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Genetically modified foods in the opinion of the second-year students of biology, biotechnology and tourism and recreation of the Jan Kochanowski University in Kielce – a preliminary study

Żywność genetycznie modyfikowana w opinii studentów drugiego roku biologii, biotechnologii oraz turystyki i rekreacji Uniwersytetu Jana Kochanowskiego w Kielcach – badania wstępne

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Słowa kluczowe: studenci, żywność modyfikowana genetycznie, GMO, wiedza, postawa studentów

Abstract

The aim of this work was to assess knowledge of and to identify awareness in second-year students of biology, biotechnology and tourism and recreation, regarding the use of genetically modified organisms (GMO) in food. The analysis of obtained results shows that about 98% of respondents know the concept of GMO and highly appreciate their knowledge of this topic. The main source of knowledge about GMO for the students is the Internet and the University. It is worth noting that 59% of respondents are aware of the use of GMO in food, while more than half do not know how the GMO in food should be labeled. In particular, students of biotechnology showed a distinctive knowledge about GMO. Over half of students of the Jan Kochanowski University in the fields of biology, biotechnology, and tourism and recreation (55%) recognized that the use of GMO poses a threat to human health.

Streszczenie

Celem niniejszej pracy było poznanie wiedzy i określenie świadomości studentów kierunków biologia, biotechnologia i turystyka i rekreacja, dotyczącej wykorzystania genetycznie modyfikowanych organizmów w żywności. Analiza uzyskanych wyników pozwala na stwierdzenie, że około 98% ankietowanych zna pojęcie GMO i wysoko ocenia swoją znajomość tego tematu. Głównym źródłem wiedzy o organizmach modyfikowanych genetycznie jest Internet oraz Uczelnia. Na uwagę zasługuje fakt, iż 59% respondentów ma świadomość stosowania GMO w żywności, natomiast ponad połowa z nich nie wie, w jaki sposób powinny być oznakowane te produkty. Studenci kierunku Biotechnologia wykazali się wyróżniającą wiedzą na temat GMO. Ponad połowa studentów UJK badanych kierunków – Biologia, Biotechnologia oraz Turystyka i rekreacja (55%) uznała, że stosowanie organizmów genetycznie modyfikowanych stanowi zagrożenie dla zdrowia człowieka.

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1. INTRODUCTION

Genetically modified organisms (GMO) and genetically modified foods (GMF) have always generated controversy. On the one hand, they hold great hopes for solving problems in the fields of agriculture, protection of environment, forestry, medicine, nutrition and food technology, but on the other hand, safety of GMO for human health and the natural environment is of great concern [Tchórz et al. 2012, Thompson, William 2008].

The enormous progress made in biotechnology, genetic engineering and development of nanotechnologies have allowed the creation of GMO, i.e., plants and animals. The structure of DNA was elucidated in 1953, the first transgenic plants (tobacco) were created in 1984, and commercial GMF production started in 1994 (tomato Flavr Savr). Today cultivation area under genetically modified plants is over 160 million of hectares worldwide, and 90% of animal feed or 70% of supermarket products contain

genetically modified additives. From GMO, almost 100% of the hormones, many drugs and vaccines, and monoclonal antibodies used in the diagnostics are produced [Rhodora et al. 2015].

According to the Polish Act of June 22, 2001, GMO or transgenic organism is an "organism other than the human organism in which the genetic material has been changed in a non-natural way by crossing or natural recombination" [Ustawa... 2001]. Thus, GMF is produced in part or in whole from GMO.

The problem of genetic modifications is related to many aspects of human life, primarily, with their health condition. Health, according to the WHO definition, is the psychological, physical and social well-being, and its basis is a homeostasis with the environment in which the human lives [Wojtczak 2009, WHO 2017]. Potential health threats associated with the emergence of GMO can be attributed concomitantly to increasing incidence

of allergic diseases caused by the presence of foreign proteins, including toxins and allergens, in GMF. Increasing resistance of humans to antibiotics can cause the emergence of drug-resistant bacterial strains in organisms. Thus genetically modified products can increase the incidence of cancer, gastrointestinal diseases, hormonal imbalance and fertility issues, immune system collapse or obesity [Séralini 2007].

Advocates of GMF focus their argument on increasing crop volumes, eliminating global hunger, increasing nutritive values of foods (fortified with lycopene, lutein and omega-3 polyunsaturated fatty acids) and reducing the degradation of ecosystems [Ishii, Araki 2016]. Furthermore, due to detailed examination and evaluation of GMF by the European Food Safety Authority (EFSA) before they are marketed, it is possible to obtain food that has been tested and fully safe [European...2010, WHO 2017].

Public opinion plays an important role in analyzing and prognosticating future prospects about both positive and negative effects of using GMO and GMF. Reliable information on the long-term impact of GMO on the natural environment, and in particular on human health, will allow consumers to make an informed choice.

The aim of the survey was to determine the state of awareness of young people – students in the fields of biology, biotechnology and tourism and recreation of Mathematics and Natural Sciences Faculty of the Jan Kochanowski University in Kielce – in terms of using GMO in food and defining their attitude to this problematic aspect. An attempt was made to demonstrate the relationship between knowledge and the choice of GMF by students. Due to the relatively small number of respondents, the research cannot be considered as representative, but it can contribute to understanding the level of knowledge among the students in Poland on GMO.

2. MATERIALS AND METHODS

2.1. Objectives of the study

The study covered 49 second-year students of biology, biotechnology and tourism and recreation of the Jan Kochanowski University in Kielce in the academic year of 2016-17. The research was conducted by the diagnostic survey method. Questionnaire was used as a research tool. It consisted of 19 questions (closed, single or multiple choice questions), 16 of which were related to knowledge about GMO, and 3 questions were to study preferences. The questionnaire was completed with a metric, which differentiated the respondents by sex, place of residence, place of origin, type of school and field of study. The questionnaire concerned students' knowledge about GMF and their motivation for buying these foods. The opinions of respondents on the impact of GMF on consumer health as well as the influence of socio-demographic and economic factors on purchasing decisions of GMF were also investigated. The prevailing answers were as follows: yes, no, I do not know / I have no opinion. Therefore, the results are clear as to the knowledge and the number of followers and opponents of genetic modifications. In order to assess the students' knowledge and their attitude to GMF, three independent groups of respondents were analyzed, thus gaining extensive information on the students' attitudes to GMF.

2.2. Ethical aspects

The questionnaire survey was completed by students while they attended the course during the day, with their consent and in the presence of their teacher. The questionnaire was anonymous and the survey met all the ethical guidelines.

2.3 Statistics

Statistical evaluation of data was performed using STATISTICA 12.0 software (StatSoft, Inc.). Results are summarized by determining the number of respondents as a percentage of the population surveyed. Spearman correlation coefficient [Sokal, James 2013] was used to determine the relationship between two qualitative variables, based on the χ^2 distribution. To test null hypothesis, the level of significance was assumed to be $\alpha \leq 0.05$.

3. RESULTS AND DISCUSSION

The practical application of GMO in food production is extremely controversial and is a subject of debate because of both potential opportunities and threats. It seems necessary to provide reliable information on the positive and negative effects of incorporation of GMO to food.

The reliability of the used questionnaire was high. The Spearman's rank correlation for socio-demographic variables ranged from 4.51 to 12.12 (all significant at $p < 0.05$).

Of the students of the Jan Kochanowski University in Kielce, studying in a stationary mode, 78% were women and 22% were men. Most of the respondents are rural residents (57%) and the rest (43%) of the students are urban residents. Of these students, 8% of the respondents lived in dormitories, 35% in homes for rent, 51% in the parents' houses and 6% in their own houses. Analysis of the students by origin indicates that only 29% of respondents belong to agricultural families, while the remaining (71%), have a non-agricultural origin (Table 1). Most of the surveyed second-year students in the Jan Kochanowski University were from high schools (86%), and only 14% from technical schools. The subjects were divided into two age groups: the first age group (17 to 21 years old) (59%) and the second age group (22 years old and older) (41%). The 17-year-old students came from Ukraine.

The analysis of data allowed us to state that the concept of GMO was widely known among the students of the three studied fields (biology, biotechnology, tourism and recreation). In the population of surveyed students, 98% of the respondents gave a correct definition of GMO. Similar results were obtained by Spodobalska and Wyrzykowska [2015], where 90% of the respondents stated that they know the concept of GMO and simultaneously none of the others responded that the term is unknown [Spodobalska, Wyrzykowska 2015]. Litwinczuk and Molga [2015], on the basis of surveys carried out in urban society (mainly people with higher education), showed that the respondents have a superficial knowledge about GMO. Most of them knew the term GMO and were able to explain it. Based on the above-mentioned studies and our own results, it can be stated that the concept of GMO is well known to students. In contrast to this, a study by Lachowski et al. [2017] indicated that the level

Table 1. Socio-demographic characteristics of the studied group (% in relation to the survey population)

Characteristics		Field of study					
		Biology N=12 n %		Biotechnology N=22 n %		Tourism and Recreation N=15 n %	
Gender	Females	11	92	15	68	12	80
	Males	1	8	7	32	3	20
Place of residence	Town	2	17	14	64	5	33
	Village	10	83	8	36	10	67
Provenance	Agricultural	7	58	2	9	5	33
	Non-agricultural (Urban)	5	42	20	91	10	67
Type of completed school	High school	11	92	20	91	11	73
	Technical school	1	8	2	9	4	27
Current place of residence	Flatshare	6	50	4	18	7	46
	Dormitory	2	17	1	4,5	1	7
	Own apartment	1	8	1	4,5	1	7
	Family home (with parents)	3	25	16	73	6	40
Age	17–21	7	58	13	59	9	60
	22 and older	5	42	9	41	6	40

Source: Our own elaboration.

of knowledge concerning GMO among adolescents completing secondary schools was generally mediocre (38.4%) or low (31.3%) and barely 18.1% of adolescents showed a high level of knowledge about GMO [Lachowski et al. 2017].

In our study, students from tourism and recreation (40%) and biology (33%) estimated their interest in the problems of GMO in food production at a moderate level, whereas nearly 95% of the students from biotechnology are currently interested in this issue ($p < 0.05$). The vast majority of biotechnology students (68%) declare that they are sufficiently informed about GMO ($p < 0.05$). The other students from biology (67%) and tourism and recreation (33%) do not have sufficient information on this subject. Therefore, it can be assumed that among the students from biotechnology the level of acceptance for the use of genetically modified ingredients will be greater. Taking into account the students' self-estimation of knowledge about GMO, more than half of biotechnology students (82%) report that they "know a lot" about this topic ($p < 0.05$). Students of biology (75%) and tourism and recreation (60%) represent a low self-esteem of their own knowledge about GMO. The testing question of students' knowledge about GMF showed a strong correlation ($p < 0.05$) between the field of studies and knowledge of the subject. Students of biotechnology showed a higher knowledge about GMO. Most respondents (86%) declared their willingness to increase their knowledge about GMO, foods containing GMO ingredients, and GMO-free food and its ingredients (e.g. GMO-fed livestock) (biology 92% of responses, $p < 0.05$; biotechnology 91% of responses, $p < 0.05$; tourism and recreation 73% of responses, $p < 0.05$).

Similar conclusions were drawn by Sadowski and Piasecka [2011], who noted that there is a need to broaden knowledge not only on GMF, but also on the phenomenon of GMO. Considering the self-

assessment of knowledge about GMO, a statistically significant influence on the state of knowledge of students of the Jan Kochanowski University is related to their non-agricultural origin ($\chi^2 = 12.12$, $p < 0.001$) and, to a lesser degree, to the age of the examined students ($\chi^2 = 6.85$, $p < 0.05$). In terms of students' sex, place of residence, types of completed school and fields of studies (biology, biotechnology, tourism and recreation), there were no statistically significant differences. Jurkiewicz and Bujak [2014] found that the provenance did not have a statistically significant impact on the self-assessment of knowledge about GMO, while sex and types of completed school considerably modulated the level of knowledge of surveyed students about modifications in GMF. Quite different results were obtained by Spodobalska and Wyrzykowska [2015], who clearly showed that young people from rural areas are more aware of the concept of GMO.

In the opinion of the surveyed students, most information regarding genetic modification of organisms can be obtained from the Internet (biology – 48% of responses, $p < 0.05$; biotechnology – 39% of responses, $p < 0.05$; tourism and recreation – 16% of responses), in academic institutions (biology – 32% of responses; biotechnology – 37% of responses, $p > 0.05$; tourism and recreation – 37% of responses), less in television (biology – 12% of responses; biotechnology – 12% of responses; tourism and recreation – 21% of responses), and in journals (biology – 8% of responses; biotechnology – 12% of responses; tourism and recreation – 26% of responses).

In the available scientific literature, the most frequently chosen answers to the question of which sources the respondents came across the concept of GMO were the Internet, television and radio, journals (press) and agricultural advisory centers [Flaczyk et al. 2013, Jurkiewicz, Bujak 2014].

According to Wilczyńska and Wittbrodt [2012], for students of nutritional sciences (Faculty of Food Sciences in Olsztyn, Poland and Faculty of Entrepreneurship and Commodity Science in Gdynia, Poland), the main source of knowledge about GMO was lectures. In this case, 32% of students learned the concept of GMO during lectures, while 14% of students from the Faculty of Environmental Protection and Fisheries of the University of Warmia and Mazury (Olsztyn, Poland), as well as from the Faculty of Mechanics and Navigation of the Gdynia Maritime University (Gdynia, Poland) indicated lectures as the main source of knowledge about GMO [Wilczyńska, Wittbrodt 2012].

In this study, among the genetically modified plants, the most frequently mentioned by the students of the Jan Kochanowski University were: tomatoes (biology – 24% of responses; biotechnology – 48% of responses, $p < 0.05$; tourism and recreation – 29% of responses, $p < 0.05$), maize (biology – 22% of responses; biotechnology – 82% of responses; tourism and recreation – 18% of responses), potatoes (biology – 31% of responses; biotechnology – 82% of responses, $p < 0.05$; tourism and recreation – 18% of responses), soybeans (biology – 21% of responses; biotechnology – 58% of responses, $p < 0.05$; tourism and recreation – 21% of responses), rice (biology – 19% of responses; biotechnology – 67% of responses, $p < 0.05$; tourism and recreation – 15% of responses), rapeseed (biology – 6% of responses; biotechnology – 88% of responses, $p < 0.05$; tourism and recreation – 6% of responses), fruits (biology – 20% of responses; biotechnology – 51% of responses, $p < 0.05$; tourism and recreation – 29% of responses), cereal (biology – 16% of responses; biotechnology – 60% of responses, $p < 0.05$; tourism and recreation – 24% of responses), flowers (biology – 6% of responses; biotechnology – 71% of responses, $p < 0.05$; tourism and recreation – 24% of responses) and beetroots (biology – 8% of responses; biotechnology – 69% of responses; tourism and recreation – 23% of responses).

Similarly, in the case of the question on genetically modified animals, the most frequently mentioned animals by students of the Jan Kochanowski University were: sheep (biology – 21% of responses; biotechnology – 52% of responses, $p < 0.05$; tourism and recreation – 27% of responses), goats (biology – 17% of responses; biotechnology – 78% of responses, $p < 0.05$; tourism and recreation – 5% of responses), swine (biology – 11% of responses; biotechnology – 64% of responses, $p < 0.05$; tourism and recreation – 25% of responses), cows (biology – 15% of responses; biotechnology – 58% of responses, $p < 0.05$; tourism and recreation – 27% of responses), laboratory animals (biology – 23% of responses; biotechnology – 49% of responses, $p < 0.05$; tourism and recreation – 28% of responses, $p < 0.05$), domestic birds (biology – 7% of responses; biotechnology – 87% of responses, $p < 0.05$; tourism and recreation – 7% of responses) and fish (biology – 14% of responses; biotechnology – 81% of responses, $p < 0.05$; tourism and recreation – 5% of responses). The respondents to the question of which of the products listed in the survey contained genetically modified ingredients responded as follows: vegetables (biology – 24% of responses; biotechnology – 50% of responses; $p < 0.05$; tourism and recreation – 26% of responses, $p < 0.05$), fruits (biology – 23% of responses; biotechnology – 49% of responses, $p < 0.05$; tourism

and recreation – 28% of responses, $p < 0.05$), grains (biology – 5% of responses; biotechnology – 79% of responses; $p < 0.05$; tourism and recreation – 16% of responses), sausages (biology – 22% of responses; biotechnology – 44% of responses; tourism and recreation – 33% of responses), dairy products (biology – 5% of responses; biotechnology – 85% of responses, $p < 0.05$; tourism and recreation – 6% of responses), oils (biology – 13% of responses; biotechnology – 81% of responses, $p < 0.05$; tourism and recreation – 6% of responses).

In the study by Jurkiewicz and Bujak [2014], young people from the Lublin Voivodship most frequently mentioned, among the genetically modified plants, tomatoes (44%), maize (30%), potatoes (20%), and with respect to genetically modified animals, they mentioned sheep, goats (48%) and swine (18%). Wilczyńska and Wittbrodt [2012] reported that among the products containing genetically modified ingredients, students most frequently mentioned starch, fruits, vegetables, milk and its products, corn, soya and colza oil.

Over half of students of the Jan Kochanowski University from biology, biotechnology and tourism and recreation (55%) considered that the use of GMO poses a threat to human health (biology – 26% of responses; biotechnology – 41% of responses, $p < 0.05$; tourism and recreation – 33% of responses), while 12% of students considered that genetically modified products were safe, but 33% were not sure of this risk. The statistically significant differences were found with respect to the criteria of school types ($\chi^2 = 4.90$, $p < 0.05$) and place of origin ($\chi^2 = 5.66$, $p < 0.05$). A similar percentage of responses were obtained when asking whether products containing genetically modified ingredients were environmentally safe. In this case, 71% of students think that they are a threat to the environment (biology – 20% of responses; biotechnology – 54% of responses, $p < 0.05$; tourism and recreation – 26% of responses), 22% of students had no opinion about harmfulness of GMO, and only 6% of respondents believe that the use of GMO is beneficial. The statistically significant differences were found with respect to the school types ($\chi^2 = 8.76$, $p < 0.05$) and the sex of the students ($\chi^2 = 7.75$; $p < 0.05$).

Similar surveys were conducted among students by Wilczyńska and Wittbrodt [2012] and Borek-Wojciechowska [2010], examining their relationship to the use of GMO and their potential health and environmental risks. These studies revealed that more than half of students were not sure whether the use of GMO poses a threat to human health or the environment. Wilczyńska and Wittbrodt [2012] reported that about 38% of respondents considered genetically modified products as safe and 12% of them thought they posed a health risk. According to Borek-Wojciechowska [2010], 26% of the students think that the GMO constitute a threat to the environment and only 14% think that their use is beneficial. In the studies by Spodobalska and Wyrzykowska [2015], the authors noted that in the first year of study 48% of respondents consider GMO to be hazardous to the environment, while in the fifth year of study, the number of respondents who consider GMO as dangerous to the environment increases up to 67%. Similarly, in a study by Jurkiewicz et al. [2014], conducted on 500 students completing secondary schools from Lublin region, respondents' opinions on genetic modifications were both positive and negative. The most

frequently reported three negative consequences by adolescents were the occurrence of new diseases in the animals, disappearance of traditional species, and occurrence of new animal species [Jurkiewicz et al. 2014]. Among positive effects of GMO the most frequently mentioned three causes were higher productivity of animal breeding, production of new medicinal products and higher resistance of animals to diseases [Jurkiewicz et al. 2014].

Litwinczuk and Molga [2015] showed that more than half of the respondents accepted the use of GMO for the production of medicines and removal of pollutants from the environment, but only few persons advocated using GMO for food production (5–7% of respondents). Some respondents admitted that they probably consumed GMF because they did not read the label on the products. According to Flaczyk et al. [2013] information on the labels of the tested products has a significant impact on their acceptance by respondents. For instance, the acceptance of yogurt with the declared presence of GMO was particularly low. In the study by Kramkowska et al. [2012], it was concluded that the evaluation of the possible impact of GMO on human health depends on the field of study, namely 39% of biotechnology students and 67% of dietetic students indicate a possible negative influence of GMO. Both biotechnology (62%) and dietetics (50%) students believed that in more than half of the cases, GMF were labeled invisibly to the consumers. The research carried out by the Public Opinion Research Centre in Poland (CBOS) [2013] shows that the overwhelming majority of Poles are of the opinion that both GMO-containing products and products from animals feeding with GMO-containing fodder should be appropriately labeled (94% and 93%, respectively) [COBOS... 2013].

According to health conditions of food and nourishment law of Poland, labels for GMF containing proteins or DNA from GMO should be labeled as follows: "this product contains genetically modified organisms". The obligation to mark new foods does not apply to GMF or GMO products if their content does not exceed 1% of the ingredients [Ustawa... 2001]. Therefore, on the packaging of soybean concentrates one can read "GMO-free" even if the concentrates contain 0.9% of genetically modified proteins.

Products with GMO are generally a source of controversy as to their impact on the health of consumers. There are no literature data that directly points to their harmfulness, their relatively short life span and their use, so many researchers claim that one cannot unambiguously state that they are not a threat to human health. Negative attitudes toward genetically modified products or GMO are also evidenced by testimonials of buyers regarding their purchase decisions. In a situation where there is a choice between a cheaper genetically modified or GMO-containing product and a much more expensive, but unmodified and GMO-free product, consumers are more likely to choose the latter one. The study by the Public Opinion Research Centre in Poland (CBOS) [2013] confirms that the vast majority of respondents (72%), who have the option to choose, buy a product that is not genetically modified and not containing GMO, even if it was significantly more expensive than the GMO-containing product.

In the study by Sadowski and Piasecka [2011], this phenomenon was observed only among people with higher education, where 50% of them see differences between traditional foods and GMF,

while only 19.4% declare that they deliberately buy genetically modified products.

The students of the Jan Kochanowski University, asked in this study about their relationship to GMF, responded in the vast majority (88%, $p < 0.05$) that the presence of genetically modified ingredients had a great impact on their diet and shopping decisions, while only 12% of respondents considered these decisions as irrelevant. Most students of biology (58%) and tourism and recreation (60%) said that they did not buy products containing genetically modified ingredients, and a huge impact on this decision, in more than 50% of cases, was price. Only students of biotechnology (68%, $p < 0.05$) stated that they would be willing to buy such foods if they would be cheaper than traditional foods (59%). The essential factor related to the choice of GMO was, according to the majority of students, the reduction of global hunger (37%).

Among the students' responses were also those as follows: the consumption of GMF may cause cancer risk (22%) and infertility (16%). The reduction of herbicide use due to the application of genetic engineering methods (10%) and increased nutritional values and extra vitamins in genetically modified plants (14%) were also mentioned. The statistically significant differences were found in the age group of 17 to 21 years old students ($\chi^2 = 9.39$, $p < 0.05$), and the place of origin group of students ($\chi^2 = 4.51$, $p < 0.05$). Students with non-agricultural provenance (48.9%) showed a high level of knowledge on disadvantages and benefits of GMF; in terms of gender preferences, women most often pointed to the significant disadvantages and benefits of GMF ($\chi^2 = 10.23$, $p < 0.001$). It is important to note that 59% of respondents are aware that there are products containing genetically modified ingredients on the Polish market, while over half of them (73%) do not know how the products should be labeled (biology – 67% of response; biotechnology – 73% of responses, $p < 0.05$; tourism and recreation – 80% of responses, $p < 0.05$). According to Borek-Wojciechowska [2010], 64% of students know that genetically modified products are present on the Polish market.

Among the products containing genetically modified ingredients indicated by students of the Jan Kochanowski University, the following products appeared on the Polish market: chips – 20% (biology – 21% of responses; biotechnology – 48% of responses, $p < 0.05$; tourism and recreation – 30% of responses), yogurt – 9% (biology – 20% of responses; biotechnology – 53% of responses; tourism and recreation – 27% of responses), alcohol – 20% (biology – 22% of responses; biotechnology – 56% of responses, $p < 0.05$; tourism and recreation – 22% of responses), hamburgers – 17% (biology – 21% of responses; biotechnology – 54% of responses, $p < 0.05$; tourism and recreation – 25% of responses), cereal – 24% (biology – 23% of responses; biotechnology – 49% of responses, $p < 0.05$; tourism and recreation – 28% of responses), and vegetable oils – 9% (biology – 27% of responses; biotechnology – 47% of responses; tourism and recreation – 27% of responses).

In the stores, where according to respondents, are sold products containing GMO are: Biedronka – 24% (biology – 22% of responses; biotechnology – 46% of responses, $p < 0.05$; tourism and recreation – 32% of responses, $p < 0.05$), Lidl – 12% (biology – 25% of responses; biotechnology – 50% of responses; tourism

and recreation – 25% of responses), real – 20% (biology – 17% of responses; biotechnology – 60% of responses, $p < 0.05$; tourism and recreation – 23% of responses), Spar – 17% (biology – 20% of responses; biotechnology – 53% of responses, $p < 0.05$; tourism and recreation – 27% of responses), Zabka – 27% (biology – 24% of responses, $p < 0.05$; biotechnology – 48% of responses, $p < 0.05$; tourism and recreation – 28% of responses, $p < 0.05$).

When questioned about their relationship to foods containing genetically modified components, the students of the Jan Kochanowski University in a vast majority (71%) responded that this issue was very important to them and it had a great impact on their dietary decisions. In contrast, 29% of respondents attributed a lower, statistically insignificant attention to GMO-containing foods. The nutritional status and knowledge of young people about GMF will play an important role in the future in shaping the food market and in the directions of its development.

4. CONCLUSIONS AND SUMMARY

1. The research has shown that the awareness of the second-year students of biology, biotechnology and tourism and recreation in the Jan Kochanowski University is high. One can distinguish the students of biotechnology, who have extensive knowledge enabling them to independently evaluate and develop their own opinion on the use of

GMO in food. As the main source of knowledge on GMO, the respondents point out the Internet and the knowledge gained during their academic education. The knowledge of students of the Jan Kochanowski University about the presence on the market and labeling of GMO-containing products is moderate. Most respondents have, however, a strong interest in the use of GMO in food, which is reflected in their purchases.

2. There exists a correlation between confidence of the respondents and the selection of GMO or GMO-free products. Along with the conviction of the respondents that GMF carry the risk of destabilizing homeostasis within the organism and become the cause of disease, the respondents are likely to choose GMO-free foods. The stronger convictions of respondents on the positive effects of genetic engineering in the food and agriculture industry the stronger tendency to choose genetically modified products.
3. There is a need to run programs that could significantly help informing Polish society about the problems of GMF.

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