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Assessment of Consumer Knowledge of Gluten-Free Food

Ocena wiedzy konsumentów na temat żywności bezglutenowej

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Abstract: The gluten-free food market has become one of the fastest-growing food markets for food intolerances. People with celiac disease, gluten intolerance, non-celiac gluten sensitivity, and other gluten-related diseases should follow a gluten-free diet. The demand for gluten-free products is growing yearly, mainly due to the increasing number of diagnosed cases. The aim of the study was to assess consumers' knowledge of gluten-free foods and covered people of all ages, and was conducted using a questionnaire. The research results indicate that most consumers have a lot of knowledge concerning gluten-free food. Moreover, most consumers know what gluten is and what products to avoid while on a gluten-free diet. They also know which diseases it causes and that it is necessary to follow a diet, but they have difficulty determining the acceptable gluten content in gluten-free products. Consumers' most crucial parameter when choosing a gluten-free product is taste. The results of the survey also show that a gluten-free diet is more popular among women than men.

Keywords: gluten, gluten-free diet, nutrition, celiac disease, gluten free food market, Crossed Grain trademark, gluten-free food producers, survey research.

Streszczenie: Rynek żywności bezglutenowej stał się jednym z najszybciej rozwijających się rynków żywności stosowanej w nietolerancjach pokarmowych. Osoby dotknięte celiakią, nietolerancją na gluten, nieceliakalną nadwrażliwością na gluten oraz innymi schorzeniami glutenoależnymi powinny stosować dietę bezglutenową. Zapotrzebowanie na produkty bezglutenowe rosło z roku na rok, głównie ze względu na rosnącą liczbę osób zdiagnozowanych. Celem pracy była ocena wiedzy konsumentów w każdym wieku na temat żywności bezglutenowej. Badanie przeprowadzono z wykorzystaniem kwestionariusza ankiety. Wyniki badań wskazują, że większość konsumentów ma dużą wiedzę na temat żywności bezgluteno-

wej. Wiedzą, czym jest gluten i jakich produktów unikać na diecie bezglutenowej oraz jakie choroby wymagają stosowania diety, ale mają trudności z określeniem dopuszczalnej zawartości glutenu w produktach bezglutenowych. Dla konsumentów najważniejszym parametrem przy wyborze produktu bezglutenowego jest smak. Wyniki badania pokazują również, że dieta bezglutenowa jest popularniejsza wśród kobiet niż wśród mężczyzn.

Słowa kluczowe: gluten, dieta bezglutenowa, żywienie, celiakia, rynek żywności bezglutenowej, znak Przekreślonego Kłosa, producenci żywności bezglutenowej, badanie ankietowe.

1. Introduction

Cereal grains are a significant component of the diet of a large number of people living in Europe. They provide many nutrients needed for the proper functioning and development of the body. They are primarily a source of dietary fibre, carbohydrates, as well as protein and minerals, which are the basis for the preparation of many products, including pasta, bread, sauces and desserts. Over the last few years, the market for foodstuffs for particular nutritional uses has been growing dynamically. More and more people are looking for products that meet their expectations and allow them to lead a healthy lifestyle.

Gluten is a complex mixture of hundreds of related but distinct plant proteins, mainly gliadin and glutenin. It belongs to the group of prolamins and is present in cereal seeds such as wheat (gliadin), rye (secalin) and barley (hordein). Gluten is widely used in industry, especially in food. It gives products elasticity and ductility.

Gluten-free foods are products that consist of, or were produced from, raw materials that do not contain wheat (as well as its varieties – durum, kamut, spelled), barley, rye, oats or their varieties, in which the maximum gluten content is 20 mg/kg (Wojtasik, Kunachowicz, and Daniewski, 2008). Nowadays, gluten-free food is in great demand, as many people struggle with diseases that require a gluten-free diet. Gluten-free foods are primarily for people who experience adverse effects after consuming gluten-containing products.

The rapid growth of this type of food market is caused by, among others, increasing awareness in society regarding gluten and gluten-related diseases. Many people suffer from celiac disease, a visceral disease that causes digestion problems leading to the disappearance of intestinal villi. Gluten-related health disorders manifest themselves in many ways. In addition to celiac disease, these include non-celiac gluten hypersensitivity (NCNG) as well as wheat allergy (Moore, 2014; Sabenca et al., 2021). The solution, and the only effective method to alleviate the symptoms of the conditions mentioned above, is a gluten-free diet, which involves completely eliminating gluten-containing products (Demirkesen and Ozkaya, 2022).

The study aimed to investigate consumers' knowledge about gluten-free foods. The first part of the paper discusses the research materials and methods used in conducting the survey and presents the sociodemographic data of the respondents.

The second part of the paper focuses on the presentation of the results of the survey and their analysis and discussion.

2. Research methodology

The survey on consumer knowledge assessment was conducted in December 2021 via the Internet, using a proprietary survey questionnaire. A Google template was used to draft the form and collect the survey results. The research sample was selected using simple random sampling. The study sample consisted of consumers; participation was anonymous and voluntary, aimed at people of all ages.

The questionnaire consisted of two parts and contained 15 closed questions. The first part included 11 questions that addressed issues related to gluten, food, and gluten-free diets, asking about gluten-free cereals, gluten-free foods, gluten-free food labelling, and diseases requiring gluten-free usage. This section included disjunctive (single-choice) and conjunctive (multiple-choice) questions, and an alternative question was also included. One of the questions asked respondents to rate on a scale the given criteria relating to gluten-free foods.

The second part consisted of four metric questions, allowing to determine the sociodemographic profile of the respondents. All the questionnaires were completed correctly, meaning a 100% response return.

A χ^2 test of independence was used to analyse the survey results; MS Excel was also used. The χ^2 test was used to determine the relation between the age of the respondents and their use of a gluten-free diet, assuming the level of significance $\alpha = 0.05$. Critical values were read from the chi-square distribution table at the level mentioned above of significance. The χ^2 independence test is primarily used in testing the interdependence of nominal variables. A variable is treated as nominal when its values represent categories and cannot be rank-ordered. The expected (theoretical) values were then calculated. These counts indicate how many respondents should represent a given research condition (Słowińska, 2019). More precisely, it is a value calculated under the assumption that there is no relation between the variables of responses and age. The following formula was used for the calculation:

$$E_{ij} = \frac{f(i.) \times f(.j)}{n}, \quad (1)$$

* n – sample size, $f(i)$ – sum of the marginal counts for row i , $f(j)$ – sum of the marginal sizes for column j .

The value of χ^2 statistic was calculated using formula (2):

$$\chi^2 = \sum_{i=1}^r \sum_{j=1}^k \frac{(O_{ij} + E_{ij})^2}{E_{ij}}, \quad (2)$$

* O_{ij} – observed counts, E_{ij} – theoretical counts, r – rows, number of categories of the trait under study, k – columns, number of categories of the trait under study, i – number of a given row, j – number of a given column.

The distribution.chi.inverse.ps function was used to calculate the critical value of χ^2_{α} in MS Excel. For the given variables, the value of degrees of freedom was 4, and $\alpha = 0.05$ was taken as the significance level.

The function distribution.chi.inverse.ps was used to calculate the critical value of χ^2_{α} in MS Excel. For the given variables, the value of degrees of freedom was 4, and $\alpha = 0.05$ was taken as the level of significance. The critical value of χ^2_{α} was 9.4877. If the value of the χ^2 test is greater than the critical value of χ^2_{α} , it allows to reject the null hypothesis of independence of variables (Słowińska, 2019). The alternative hypothesis can then be accepted, stating a relation between the two variables (at a significance level of $\alpha = 0.05$).

A total of 140 respondents participated in the survey, out of which 119 females (85%) and 21 males (15%). The sociodemographic profile of the respondents is shown in Table 1.

Table 1. Characteristics of the respondents

Tabela 1. Charakterystyka respondentów

Profile of respondents		Number of respondents	Percentage
Gender	Female	119	85
	Male	21	15
Age	Under 18 years	4	3
	18-25 years	42	30
	26-35 years	41	29
	36-55 years	48	34
	Over 55 years	5	4
Education	Basic Education	4	3
	Vocational Education	5	4
	Secondary Education	58	41
	Higher Education	73	52
Place of residence	Village:	28	20
	town up to 50 000 residents	22	16
	town from 50 000 up to 150 000 residents	31	22
	town from 150 000 up to 500 000 residents	17	12
	town over 500 000 residents	42	30

Source/Źródło: own study/opracowanie własne.

The most numerous respondents were 36-55 years old (34%), while the smallest group was under 18 (3%). More than half declared a university education (52%). Among the remaining respondents, 41% had secondary education, 4% vocational, and 3% elementary education. Most respondents came from large towns with more

than 500 thousand inhabitants (30%) and towns with 50 thousand up to 150 thousand inhabitants (22%). The numerous but minor group were the respondents from towns with 150 thousand to 500 thousand inhabitants (12%).

3. Survey results and their discussion

3.1. Analysis and evaluation of survey results

The respondents were familiar with the concept of gluten. As many as 88% of those interviewed declared that they know what gluten is. Some people were not sure of their knowledge and only 5% did not know this concept. The distribution of answers to this question, depending on the gender of respondents, is presented in Figure 1.

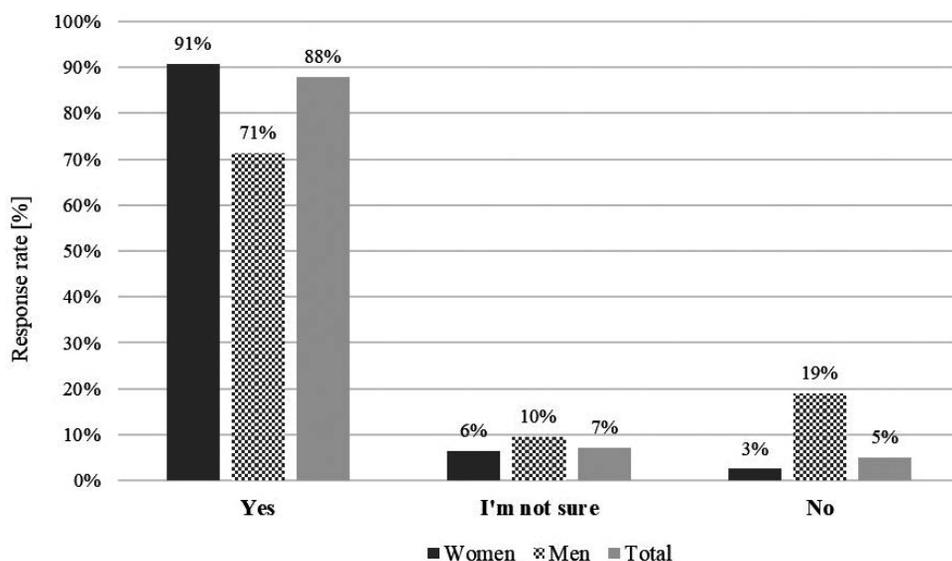


Fig. 1. Distribution of respondents' answers to the question on knowledge of the definition of gluten, based on the gender of respondents and the total number of respondents

Rys. 1. Rozkład odpowiedzi respondentów na pytanie dotyczące znajomości definicji glutenu – z uwzględnieniem respondentów oraz ogólnej liczby respondentów

Source/Źródło: own study/opracowanie własne.

The data shows that the topic of gluten-free foods interested women much more than men. Women tend to be more interested in different types of diets, including gluten-free ones, so the concept of gluten was familiar to most of them. Gluten-dependent diseases – non-celiac gluten sensitivity, or celiac disease – affect women more often than men, and women report more complaints after consuming gluten (Michałowska, Pastusiak, and Bogdański, 2017).

In response to the question of what group of nutrients gluten belongs to, 64% of the respondents said gluten is a plant protein, which was the correct answer. In contrast, 21% marked the answer “gluten is not a nutrient”. The survey found that 6% of the respondents did not know what gluten is, and 9% indicated that it belongs to the group of carbohydrates, and only 1% thought that the compound in question belongs to the group of fats. Figure 2 shows the answers, depending on the respondents’ education.

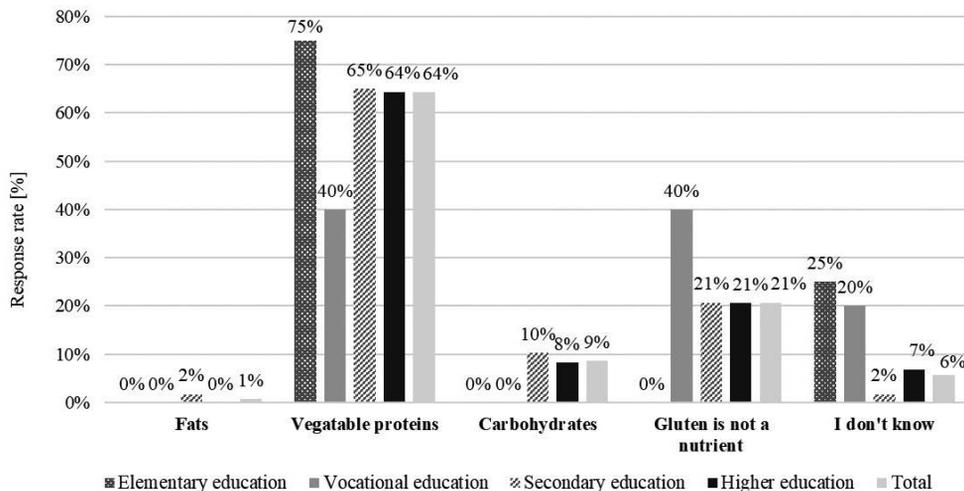


Fig. 2. Distribution of respondents' answers to the question about the group of nutrients to which gluten belongs, based on the education of the respondents and the total number of respondents
Rys. 2. Rozkład odpowiedzi respondentów na pytanie o grupę składników odżywczych, do której należy gluten, z uwzględnieniem wykształcenia respondentów oraz ogólnej liczby respondentów
 Source/Źródło: own study/opracowanie własne.

The question was also analysed according to the education of the respondents. This was to check whether people with higher education have more knowledge in this subject than those with elementary education. People with primary education most often marked the correct answer – 75% of the respondents in this group, while the remaining 25% did not know the answer to this question. The responses of people with secondary and higher education were very similar. The correct answer was given by 65% of respondents with secondary education and 64% of those with higher education. As many as 21% of the respondents from each group indicated that gluten is not a nutrient. The answer “carbohydrate” was marked by 10% of those with high school education and 8% of those with a college education. Only 40% of those with vocational education indicated plant proteins as an answer, and the same number of respondents with such education indicated that gluten is not a nutrient, which shows that people with vocational education have relatively low knowledge about gluten.

The survey also showed that those with primary education have the most excellent understanding of gluten, followed by those with secondary and higher education.

Another single-choice question concerned the use of a gluten-free diet. More than half of the respondents (60%) admitted that currently followed or used to follow a gluten-free diet, while 40% of the respondents never followed or did not follow a gluten-free diet. The distribution of answers to this question, depending on the age of the respondents, is shown in Figure 3.

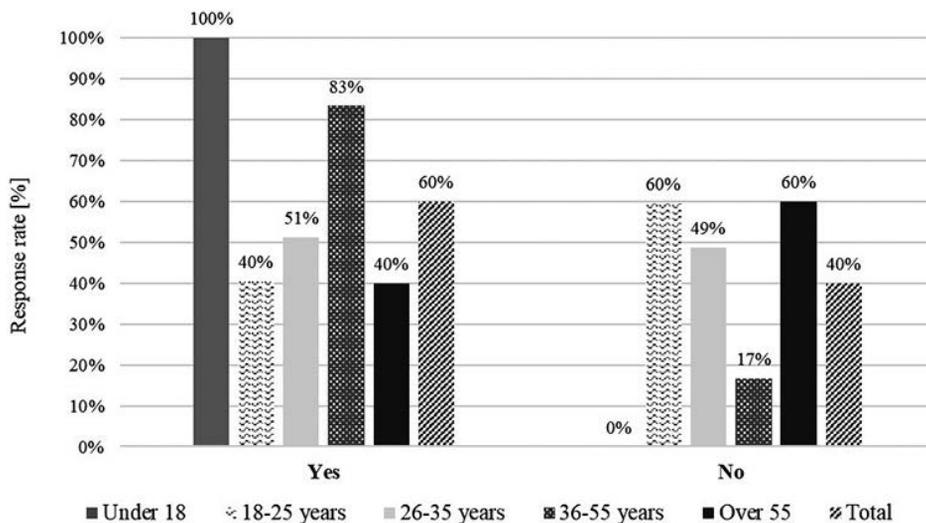


Fig. 3. Distribution of respondents' answers to the question regarding the use of a gluten-free diet in the past or now, based on the age of respondents and the total number of respondents

Rys. 3. Rozkład odpowiedzi respondentów na pytanie dotyczące stosowania diety bezglutenowej w przeszłości lub obecnie na podstawie wieku respondentów oraz ogólnej liczby respondentów

Source/Źródło: own study/opracowanie własne.

The question was analysed in terms of the age of the respondents. The purpose of the chart was to show the percentage of young and elderly respondents who used to or currently use the diet. It raises the issue of whether it is older or younger people who are more likely to reach for the said gluten-free foods. According to the survey data, 83% of the respondents in the middle-aged group (36-55 years) and all those under the age of 18 used to or follow a gluten-free diet. More than half of the respondents aged 26-35 (51%) also declared that they were on a gluten-free diet in the past or currently. The answer that they were or are not on a diet 60% was marked by the respondents aged 18-25 years and 60% of those over 55. It can be concluded that this is due to undiagnosed ailments and the lack of need to follow a diet by most people in the indicated age groups.

Irresponsible diet application or consuming gluten by ill people may lead to serious side effects, including cancer. It is also essential that in patients with celiac disease, a gluten-free diet should be followed for life (Grzymisławski, Stankowiak-Kulpa, and Włochal, 2010).

The respondents' answers to the question "Have you followed or are you following a gluten-free diet?" are presented in Table 2. The results were analysed concerning the age of the respondents, using the χ^2 test of independence.

The first step of the statistical analysis was to present the observed values, those obtained from the test results (Table 2).

Table 2. Observed values

Tabela 2. Wartości obserwowane

Age	Follow a diet		Total
	Yes	No	
Under 18 years	4 (2.9%)	0 (0%)	4 (2.9%)
18-25 years	17 (12.1%)	25 (17.9%)	42 (30%)
26-35 years	21 (15%)	20 (14.3%)	41 (29.3%)
36-55 years	40 (28.6%)	8 (5.7%)	48 (34.3%)
Over 55 years	2 (1.4%)	3 (2.1%)	5 (3.6%)
Total	84 (60%)	56 (40%)	140 (100%)

Source: own elaboration based on (Słowińska, 2019).

Źródło: opracowanie własne na podstawie (Słowińska, 2019).

The expected values are shown in Table 3.

Table 3. Expected values

Tabela 3. Wartości oczekiwane

Age	Follow a diet		Total
	Yes	No	
Under 18 years	$\frac{4 \times 84}{140} = 2$ (1.4%)	2 (1.4%)	4 (2.9%)
18-25 years	25 (17.9%)	17 (12.1%)	42 (30%)
26-35 years	25 (17.9%)	16 (11.4%)	41 (29.3%)
36-55 years	29 (20.7%)	19 (13.6%)	48 (34.3%)
Over 55 years	3 (2.1%)	2 (1.4%)	5 (3.6%)
Total	84 (60%)	56 (40%)	140 (100%)

Source: own elaboration based on (Słowińska, 2019).

Źródło: opracowanie własne na podstawie (Słowińska, 2019).

After comparing the data in Table 2 and Table 3, it became apparent, among other things, that more people aged 36-55, more than the expected numbers, used or were using a gluten-free diet.

Table 4 shows the components of the χ^2 statistic and the result of the non-independence test. The value of the χ^2 statistic was 23.4.

The critical value of χ_{α}^2 was 9.4877. The value of the χ^2 test was greater than the critical value of χ_{α}^2 . This allowed to reject the null hypothesis of independence of the variables (Słowińska, 2019). The alternative hypothesis was accepted based on the result, stating a relation between the respondents' diet adherence and their age (at the significance level $\alpha = 0.05$).

Table 4. χ^2 test result – correlation between the use of diet and age of the respondents

Tabela 4. Wynik testu χ^2 – zależność stosowania diety względem wieku respondentów

Age \ Follow a diet	Yes	No	Total
Under 18 years	$\frac{(4 - 2)^2}{2} = 2$	2	4
18-25 years	2.6	3.8	6.4
26-35 years	0.6	1	1.6
36-55 years	4.2	6.4	10.6
Over 55 years	0.3	0.5	0.8
Total	9.7	13.7	23.4

Source: own elaboration based on (Słowińska, 2019).

Źródło: opracowanie własne na podstawie (Słowińska, 2019).

The next question aimed to check the respondents' knowledge on the maximum amount of gluten in gluten-free food. The most common amount of gluten was 20 mg/kg of product; this answer was marked by 34% of the respondents. One of the other incorrect answers was marked by 66% (Figure 4).

According to European Commission Regulation (EC) No. 41/2009 of 2009, which describes in detail the recommendations for the composition and its recording on food labels for people requiring a gluten-free diet, the term "gluten-free product" is used when the gluten content in food does not exceed 20 mg/kg.

The collected data shows that the respondents did not know the correct answer to this question. As many as 27% marked the answer "I don't know", which proves the low awareness of gluten content in gluten-free products.

The next question was one of the multiple-choice questions. The survey questionnaire asked about naturally gluten-free cereals. The distribution of answers given to this question is presented in Figure 5.

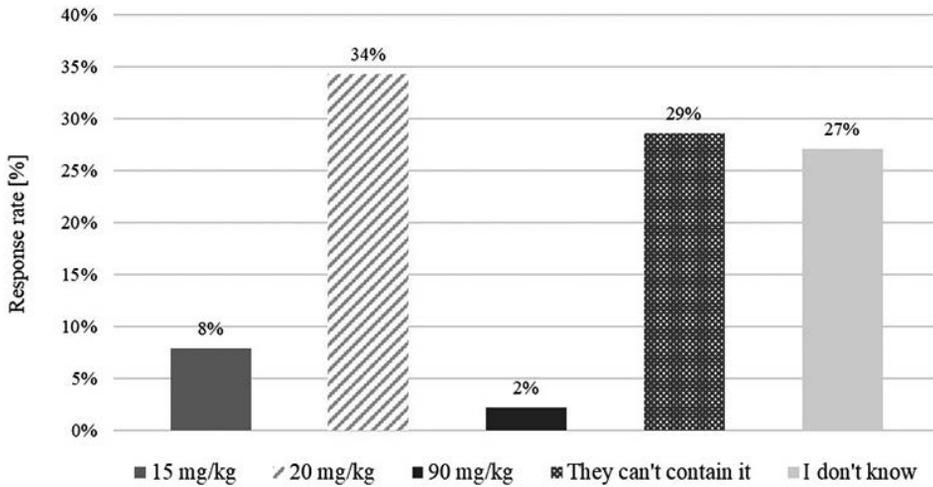


Fig. 4. Distribution of respondents' answers to the question regarding the maximum allowable amount of gluten in gluten-free products

Rys. 4. Rozkład odpowiedzi respondentów na pytanie dotyczące maksymalnej dopuszczalnej ilości glutenu w produktach bezglutenowych

Source/Źródło: own study/opracowanie własne.

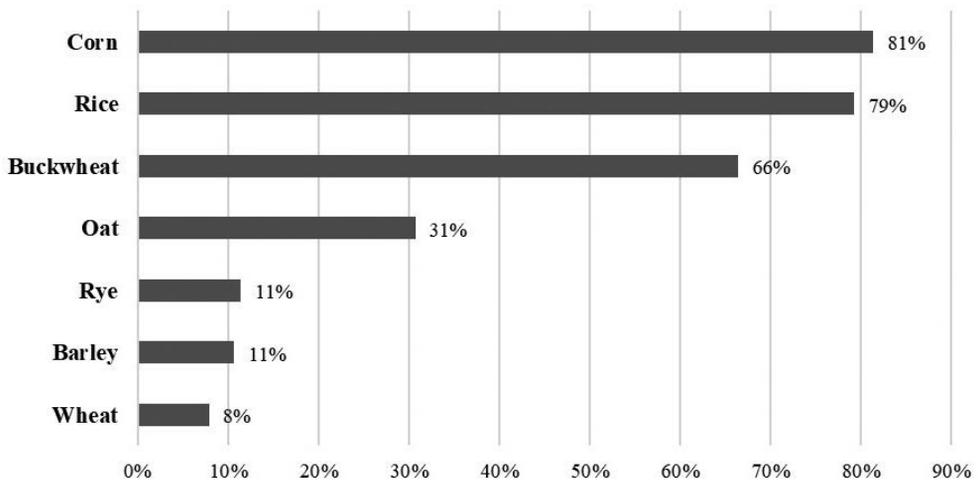


Fig. 5. Distribution of the respondents' answers regarding cereals naturally gluten-free

Rys. 5. Rozkład odpowiedzi respondentów na pytanie dotyczące zbóż naturalnie niezawierających glutenu

Source/Źródło: own study/opracowanie własne.

The respondents were overwhelmingly able to identify grains that do not contain gluten. The most common responses included corn (81%), rice (79%), and buckwheat (66%). As Rachtan-Janicka and Hassa (2020) suggested, these crops are considered naturally gluten-free. The respondents were least likely to mark barley, rye, and wheat (8-11%), as cereals that contain gluten. Oats were selected by about one-third of the respondents. According to Commission Implementing Regulation (EU) No 828/2014, oats included in gluten-free or deficient gluten foods must be specially formulated, as there is a risk of contamination of oats with grains from other cereals. The consumption of contaminated oats can cause adverse health effects in people with gluten intolerance. The gluten content of oats should not exceed 20 mg/kg (European Commission Regulation (EC) No. 41/2009).

The next question was also a multiple-choice question, in which the respondents were asked to indicate the products which contain or may contain gluten. In the surveyed group, as many as 99% of people indicated wheat flour and 96% pasta. A large proportion of respondents indicated bread crumbs (88%), cereal coffee (80%), chips (79%), beer (78%), semolina (77%), and sauces and dressings (73%). Only 6% indicated fruit juices, and 4% butter. The detailed distribution of the responses to the questions is shown in Figure 6.

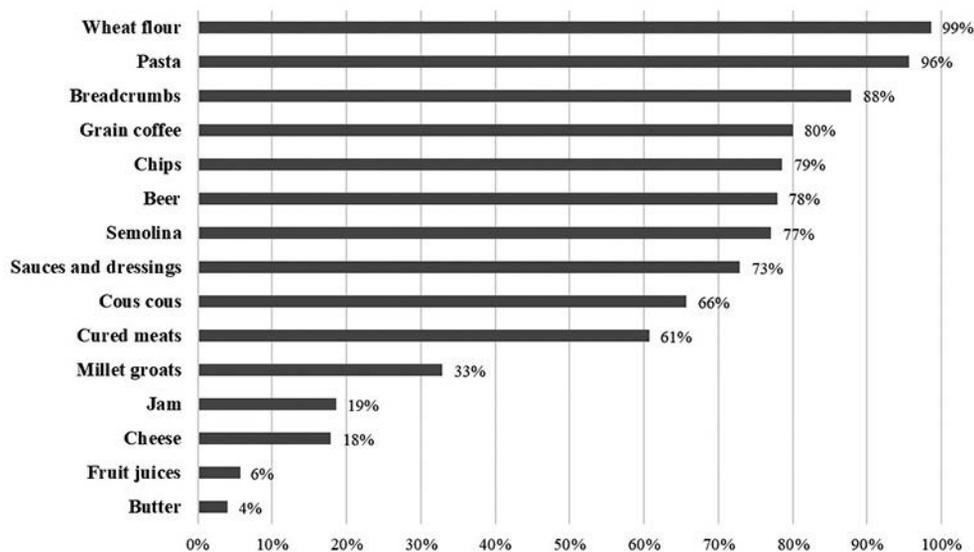


Fig. 6. Distribution of the respondents' answers regarding products that they believe contain or may contain gluten

Rys. 6. Rozkład odpowiedzi respondentów na pytanie dotyczące produktów, które ich zdaniem zawierają lub mogą zawierać gluten

Source/Źródło: own study/opracowanie własne.

The respondents' knowledge about products containing or which may contain gluten is relatively high; as many as 138 out of 140 the respondents, i.e. almost 100%, indicated wheat flour as a source of gluten. This is one of the products that people suffering from gluten-related diseases should be especially careful about. Many also mentioned: pasta, breadcrumbs, cereal coffee, crisps, beer, semolina, couscous, sauces, and dressings. The respondents knew which products to avoid while shopping for someone on a gluten-free diet. Only 4-6% indicated butter and fruit juices, and 18-19% named cheese and jam as gluten-containing products. The respondents had doubts whether millet groats contain gluten, and 33% of them considered that this was a product that might contain it. The gluten content in cold meats was much less in doubt, with 61% marking this product as containing gluten.

In the next part of the questionnaire, the respondents were asked to determine what the Crossed Grain Trademark on the packaging of some products means. The figure below showing the responses to the question was based on the criterion of place of residence. The purpose of interpreting the question in this way was to examine whether people living in larger cities are more likely to recognize the Crossed Grain Trademark than those in rural areas. In smaller towns, gluten-free foods are not readily available, and thus those living in these areas may have less possibility to recognise these foods on store shelves. The distribution of answers to the question regarding knowledge of the symbol of the Crossed Grain Trademark, depending on the respondents' place of residence, is presented in Figure 7.

Most of the respondents (89%) indicated that this symbol denotes a gluten-free product. Almost all residents of very large towns (over 500,000 inhabitants) marked the correct answer (95%). The answer "wheat-free product" was indicated mainly by people living in the countryside (15%). In contrast, the answer "low gluten content product" was selected primarily by residents of large towns (population of 150-500 thousand) – it was marked by 12% of respondents.

The licensed Crossed Grain Trademark (CGT) is an internationally registered trademark that can only be used, under licence, on food and drink products that meet the AOECs (Association of European Coeliac Societies) standard. Among consumers with celiac disease, the symbol appears to be seen as the most essential way of communicating that a product is safe for them to consume (Figure 8).

The symbol on the packaging is information for the consumer that the product has been tested for gluten, and the production plant has been audited for gluten-free production by AOECs standards (Crossed Grain).

The purpose of the next multiple-choice question was to test the respondents' knowledge of diseases that require a gluten-free diet (Figure 9). In addition to the listed diseases, the respondents could also indicate other diseases that, in their opinion, required a gluten-free diet. This option was selected by 5% of respondents who indicated Hashimoto's and endometriosis.

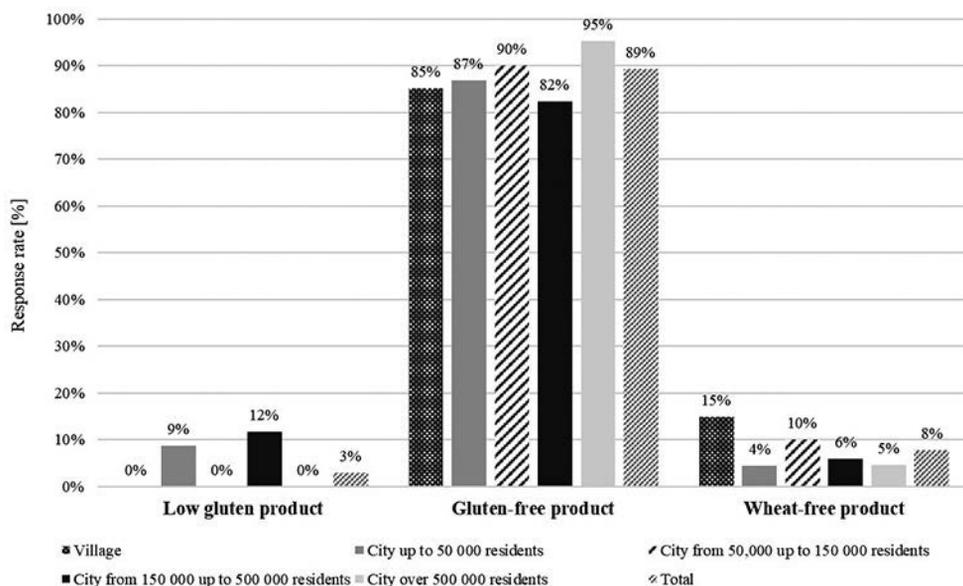


Fig. 7. Distribution of the respondents' answers regarding the knowledge of the crossed grain symbol, based on their place of residence and the number of respondents

Rys. 7. Rozkład odpowiedzi respondentów na pytanie dotyczące znajomości symbolu Przekreślonego Kłosa – w zależności od miejsca zamieszkania i liczby respondentów

Source/Źródło: own study/opracowanie własne.



Fig 8. Crossed Grain Trademark.

Rys. 8. Licencjonowany znak Przekreślonego Kłosa.

Source/Źródło: <https://www.przekreslonyklos.pl>.

Gluten-related health disorders manifest themselves in many ways, including celiac disease, non-celiac gluten sensitivity (NCGS), and wheat allergy (Moore, 2014; Sabenca et al., 2021). Almost all the respondents (94%) indicated that gluten sensitivity requires a diet; the vast majority (81%) correctly identified celiac disease, while only 34% identified Duhring's disease, which also requires a gluten-free diet. People suffering from irritable bowel syndrome do not need to follow a gluten-free diet, and this answer was indicated by a quarter of the respondents. A significant minority (5-7%) indicated gastric ulcer disease, diabetes, or another disease. It can be

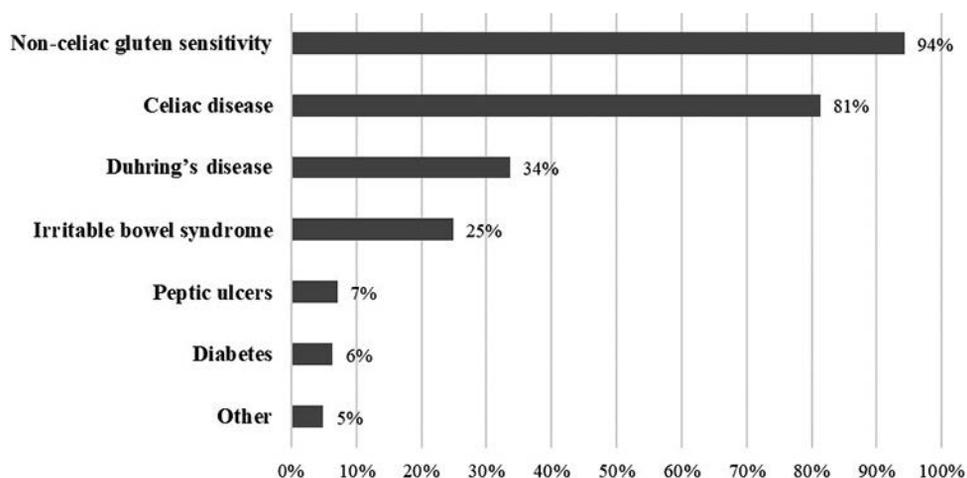


Fig. 9. Distribution of respondents' answers regarding diseases requiring a gluten-free diet

Rys. 9. Rozkład odpowiedzi respondentów na pytanie dotyczące chorób wymagających stosowania diety bezglutenowej

Source/Źródło: own study/opracowanie własne.

concluded that respondents were aware of which diseases require a gluten-free diet, and when it is not necessary.

Currently, about 1% of the population in most Western countries suffers from celiac disease (Welstead, 2015). According to the Polish Association of People with Celiac Disease and on a Gluten-Free Diet, in Poland, people with celiac disease represent 1-2% of the population – around 400 thousand people, and this number is constantly increasing. However, more and more effective methods of diagnosing gluten-dependent diseases are appearing year by year, and the public's awareness and knowledge of them are growing.

In the next multiple-choice question, the respondents were asked to indicate the most frequently selected groups of gluten-free products (Figure 10).

More than half of the respondents were interested in gluten-free products and declared their purchase. most often pasta (59%), bread (56%), and flour (53%), and slightly less frequently chose sweets (27%) and meat products (21%); they usually did not buy ready-made meals (only 7% provided such an answer). It may be assumed that the reason for preparing meals at home was the certainty that such prepared meals contain only verified ingredients, without flavour enhancers that may contain traces of gluten. For 24% of the respondents, gluten-free food was neutral: they did not buy it and were not interested in this product. Other gluten-free products mentioned and purchased by the respondents included vegetable pasta, fish, spices, and healthy snacks.

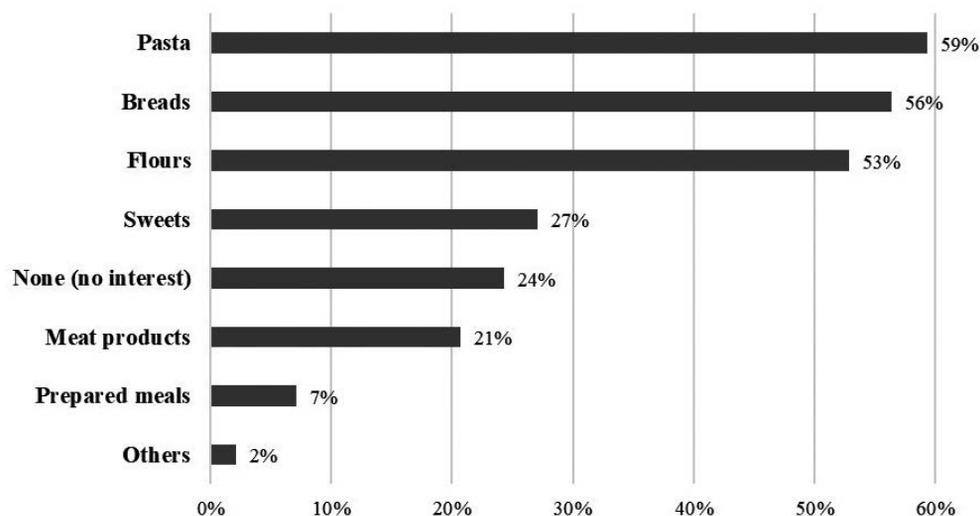


Fig. 10. Distribution of respondents' answers regarding the most frequently chosen groups of gluten-free products

Rys. 10. Rozkład odpowiedzi respondentów na pytanie dotyczące najczęściej wybieranych grup produktów bezglutenowych

Source/Źródło: own study/opracowanie własne.

The gluten-free food market is constantly expanding with new products made from various raw materials. In the past, the most popular foods were those made with gluten-free wheat starch. The main products offered were bread, flour, cake concentrates, and biscuits. Nowadays, those affected can choose from a wide range of gluten-free products from every assortment. The availability of gluten-free meats, pasta, sweets, snacks, and spices has increased (Lange, 2013; Wojtasik and Kunachowicz, 2014).

In the next question, the respondents were asked to mark the producers whose products they buy most often (Figure 11). Up to 54% chose Schär brand products, which were the most popular among consumers.

More than one-third of the respondents (37%) did not pay attention to the producer when buying gluten-free food. A similar number chose the brand Bezgluten (34%), followed by Balviten (24%), Celiko (23%), and Glutenex (20%). Among other answers indicated by the respondents (8%), the most frequent were Incola, Putka, Sano Gluten Free, Nutri Free, Pikok, and 5 transformations.

The collected data show that consumers usually buy products from well-known companies that are available in most shops, or do not pay attention to the producer. As the gluten-free diet has become popular and is not chosen only by people with celiac disease, more and more producers of this food have appeared on the market.

According to Rybicka (2014), Poland's total market share of Bezgluten and Glutenex is about 25%.

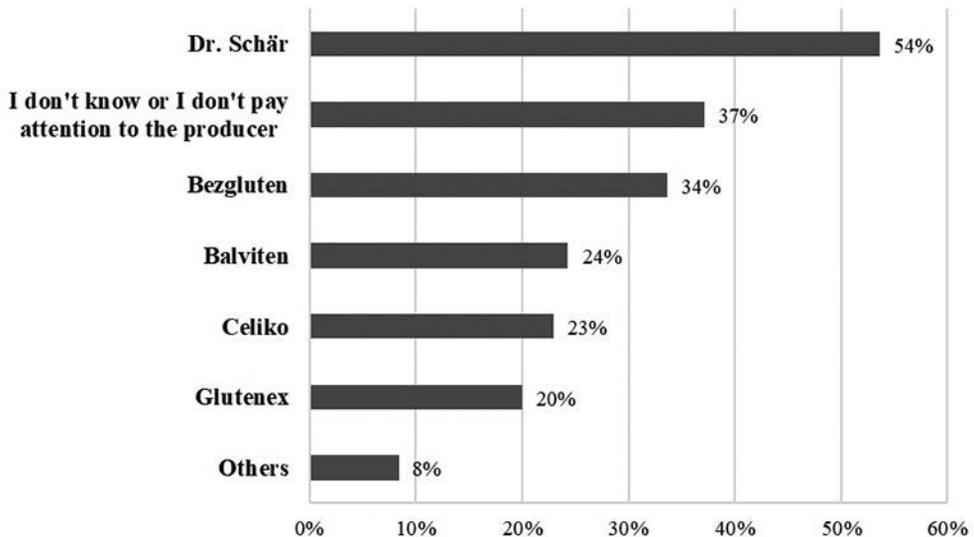


Fig. 11. Distribution of respondents' answers regarding the most frequently chosen producers of gluten-free food

Rys. 11. Rozkład odpowiedzi respondentów na pytanie dotyczące najczęściej wybieranych producentów żywności bezglutenowej

Source/Źródło: own study/opracowanie własne.

In the last question, the respondents were asked to assess the individual characteristics of gluten-free products, which affect the choice of this particular product. The lowest rating of 1 meant that the feature has little influence on the consumer's purchase of the gluten-free product. The highest rating of 5 indicated that the parameter has a very high impact on the purchase of the product, and the respondents paid the most attention to this feature when choosing the product. The detailed distribution of answers to this question is shown in Figure 12.

When choosing a gluten-free product, more than half of the respondents followed the taste (56%) and quality (51%), another important aspect was also the availability of the product in different shops – 36% said that this criterion most significantly affects the purchase of the product. Due to the rapidly growing market for gluten-free food, these products are available almost everywhere – in larger supermarkets, online shops, smaller grocery shops, and organic and health food stores. Customers can easily distinguish gluten-free food from food containing gluten, because gluten-free products are usually placed on separate shelves. In larger shops, one can find them in sections dedicated to gluten-free food or health food (Lange, 2013). The pro-

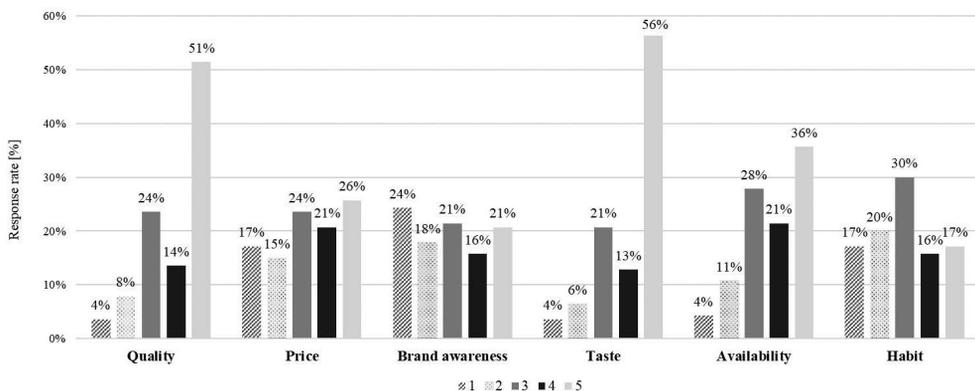


Fig. 12. Distribution of respondents' ratings regarding the impact of parameters on the purchase of gluten-free products.

Rys. 12. Rozkład ocen respondentów w odpowiedzi na pytanie dotyczące wpływu parametrów na zakup produktów bezglutenowych

Source: own study.

Źródło: opracowanie własne.

duct name did not usually inspire customers – as many as 24% of the respondents rated this parameter at level 1. Product habituation and price also did not have a significant impact. The respondents knew that gluten-free products are generally more expensive than their traditional equivalents in the version with gluten. As shown in a study by Myszkowska-Ryciak, Harton, and Gajewska, (2015), some gluten-free products are four to eight times more expensive than their traditional equivalents. Despite this, the price was not a decisive parameter for the respondents.

3.2. Discussion of the survey results

Gluten-free foods are less nutritious and more expensive than their gluten-containing variants. However, in recent years gluten-free diets have also become trendy among patients without celiac disease (Christoph, Larson, Hootman, Miller, and Neumark-Sztainer, 2018). The main reason is the scientifically unsubstantiated belief that a gluten-free diet is a healthy dietary option (Arslain, Gustafson, Baishya, and Rose 2021; Xhakollaria, Canavari, and Osman, 2019). Many believe a gluten-free diet promotes weight loss or relieves acne symptoms (Christoph et al., 2018; Newberry, McKnight, Sarav, and Pickett-Blakely, 2017). However, healthy people benefit more from consuming wheat and other gluten-containing products than from needlessly remaining on a gluten-free diet (Sabenca et al., 2021).

This study shows that the respondents have considerable knowledge of gluten-free food. The data indicates that most of them (64%) correctly defined gluten as a plant protein, and a decidedly smaller group (21%) say it is not a nutrient.

In a study by Heś, Jędrusek-Golińska, Górecka, Kobus-Cisowska and Zajac (2013), up to 98% of the respondents knew what gluten was. However, it should be mentioned that the study was conducted on people with an intolerance of gluten; therefore, the respondents knew the concept well. On the other hand, the study of Ścibor et al. (2015) proved that there was scarce knowledge regarding gluten. Among the interviewees, only 16% mentioned that the compound is a protein. The rest answered that gluten is a sugar or fat, or did not know the answer to the question.

In the survey questionnaire, the respondents were asked about gluten-free products' acceptable amount of gluten. Less than half answered the question correctly. This indicates rather low consumer awareness of the composition of gluten-free foods. Understandably, those who need to follow a diet due to illness will know the answer to more specific questions about the gluten-free diet. A significant proportion of consumers do not go into detail about the diet. People who do not buy these products very often do not look at the ingredients or read the literature on the subject. Marszałek (2017) showed that up to 87% of the respondents marked the answer as 20 mg/kg of product, which indicates a very high knowledge among the group in which the survey was conducted: note that the survey was conducted among people on a gluten-free diet.

A gluten exclusion diet used to be followed by people affected mainly by coeliac disease or gluten allergy. Over the years, with the development of research methods, other diseases were diagnosed that require gluten-free foods, such as non-coeliac gluten sensitivity (Kowalczyk-Vasilev et al., 2018; Sabeņa et al., 2021). According to the authors' research, it can be concluded that the respondents' knowledge about diseases requiring a gluten-free diet is good. When asked about diseases requiring a diet, respondents most frequently selected answers such as gluten sensitivity, coeliac disease, and Dühring's disease. According to Ścibor et al. (2015), the number of people with gastrointestinal complaints is steadily increasing. Sufferers need to monitor the products they consume for gluten content (Banera and Myślińska, 2019). A study by Bubis and Przetaczek-Rożnowska (2016) found that about 30% of patients did not follow doctors' recommendations as strictly as they should. According to Enaud et al. (2022), the duration and adherence to a gluten-free diet are the main factors influencing the quality of life of coeliac disease patients.

There are many products on the market for people on a gluten-free diet, yet not every consumer knows which ones may or may not contain gluten. El Khoury et al. (2018), suggested that, based on a survey of 2,681 people, up to 85% of those affected by coeliac disease had trouble identifying which food was gluten-free. The authors' own research shows that the respondents are very aware of which products may contain or do contain gluten. Wheat flour, pasta, breadcrumbs, cereal coffee, beer, and crisps were most commonly identified by respondents as gluten-containing products. The problem for some of the respondents was millet groats, as one-third stated that the product may contain gluten. According to Konińska, Marczewska, Sabak-Huzior, and Żródłak (2017), buckwheat or millet groats can become contaminated

with gluten cereals at the sowing stage, so it is best to buy those labelled gluten-free. Heś et al. (2013), also indicates high consumer awareness: as many as 96% of those participating pointed to wheat flour as the main gluten-containing product. Other frequently ticked answers were rye flour, oatmeal, semolina, breadcrumbs, and beer. The respondents also identified gluten content in meat products. According to the authors, the respondents avoided cereal products for fear of contamination, as only 14% ticked buckwheat groats. The results of the study presented by Marszałek (2017) were similar, with wheat flour, crisps, breadcrumbs, wafers, and barley flour identified as high gluten products by the most significant number of the respondents; 40% of also pointed to millet groats. Compared to the authors' own study, the respondents' knowledge of couscous porridge, beer, and cured meats was higher, however they had less knowledge of dressings – selected by 43%, while in the other study it was as high as 73%. This may indicate that consumers are becoming more aware and read labels.

Consumers who want to be sure that a given product is gluten-free should choose products that are marked with the Crossed Grain Trademark. The research shows that the vast majority (89%) recognised this licensed trademark. It can be deduced that there are no noticeable differences in knowledge of this subject by place of residence. As shown by Heś et al. (2013), the label makes it easier for consumers to buy gluten-free food daily. The results of Marszałek (2017), indicated that some respondents even buy products with the licensed label several times a week (55%), while others make such purchases occasionally (4%). This may be related to the lack of health effects after consumption of non-certified products. It can also be assumed that the respondents ignore whether a product is marked with the Crossed Grain Trademark.

Nowadays, gluten-free products are readily available worldwide. In the survey by Marszałek (2017), the respondents were asked to identify the manufacturers whose gluten-free foods they most frequently purchase. The most significant number opted for Schär products (34%), followed by Bezgluten (25%), Balviten (16%), and Glutenex (8%). The respondents indicated the product groups they most often choose. The most common choice was bread and pasta, and similar results were obtained in the authors' own research. More than half of those asked bought gluten-free products made by Schär, followed by Bezgluten, Balviten, Glutenex, and Celiko. Interestingly, more than a third did not pay attention to the brand when making their purchases. More than half of the respondents indicated pasta, bread, and flour in terms of the most frequently selected product groups, thus the most commonly chosen products were those which form the basis of one's diet.

In their daily shopping, consumers pay attention to various characteristics of the product. According to the authors' own research, the parameter that played a significant role in choosing a gluten-free product was its taste, and second important attribute was quality. Marszałek (2017) obtained similar results in her study. For the respondents, the product's taste was the most important, while features such

as quality, product availability, and brand awareness appeared to be less critical. To conclude, consumers are willing to pay more for gluten-free products, but at the same time, they expect the taste and quality of these products to be at a high level.

4. Summary and conclusions

The research described in this thesis aimed to test consumers' knowledge of gluten-free foods and related issues. Currently, many shops have a wide range of gluten-free products; as the research indicates, consumers recognize these products. Each year the market is enriched with even more gluten-free products, and as the demand for them increases, so does the number of companies that produce them.

The survey results indicate that most of the respondents had considerable knowledge of gluten-free food, and more interest in this type of product was characteristic for women. This may be due to the higher prevalence of gluten-related diseases among females, and a willingness to learn about the most popular diets. Up to 24% of the respondents showed no interest in gluten-free products.

Young and middle-aged people most frequently follow a gluten-free diet. Most respondents knew the basics of this diet – which cereals did not contain gluten and could indicate which do not. However, majority were unfamiliar with this topic and did not know the acceptable amount of gluten in gluten-free products. It can be concluded that this lack of awareness was due to a lack of interest in such products, or not opting for certified products that are tested for gluten. The overwhelming majority of consumers (89%) knew what the Crossed Grain Trademark meant and thus could identify gluten-free products from those containing gluten. Most respondents with vocational education (60%) could not answer to which nutrient group gluten belongs.

The authors' own research also showed that the most popular gluten-free products used in the daily diet were bread, pasta, and flour. Less often consumers used ready-made meals, which may result from low trust in the content listed on the labels of these products. The leader in the Polish market among manufacturers of gluten-free food, taking into account the recognition and consumption, is Schär. Consumers are increasingly choosing products from Polish companies, which proves the growing range of gluten-free products from domestic manufacturers. The main factors influencing the purchase of gluten-free products are their taste and quality, and much less frequently, their price or availability.

According to the data obtained from the survey, consumer knowledge about gluten-free food is high and continuously increasing. Consumers are increasingly interested in the gluten-free food market and pay attention to what they eat and what products they buy.

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