Scientific Journal Warsaw University of Life Sciences – SGGW
Problems of World Agriculture volume 16 (XXXI), number 4, 2016: 260–271

**Joanna Pławińska-Czarnak[1], Janusz Bogdan, Tomasz Podlasiewski, Krzysztof Anusz, Joanna Zarzyńska**
Warsaw University of Life Sciences – SGGW

# Consumer Safety Awareness – How the Labelling Can Protect Health of Gluten-Intolerant People

**Abstract.** Recent years have witnessed a growing number of people who are gluten-intolerant and whose diet cannot contain gluten (celiac disease, allergy to gluten and gluten-intolerance). Consequently, the consumers' interest in non-gluten diet is progressively increasing. Gluten is a mixture of prolamins and glutelins, present in the cereal grains: wheat (gliadin), rye (secalin) and barley (hordein). Wide use of gluten in the food industry results from its positive influence on products' consistency, taste and moisture preserving. Since the only effective method of gluten-related diseases treatment is a strict gluten-free diet, this study examines the market of the gluten-free carbohydrate products. A growing desire to avoid gluten is changing the whole food industry. The task was to analyze the labelling correctness of selected nutriments suitable for gluten-intolerant people. The analysis was based on the current EU and national regulations. Besides of common EU regulations and directives dedicated to food production sector and food safety, we can find specified law regulating the composition and labelling of foodstuffs suitable for people intolerant to gluten. In total, 100 food products were subjected to the analysis, divided into 5 groups of gluten-free carbohydrate products (flours, groats and rice, pastas, snacks and sweets, breads).
Summarizing our research the correct labelling of analysed products was present in all examined groups. 97% of the items were labelled by a text stating they were gluten-free products. Also, the composition of the assortment did not give rise to objections to their gluten-free characteristics. 86% of the analysed gluten-free food was produced from natural free-gluten ingredients, whereas 14% was made of low-gluten wheat ingredients. 78% of the examined items were gluten-free products, bearing both text and graphic labelling as gluten-free products. 63% out of this group were products with the AOECS (Association of European Celiac Societies) certificate for safe gluten-free foodstuff.

**Keywords:** gluten, celiac disease, gluten-free nutrition, gluten-free diet

## Introduction

One of the key measures to ensure the safety and quality of food is the monitoring and detection of ingredients harmful to consumers. As an example of such ingredients, we can mention gluten, which can be dangerous for gluten -intolerant people. The subject of gluten-free or restricted gluten food is a huge economical task currently. There are prognoses, that production of meat-free products would no longer be profitable (e.g. sales of meat alternative have flattened in US since 2008). However consumers are presenting rapidly growing demand for products without gluten. Also American people, as health-conscious, were first in significant increase of sale of this type of products. In recent years sale have surged from 5.4 billion dollars to 8.8 billion, Europe is quickly catching up. In most countries there is double-digit sales growth (leading country is Great Britain). US forecasts for 2017 showing further, 61% of sales growth (2018, 38.5% up – after The Economist data). It is not only food manufacturing market change, also restaurants are beginning to offer gluten-free versions/substitutes of their popular foods, to accommodate

[1] PhD, Department of Food Hygiene and Public Health Protection, Faculty of Veterinary Medicine, WULS-SGGW, Nowoursynowska Str. 159, 02-776 Warsaw, Poland, e-mail: joanna_plawinska@sggw.pl

growing consumer base. In recent years, a massive interest in the gluten-free diet has been noticed. The reason for the growing interest is the increasing frequency of diagnosing gluten sensitivity and celiac disease. It is estimated that one out of 100 individuals in Europe suffers from the celiac disease (Cheng et al., 2010; Czerwińska, 2009; Malekzadeh, et al. 2005). Celiac disease is characterized by the intolerance to gluten. Gluten is a spare protein in cereals such as wheat, rye, triticale and barley (Matsuo et al., 2004). The diet of a gluten-intolerant person cannot contain many of very popular food products, such as bread, corn flakes or pastas. The cereals are used as the source of fibre, and gluten as a condiments' carrier, therefore, the gluten-free diet must also exclude many types of meat-products (sausages, ham, mortadella, etc.) and milk products (cheese, yoghurts, creams etc.) (Dziuba et al., 2009; Matsuo et al., 2004). In addition, gluten is frequently present in a great number of ready to use soups and sauces (Wojtasik et al., 2010).

Celiac disease is an incurable disease that may be diagnosed at every age. Currently, 60% of lately diagnosed cases affect adults, 15-20% of whom are aged 60 and more (Dziuba et al., 2009). The pathogenesis of this illness results from the interaction between environmental factors (consumed gluten), genetically based and immunological factors. The only efficient method to counteract the celiac disease is a strict gluten-free diet that must be applied lifelong. The symptoms of the disease might be very characteristic: diarrhea, flatulence or loss of weight. Children might suffer from various disorders in physical development, mainly growth dysfunction (short stature) (Cheng et al., 2010, Sategna-Guidetti et al., 1998). However, the celiac disease might also give very untypical symptoms, not related to the digestive tract, a feature that is delaying the correct diagnosis. It can be i.e. anemia, hemorrhages (bleeding), weakness, depression, constant tiredness, skin symptoms, neurological or endocrinological symptoms, and osteopenia – all of them related to the disruptions of vitamins and mineral nutrients absorption. If not treated, the disease may lead to serious complications, such as life-threatening malnutrition, osteoporosis, pathological fractures, fertility disruptions, neurological disruptions, primary cirrhosis, fatty liver, anemia. An increased risk of gastrointestinal tract tumors (colon lymphoma) can be noticed (Hu et al., 2006; Malekzadeh et al., 2005; Sapone, 2012). Celiac disease often co-exists with such illnesses as type 1 diabetes, or the Hashimoto disease (Hill et al., 2005).

There are also diseases not considered as gluten-dependent, in which the non-gluten diet is recommended: Inflammatory Bowel Diseases (IBD), type 1 diabetes, Hashimoto disease, child autism spectrum disorder (i.e. Asperger syndrome) or child ADHD (Currie et al., 2012; Sapone, 2012; Zali et al., 2011). The Food Law in Poland is regulated by the national legislation, i.e. law acts and corresponding regulations, as well as by the EU laws, obligatory in all countries of the European Union. The EU laws take the form of directives (must be implemented in every member state) and regulations (are directly binding for all EU countries). The national legislation in the area of interest is: The Act on the Food and Nutrition Safety, The Act on the State Sanitary Inspection and corresponding regulations.

Among the EU acquis, which are worth mentioning are the regulations of the European Parliament and the European Council, forming the so-called "Hygiene Package", i.e.: Regulation No 178/2002 on the general principles and requirements of food law, establishing the European Food Safety Authority and procedures for food safety; Regulation 852/2004 on the hygiene of foodstuffs; Regulation no. 882 ensuring proper checks on food and animal feed; Regulation no. 853/2004, laying down specific hygiene rules for food of animal origin for food business operators; Regulation no. 854/2004 on the

organisation of official checks on products of animal origin intended for human consumption.

The following regulations on the food for gluten-intolerant people are in use: Regulation no. 41/2009 on the composition and labelling of foodstuffs suitable for people intolerant to gluten; Regulation no. 828/2014 on the requirements for the provision of information to consumers on the absence or reduced presence of gluten in food; Regulation no. 1169/2011 on the provision of food information to consumers; changes in the Regulations no. 1924/2006 and no. 1925/2006; annulment of the Directives: 87/250/EWG, 90/496/EWG, 1999/10/UE, 2000/13/UE, 2002/67/UE and, 2008/5/UE, of the Regulation no. 608/2004.

The food labelling is defined in the Regulation no. 1169/2011 as any tag, logo, trademark, illustration or other description in the form of print, illustration, stamp, press or other, applied on the packaging or wrapping surface, or attached to the food container. The label must be clear to support the customers in the conscious choice of their food and diet. The basic criteria for the correctness of the labelling are the accuracy and readability of information on the packaging. The producer must not give misleading information or imply product's extraordinary characteristics. Thus, the information about the ingredients that might cause allergies or reactions of intolerance must be duly indicated, apart from such information as: product's name, producer's name, country of origin, ingredients list, net amounts of ingredients, "best before" indication, storage conditions, nutrition values and list of supplements. The information on allergy risks is vital since some of allergies or intolerance reactions might become for some people health - or even life - threatening. Therefore, in order to ensure the legal consistency and approximation in all EU member countries, voluntary food and nutrition declarations on the labels should be effectuated according to the Regulation no. WE/1924/2006 laying down the provisions on nutrition and health claims made on foods.

The Regulation UE/41/2009 considers the Council Directive 89/398 as of 3 May 1989 on the approximation of the laws of the Member States relating to foodstuffs intended for particular nutritional uses. Hereto, gluten free products for celiac disease patients (people with permanent gluten intolerance) were included. The provisions contained in the Regulation mentioned above are intended to unify the rules on the use of terms referring to the absence of gluten in products sold in the EU countries and to ensure a high level of consumer protection. Gluten, as a substance harmful to gluten-intolerant consumers, was scientifically identified in the following cereals: wheat (and its various sorts, such as durum, spelt or kamut), rye, barley, oat and their sorts. It should be remembered that removing gluten from food products is technologically very difficult. Many special foodstuffs were approved for sales, containing small, secure amounts of gluten (UE no. 41/2009). Special nutrition products, meeting the requirements set for celiac disease patients, should be labelled as "gluten-free products" or "gluten low-content products". Such products, in order to achieve compliance with the provisions of the Regulation, have been subjected to technological processes such as the use of specially processed foods, which reduced the content of one or more ingredients containing gluten or, where such components were replaced with others, naturally gluten-free substances.

National and EU law defines three categories of special nutrition products for people with gluten-intolerance:

1. gluten-free food, where the total amount of gluten must not exceed 20 mg $kg^{-1}$;
2. food with a low-level of gluten - the total amount of gluten must not exceed 100 mg $kg^{-1}$ (Codex Alimentarius Commission (2015);
3. general nutrition products not containing natural gluten, that can be consumed by people suffering from celiac disease (COMMISSION REGULATION (EC) No 41/2009).

The correct identification of food that can be safe for consumers on a gluten-free diet requires a very good knowledge of the gluten-free products' market and has to be built on the consumer's trust toward the producer. Now, the only method recommended by Codex Alimentarius to examine the presence of gluten in food is the Enzyme-Linked Immunosorbent Assay ELISA R5 Mendez, which applies the R5 monoclonal antibodies. This method can be applied only in laboratories. The test detection limit should not exceed 10 mg gluten $kg^{-1}$ in dry mass (Kupper, 2005). The identification of the gluten-free food products available on the Polish market is largely enhanced by the „List of gluten-free products" publication. It is published and annually reviewed by the Polish Association of People with Celiac Disease and on Gluten-Free Diet (Polskie Stowarzyszenie Osób z Celiakią i na Diecie Bezglutenowej). This association grants licences to use the international symbol of a strikethrough grain ear of the safe gluten-free food AOECS (Association of European Celiac Societies) in Poland. This licence labeled on the product gives the full consumption safety, since it certifies that the producer strictly co-operates with the association and checks regularly the whole product range in terms of gluten content.

Among the wide range of non-gluten products available on the market, natural gluten-free products are very important, e.g.:

- Gluten-free cereal products, the seeds of which serve to obtain flour, white rice, brown rice, corn, buckwheat, millet, almonds, quinoa, amaranth, millet flour, edible chestnuts, edible acorns;
- Starch: potato starch, corn starch, rice starch, cassava starch;
- Grits: millet, buckwheat and maize;
- Fresh meat, fish, seafood, eggs;
- milk and milk products: fresh milk, natural yoghurt, kefir and other naturally fermented drinks, unprocessed cheese and white cheese;
- Fats: butter, lard, margarine, vegetable oils, i.e. grape seeds oil;
- Fresh food and vegetables;
- Sugar and sweets: white sugar, cane sugar, honey, sweets made of non-gluten ingredients, i.e. fruit drops;
- Non-alcoholic drinks: tea, natural coffee, fruit juices, mineral water, compotes, herbal infusions;
- Alcoholic drinks: potato vodka, rum, wine, grappa, cognac, brandy, tequila, calvados, malibu, kahlúa, campari, gluten – free beer, ciders;
- Spices: salt, pepper, fresh herbs, wine vinegar, apple vinegar, gluten - free soy sauce Tamari.

The products listed above do not contain gluten in their natural form; however, when stored in wrong conditions, processed or spiced, they can lose their gluten-free characteristics. Bearing in mind that possibility, a gluten-intolerant consumer should always additionally verify the purchased products in respect of the applied supplements or allergens, as indicated on the product's label (celiakia.pl).

Apart from the mentioned above natural gluten-free products, the following food supplements can be applied for the manufacturing of food for people with gluten-intolerance (celiakia.pl):

E410 – carob meal (thickener, stabilizer, gelling agent, emulsifying agent);
E412 – guar gum (thickener, stabilizer);
E415 – xanthan gum (thickener, stabilizer);
E406 – agarwood (thickener, gelling agent);
E407 – carrageenan (thickener, stabilizer, gelling agent, emulsifying agent);
E440 – pectin;
E1401 – modified starch (corn), (thickener, stabilizer);
glucose-fructose syrup,
maltodextrin,
E466 – carboxymethylcellulose (emulsifying agent);
Egg' albumin.

## Data and methodology

The aim of the project was to verify whether gluten-free and low- gluten content products available on the Polish market are properly labelled regarding gluten content, according to the current law.

The work methodology was based on the analysis of the labelling content and of the correctness of labelling of selected food products dedicated to gluten-intolerant people. Between October 2015 and January 2016, 100 products were subject to analysis, all of them coming from various eco shops offering special food products, located in Warsaw and Józefów, as well as one internet shop specialized in gluten-free food. The examined products for people on a gluten-free diet were divided into 5 groups: 1. flours, 2. groats, rice and grains, 3. pastas, 4. sweets and snacks, 5. bread and pastries.

The evaluation criteria of the gluten-free product labelling correctness were based on the verification of the consistency of the applied labelling with national and EU law, in particular: Regulation no. UE/41/2009 of 20 January 2009, Regulation no. UE/828/2014 of 30 July 2014, Regulation no. UE/1169/2011 as of 25 October 2011, the Act of Law as of 26 August 2006 on the food and nutrition safety, the Codex Standard for Foods for Special Dietary Use for Persons Intolerant to Gluten from 2008. The first task was to examine whether the product for special dietary use is labelled as a gluten-free foodstuff or a gluten low-level foodstuff. Then, the labelling graphics "gluten free" was examined, as it was important, to verify if the product helds the AOECS certification. The analysis considered both information placed on the label, as well as on the packaging of the product. Additionally, other graphic labelling was examined, which might have indicated other characteristics of the analysed product. At the next stage the product composition examination was performed. The final evaluation was dependent upon the application of the gluten-free wheat products and upon the application of the natural gluten-free ingredients. Preservatives and additional substances present in the examined products underwent the analysis, as well.

## Results

The first analysed group of products comprised flours for gluten-intolerant persons. Products of the most common gluten-free food manufacturers were selected, i.e. Schär, Bezgluten, NutriFree, Balviten, Le Venezine, JizerskePekamy, BauckHof, Glutenex and Incola Gluten Free.

The results of the products' analysis from the 1st group revealed that the labelling of gluten-free flours was in line with the law. The products were labelled as gluten-free both in text and graphically. Regrettably, not all of them held the AOECS symbol of safe gluten-free food. 14 out of 20 samples had that commonly acknowledged symbol. In the rest of the cases, there were various versions of pictograms of the strikethrough ear designed by the particular manufacturers. In this product group no low-level gluten products were noticed.

Six products were partly composed of wheat ingredients, technologically deprived of gluten. They are particularly common as ingredients in gluten-free flour mixtures for pastries, cakes and bread. Nonetheless, the basic components of all examined flours labelled as "gluten-free" were natural gluten-free compounds such as corn starch (14/20), potato starch (8/20), corn flour (7/20), rice flour (4/20), cassava starch, lupine flour (3/20). The market offers encompasses also flours labelled as gluten-free that are of natural origin only, such as corn, rice, amaranth or buckwheat. The main thickener applied in the manufacturing of gluten-free flours is the guar gum. Its presence was detected in 12 out of 20 products. A very common technological ingredient applied as raising agent is sodium bicarbonate. There were 7 products among the examined group that had this substance in their composition. Due to their characteristics, the supplements listed above replaced gluten that does not appear in gluten-free flours (Figure 1.).

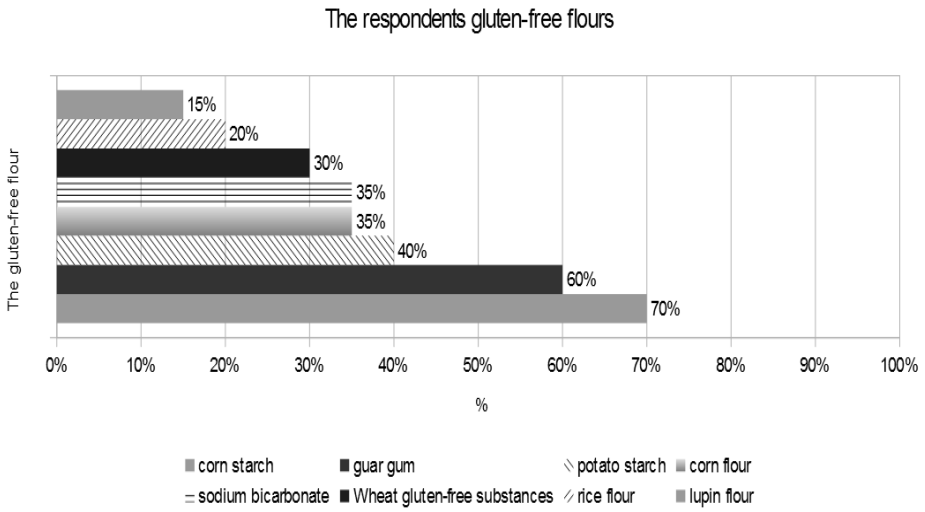


Fig. 1. The results of analysis of gluten – free flours. The evaluation of flour types most popularly present on the market (on the base of raw material) (%)

Source: own data.

The second analysed group of products consisted of groats, rice and cereals, designated for consumers who are gluten-intolerant. Products from big brands of gluten-free food producers were selected, along with products of smaller suppliers of groats, rice and natural gluten-free cereals. The assortment of groats, rice and cereals for gluten-intolerant consumers can be divided into two subgroups. First, there are products of natural gluten-free origin for a special nutrition purpose, having a producer's declaration that they are completely gluten-free. Second, there are natural gluten-free products, widely accessible, bearing no indication of a gluten-free product. The first subgroup consists mainly of groats and cereals offered by companies producing safe nutrition products for gluten-intolerant people. These are products classified as special nutrition products, suitable for people that do not tolerate gluten.

The second subgroup consists of nutrition products based on natural gluten-free products that are widely common on the market.

In most cases groats, rice and cereals were labelled as gluten-free products, both in text and graphically. The analysis did not reveal any low-gluten products. Unfortunately, only in 3 cases, the product was certified by the AOECS symbol. 8 out of 20 products were labelled by a non-certified graphic symbol of the strikethrough ear. A significant group (9 items) of nutritional products did not have any graphic symbols which would indicate their gluten-free composition. Three products showed no indication that they were gluten-free, and one product was marked with the English information „gluten free" (the original transcription, with no Polish translation). The rest of the products from this subgroup had some kind of indication in their names that they were gluten-free.

According to the observations, often the location of the product on the particular shelf in the shop was supposed to indicate that it was a gluten-free product. Sometimes, this role was played by the gluten-free origin, or the name of the product. The majority of the examined assortments (13 out of 20 items) were ecological products. Despite such labelling is expected to increase the consumers' trust level, in fact it presents no guarantee of the gluten-free food quality. This finding has been confirmed by the analysis of the gluten content in food products that is available on the website www.celiakia.pl, e.g. from May 2014, showing an example of the ecological buckwheat flour "BIO Babalscy", which contained over 400 mg of gluten per 1 kg of the product.

It is important that the consumer possesses the right amount of knowledge on products which can be suitable for him while choosing groats and cereals, as in most cases, he deals with a one-ingredient assortment. However, it must be clear that the gluten-free characteristic of a product results not only from the raw material, but also from the conditions of growth, storage and processing. As the analysis reveals, not all groats and cereals that are naturally gluten-free bear the information "gluten-free". Gluten-intolerant people are advised to consume products such as: quinoa, millet, buckwheat, white rice or brown rice. The gluten-free nutrition is defined in the domestic and EU laws that make the producer responsible for a careful examination of the gluten-free food in respect of the gluten content. In order to follow those requirements, the producer needs to obtain an adequate gluten-free raw material. Then, he must process it and store it in conditions that limit to the minimum the contamination of the final product by gluten. For many companies, such an investment appears unprofitable, thus they decide not to label their products as gluten-free.

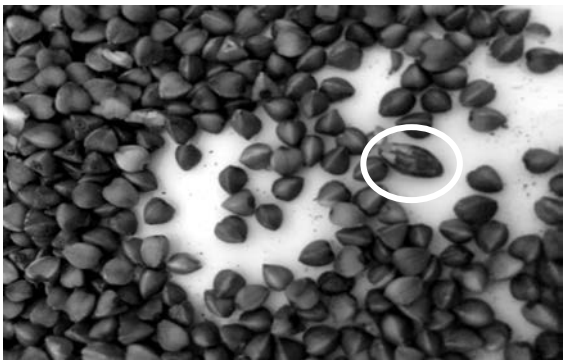

Figure 2. Buckwheat, labelled as an ecological product. The white circle indicates a gluten grain, contaminating the buckwheat, theoretically a natural gluten-free product

Source: own data.

The third group of the analysed products contained pastas for gluten-intolerant consumers. Currently there is already a wide range of various gluten-free pastas on the market. They, however, differ in respect of their composition and shape. Traditional pastas, such as: spaghetti, lasagne – all of them can be purchased in a big variety. Their basic component that commonly replaces the wheat flour is the corn flour (13 out of 20 cases), rice flour (13 out of 20 cases) and their mixtures. Such ingredients as potato starch, corn starch (4/20) or buckwheat flour (3/20) are also added. Two cases reported the addition of gluten-free wheat starch.

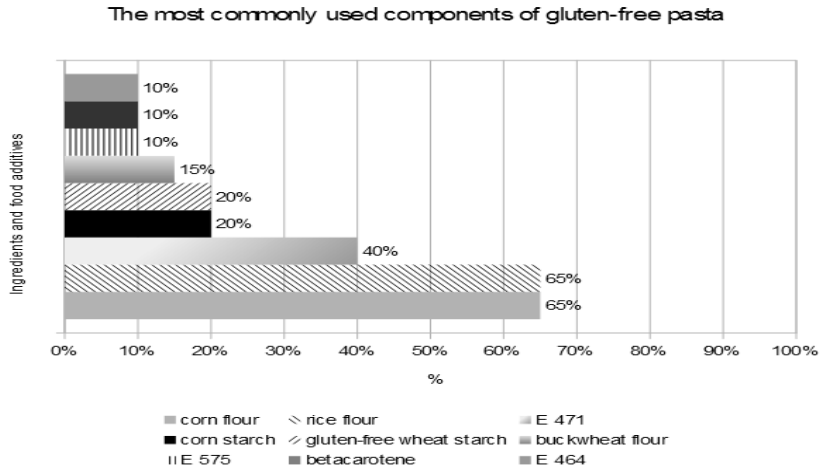


Fig. 3. The results of labels analysis of gluten –free pasta. The diagram presents the most common ingredients and food additives used in the manufacturing process of different kinds of pasta (%)

Source: own data.

The most common supplements applied in gluten-free pastas were: E 471 (i.e. mono and diglycerides of fatty acids, performing as emulsifying agent (8 out of 20 cases). E 575, i.e. glucon acid lactones, performs the acidity control (2/20). The analysis of the

composition revealed that beta carotene was used as a dye (2 cases), and hydroxypropyl methylcellulose (E 464), was added as a thickener (also 2 cases). Those data indicate that application of additional substances in the production of gluten-free pastas was a scarce (Figure 3).

To sum up, it can be stated that the labels of the gluten-free pastas available on the Warsaw area market indicate that producers apply the domestic and EU regulations. In the group of the examined products, again, only the gluten-free products were observed; no low-level gluten products could be noticed. In 18 cases, apart from the text information, also graphic signs were applied, out of them 10 had the certified symbols of safe gluten-free food AOECS. The absence of such symbol was reported in two cases.

The fourth analysed group comprised snacks and sweets for gluten-intolerant consumers. Snacks and sweets is a group with a wide variety of assortment, including e.g. cakes, candy bars, salt sticks and chips. The examined products were classified to gluten-free products (no products with a low-level of gluten). More than a half of the sweets and snacks (12/20) exhibited both text and graphic information on their gluten-free characteristics. The AOECS certification for safe gluten-free food was present with 10 items from the entire group of products. In 8 cases, no graphic information was available. The composition of the examined products was fairly varied. Their common denominator was the application of natural gluten-free substances such as: rice flour, buckwheat flour, potato flour, potato starch, rice starch, cassava starch, corn starch, corn flakes, and expanded amaranth or millet grains. In 3 cases, there were wheat gluten-free products on stock. Those substances presented a kind of basis for gluten-free snack and sweets. The rest of the components depended on the product's character. As fatty substances, hardened palm or rapeseed oil, sunflower oil, vegetable margarines, or mono and diglycerols were applied. The producers of sweets and snacks warned of allergens like eggs, peanuts, almonds and soy. In the examined group of products, no traces of gluten containing supplements were observed.

The fifth group of analysed products consisted of bread for gluten-intolerant people. For persons who not tolerate gluten, one of the biggest challenges in their gluten-free diet is the necessity to avoid consuming of traditional bread. The problem pose even those natural gluten-free products that are prepared in a traditional bakery, since during the gluten and gluten-free production process, cross-contaminations often occur. On the Polish market, there is already a wide range of gluten-free bakery products. Twenty examined items were all classified as gluten-free food. The great majority of them (17 items) had text and graphic symbols, informing about the absence of gluten in the product composition. More than half of this group (12 items) was labelled by the AOECS certificate. Only three products exhibited no additional graphic symbol, signifying the gluten-free food.

The basis for the gluten-free bakery products was corn starch, present in 19 out of 20 products, as well as rice flour (15 out of 20). Yet, other key ingredients were unsaturated vegetable fats, present in their various forms in 18 out of 20 items. One of the most commonly used fats is olive oil. 80% of the examined products showed yeast in their composition. 16 products contained the addition of natural roughage from apples or potatoes.

In the examined assortment, the presence of the following substances was noted: buckwheat flour (7/20), rice starch (6/20), potato starch (4/20), corn flour (4/20) and cassava starch (2/20). Only in 3 items, gluten-free wheat starch was used. Technological supplements applied in the production of gluten-free bread that were present most

frequently in the composition of the examined products were: E 471 i.e., mono and diglycerides of fatty acids performing as emulsifying agent (18/20), hydroxypropyl methylcellulose (E 464) applied as thickener (9/20), acidity regulator E 575, tartaric acid (4/20), citric acid, guar gum and E 330, E450, E 282 (Figure 4).

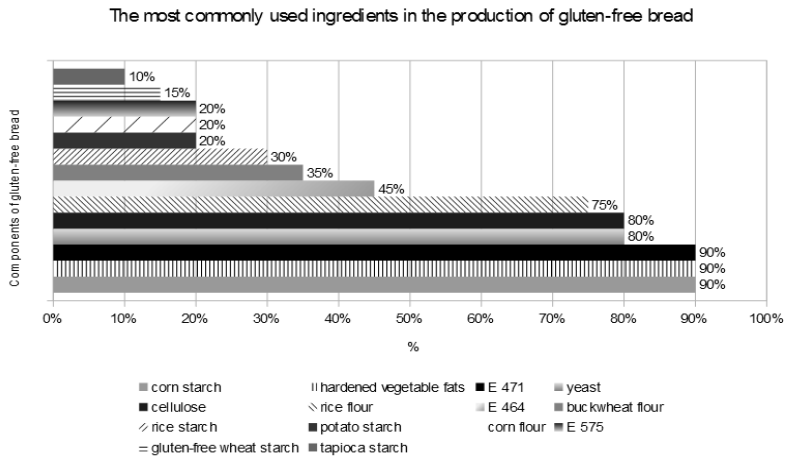


Fig. 4. The results of labels analysis of gluten – free bread. The diagram presents the most common ingredients used in the manufacturing process of different types of bread (%)

Source: own data.

## Summary

On the basis of the present analysis of the composition and the labelling correctness of selected foodstuffs such as: groats, flours, rice, corns, pastas, snacks, sweets and bakery products suitable for gluten-intolerant people, it can be summarized that the correct labelling of those analysed products was present in all examined groups. 97% of the items were labelled by a text stating they were gluten-free products. Also, the composition of the assortment in question did not give rise to objections to their gluten-free characteristics. 86% of the analysed gluten-free food was produced from natural free-gluten ingredients, whereas 14% was made of low-gluten wheat ingredients.

To sum up, 78% of the examined items were gluten-free products, bearing both text and graphic labelling as gluten-free products. 63% out of this group were products with the AOECS certificate for safe gluten-free foodstuff. Products holding such certificate are particularly recommended for people suffering from the celiac disease, as they guarantee the full safety of the production conditions and application of all required standards regarding the gluten content limits in the final product.

However, it must be stated that the biggest problem on the national gluten-free market is the insufficient observance of the production quality standards by the manufacturers. The condition of the gluten-free assortment offered on the Polish market is examined by means

of random checks performed by the Polish Association of People with Celiac Diseases and on Gluten-Free Diet (Polskie Stowarzyszenie Osób z Celiakią i na Diecie Bezglutenowej) that assigns laboratories with the task of marking the gluten content in gluten-free nutrition products. The results of the tests are published online on the association's website www.celiakia.pl.

The text-labelled products with no additional graphic labelling amounted to 33% of the tested group. 33,3% were one-ingredient products, prepared from natural gluten-free materials. Manufacturers often do not place information on the packaging of gluten-free nature of the product because although it is a naturally gluten-free product there is no guarantee that there had not been any contamination during the production process. As a matter of fact, companies that do not specialize in the production of gluten-free products often do not have safe, "gluten-free" production lines or storage houses.

The study revealed that apart from the graphic illustration informing that the given product is gluten-free, there are also pictograms informing about the absence of other potentially allergenic ingredients, mainly wheat ingredients (12%), milk – lactose (30%), eggs (24%), sugar (1%), soy (3%) and genetically modified GMO products (4%). In the composition of the examined products, no additional ingredients were detected that might have contained gluten. The great majority, i.e. 86% of the total number of analysed foodstuffs, were based only on natural gluten-free ingredients. The rest, i.e. 14% of the total number, exhibited the addition of wheat ingredients that were deprived of gluten.

Buying a gluten-free product requires a fair amount of trust towards the producer as in home conditions no customer is able to detect potential contamination with gluten of groats, flours, rice, corns, pastas, sweets, snacks or bread. Thus, it gives much rise to optimism that 40% of products had the AOECS certification for safe gluten-free food, issued in Poland by the by the Polish Association of People with Celiac Diseases and on Gluten-Free Diet (Polskie Stowarzyszenie Osób z Celiakią i na Diecie Bezglutenowej). Only AOECS-labelled gluten-free nutrition products guarantee the highest consumption safety.

The presented study examined the compatibility of the labelling with the law and the declared composition of gluten-free products. Even though, both aspects seemed to be correct, the daily practice defies such optimism. As the market analyses reveal, the gluten-free food is frequently contaminated by gluten. For example: gluten-free bread "Białobrzeski" from a bakery exceeded twice the gluten content limit (www.celiakia.pl). Regrettably, such cases are not rare. Along with the recognition of the necessity to eat gluten-free food, there is an increasing number of theoretically gluten-free products. They are customarily processed in the same place (production line) as traditional products containing gluten, therefore, they may easily become contaminated. Same silos, self-sown gluten cereal grains, same transport, grinding and processing on the same premises – all of these factors contribute towards the enhanced contamination danger. Those observations also used to be confirmed by the consumers' own experience, i.e. finding fragmented grains of wheat while cooking groats (fig.2), or noticing flour layer on groats. The examples mentioned above show that despite the wide range of manufactured gluten-free products and natural gluten-free products on the market, not all of them fulfil the quality criteria. On the other hand, the health of the gluten-intolerant people largely depends on the credibility of the manufacturers and distributors of the gluten-free food.

The aim of the next study will be the examination of the food samples, from products not labelled as gluten-free, in which the list of composition did not contain information

about the presence of gluten derivatives; hence, no gluten presence is assumed. The study will be conduct with the use of Enzyme-Linked Immunosorbent Assay R5 Mendez ELISA.

The project was financed by the funds of the KNOW (Leading National Research Centre) Scientific Consortium "Healthy Animal - Safe Food".

## References

Cheng, J., Brar, P., Lee, A., Green, P. (2010). Body mass index in celiac disease. Beneficial effect of a gluten-free diet. *Journal of Clinical Gastroenterology*. 44(4), 267-271.

Czerwińska, D. (2009). Charakterystyka żywności bezglutenowej, *Przegląd Zbożowo-Młynarski*, 4(12), 8-10.

Codex Alimentarius Commission (2015). Ad hoc Working Group on the Revision of the Standard for Gluten-free Foods. Agenda Item 4, CRD 1, November 2008.

COMMISSION REGULATION (EC) No 41/2009 of 20 January 2009 concerning the composition and labelling of foodstuffs suitable for people intolerant to gluten.

COMMISSION IMPLEMENTING REGULATION (EU) No 828/2014 of 30 July 2014 on the requirements for the provision of information to consumers on the absence or reduced presence of gluten in food.

Currie, S., Hadjivassiliou, M., Clark, M.J., Sanders, D.S., Wilkinson, I.D., Griffiths, P.D., Hoggard, N. (2012). Should we be 'nervous' about coeliac disease? Brain abnormalities in patients with coeliac disease referred for neurological opinion. *J Neurol Neurosurg Psychiatry*; 83, 1216-1221.

Dziuba, J., Fornal, Ł. (2009). Biologicznie aktywne peptydy i białka żywności, Warszawa, Wydawnictwo Naukowo-Techniczne, 271-350.

Hill, I.D., Dirks, M.H., Liptak, G.S. (2005). Guideline for the diagnosis and treatment of celiac disease in children: recommendations of the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. *J. Pediatr. Gastroenterol. Nutr*., 40, 1-19.

http://www.celiakia.pl/kategoria/badania/.

Hu, W.T., Murray, J.A., Greenaway, M.C., Parisi, J.E., Josephs, K.A. (2006). Cognitive impairment and celiac disease. *Arch Neurol*; 63: 1440–1446.

Kupper, C. (2005). Dietary guidelines and implementation for celiac disease. *Gastroenterology*, 128(4.1) 121-127.

Malekzadeh, R., Sachdev, A., Ali, A.F. (2005). Coeliac disease in developing countries: Middle East, India and North Africa. *Best Prac Res Clin Gastroenterol*, 19, 351-358.

Matsuo, H., Morita, E., Tatham, A.S., Morimoto, K., Horikawa, T., Osuna, H., Ikezawa, Z., Kaneko, S., Kohno, K., Dekio, S. (2004). Identification of the IgE-binding epitope in omega-5 gliadin, a major allergen in wheatdependent exercise-induced anaphylaxis. *J Biol Chem*, 279, 12135–12140.

Niederhofer, H. (2011). Association of Attention-Deficit/Hyperactivity Disorder and Celiac Disease: A Brief Report. The Primary Care Companion to CNS Disorders. 13(3): PCC.10br01104. doi:10.4088/PCC.10br01104.

REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004.

Sategna-Guidetti, C., Bruno, M., Mazza, E. (1998). Autoimmune thyroid diseases and coeliac disease. *European Journal of Gastroenterology and Hepatology*. 10(11), 927–931.

Sapone, A., Bai, J.C., Ciacci, C. (2012). Spectrum of gluten-related disorders: consensus on new nomenclature and classification. *BMC Med.* 10, 13.

Wojtasik, A., Daniewski, W., Ratkovska, B., Kunachowicz, H. (2010). Ocena wybranych produktów spożywczych w aspekcie możliwości ich stosowania w diecie bezglutenowej. Cz. II. Informacje podawane na etykietach produktów a możliwość właściwego wyboru. *Bromat. Chem. Toksykol.*, 43, 4, 461-468.

Zali, M.R., Rostami Nejad, M., Rostami, K., Alavian, S.M. (2011). Liver complications in celiac disease. *Hepatitis Monthly*, 11(5), 333-341.