 286 | 57.8 |
| | Correct answer | 109 | 43.8 | 100 | 40.7 | 209 | 42.2 |
| Total | | *249 | 100.0 | *246 | 100.0 | 495 | 100.0 |
| Percentage of food products based on GMO | Does not know or incorrect answer | 210 | 84.0 | 214 | 86.3 | 424 | 85.1 |
| | Correct answer | 40 | 16.0 | 34 | 13.7 | 74 | 14.9 |
| Total | | 250 | 100.0 | *248 | 100.0 | 498 | 100.0 |
| Labelling of products containing GMO ($\chi^2 = 21.241$; $p < 0.001$) | Does not know or incorrect answer | 158 | 66.4 | 100 | 45.0 | 258 | 56.1 |
| | Correct answer | 80 | 33.6 | 122 | 55.0 | 202 | 43.9 |
| Total | | *238 | 100.0 | *222 | 100.0 | 460 | 100.0 |

*Lack of data not considered

food products containing GMO and the knowledge of the method of labelling products containing GMO. Analysis of the replies obtained indicated that the adolescents had the most correct information about the essence of genetic engineering. Nearly two-third of the respondents (61.5%) provided the correct answer to this question (Table 3). A considerably lower percentage of adolescents provided a correct answer whilst defining the term 'transgenic organism' (42.2%) and correctly answered the question about the method of labelling products containing GMO (43.9%). Only 14.9% of the respondents correctly assessed the percentage of food products containing GMO.

The above-mentioned aspects of knowledge concerning GMO did not differ by respondents' gender, type of family they came from (agricultural, non-agricultural) and place of residence (rural, urban). However, certain aspects of knowledge concerning GMO were related with the type of school attended by the respondents (Table 3). Adolescents who attended General Secondary Schools had a considerably better knowledge of the essence of genetic engineering, compared to those from Agricultural Secondary Technical School. Nearly three-fourth of adolescents who attended General Secondary Schools and a half of those from Agricultural Secondary Technical School provided a correct answer to this question. Adolescents attending Agricultural Secondary Technical School showed a better knowledge concerning the method of labelling food products containing GMO. More than half of them (55.0%) provided the correct answer, whilst in the group of adolescents from General Secondary Schools, the percentage of correct answers was significantly lower (33.6%).

Considering the answers to four detailed aspects of knowledge concerning GMO, an overall assessment of respondents' knowledge in this respect was performed. It was assumed that the provision of a correct answer to all four questions designates a high level of knowledge, whereas one correct answer or lack of correct answers is designated as a low level of knowledge. The remaining variants, that is, two to three correct answers, are a mediocre level of knowledge. Based on this evaluation scale, it was found that the highest percentage of adolescents in the study (43.8%) possessed a low level of knowledge concerning GMO (Table 4). A slightly smaller percentage of respondents (37.9%) showed a mediocre level of knowledge, whilst less than one-fifth of them (18.4%) possessed a high scope of knowledge about GMO.

The overall assessment of the level of knowledge concerning GMO amongst adolescents completing secondary schools did not differ according to gender, place of residence and type of school. However, significant differences were found in subgroups selected according to the type of adolescents' family of origin. Adolescents from non-agricultural families showed a higher level of knowledge about GMO, compared to those from agricultural families (Table 4).

4. CONCLUSIONS

The results of the study showed that the greatest majority (70.9%) of adolescents completing secondary schools are not interested at all in the problems related with GMO. In consequence, their

Table 4. Overall assessment of knowledge about GMOs by type of respondents' family.

| Level of knowledge | Adolescents' family | | | | Total | |
|--------------------|---------------------|--------------|--------------|--------------|------------|--------------|
| | Non-agricultural | | Agricultural | | N | % |
| | N | % | N | % | | |
| low | 79 | 37.8 | 114 | 49.1 | 193 | 43.8 |
| mediocre | 82 | 39.2 | 85 | 36.6 | 167 | 37.9 |
| high | 48 | 23.0 | 33 | 14.2 | 81 | 18.4 |
| Total | *209 | 100.0 | *232 | 100.0 | 441 | 100.0 |

$\chi^2 = 8.001$; $p < 0.05$; * lack of data not considered

level of knowledge of this problem is low and usually superficial. The level of adolescents' interest in the application of genetic engineering in agriculture is rather low and does not considerably differ from that possessed by the rest of society. Every fifth adolescent in the study admitted that he or she had no knowledge concerning GMO, whilst every third evaluated own knowledge about health effects of consumption of products containing GMO as very low. In addition, more than two-fifth of respondents were unfamiliar with the basic problems related with GMO.

The results obtained are in accordance with analyses by other researchers who formulated their conclusions based on studies in Poland and other EU countries. These studies show that the buyers of products and their consumers possess little knowledge about genetic bioengineering and GMOs [Jaworska, Kapuścińska 2010; Michalik, Modzelewska 2011; Wilczyńska, Wittbrodt 2012; Report from studies 2013].

Analysis of the relationship between the level of knowledge concerning GMO and the respondents' demographic characteristics showed no significant differences in this level according to gender and place of residence (rural, urban). An interesting finding is the generally higher level of knowledge about GMO amongst adolescents from non-agricultural families, compared to those from agricultural families. It should be presumed that those who are engaged in food production are, to a lower degree, interested in the scope of problems related with GMO than those who primarily take the role of consumers.

Analysis of the detailed aspects of knowledge about GMO indicated that the greatest differences in the level of knowledge were found according the type of school attended by adolescents in the study. Adolescents who attended General Secondary Schools were better informed concerning theoretical issues, for example, the essence of genetic engineering, compared to those who attended Agricultural Secondary Technical Schools, whereas those from Agricultural Technical Schools showed a higher level of knowledge of the methods of labelling food products based on GMO. The observed differences confirm that school education is of great importance in the shaping of knowledge about GMO. Simultaneously, it is an alarming fact that adolescents attending agricultural schools, who are being prepared to perform the occupation of a farmer and, possibly, may soon face the necessity to make a decision about agricultural production with the use of GMO, have insufficient theoretical knowledge. For contemporary adolescents, the Internet is an important source of knowledge about the world, including GMO [Szczurowska 2005]. Unfortunately, the information contained on websites is not always correct and organised. Therefore, it seems that agricultural schools should prepare the future food producers for making beneficial and responsible decisions based on profound knowledge, including the knowledge concerning GMO.

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