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THE EXISTENCE OF GLUTEN-FREE AND FUNCTIONAL PASTA IN HUNGARY

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ABSTRACT

Nowadays, instead of traditional wheat grains, alternative cereals, also known as pseudocereals, are increasingly coming to the fore. The reason for this is, among other things, that more and more people struggle with food allergies and intolerances. Gluten-related disease - such as gluten sensitivity - is a chronic disease of the small intestine with malabsorption, which is triggered by gluten, a vegetable protein found in certain cereals, in people who are sensitive to it. Because of this, the demand for foods in which alternative gluten-free pseudocereals play a prominent role has understandably increased. Our research and development goal was aimed at getting to know and examining the different raw materials and their functional enrichment possibilities, which has led to the development of a new range of pasta products.

INTRODUCTION

Wheat appeared, about 10,000 years ago in the so-called „fertile crescent" of Southeast Asia (present-day Turkey, Palestine, Lebanon and northern Iraq). Wheat cultivation dates back to the beginning of agriculture, when various wild cereals, including wheat and barley, appeared spontaneously [1].
Wheat/gluten-related diseases can be divided into three different disorders: autoimmune, allergic and neither autoimmune nor allergic.
The term gluten is used to describe wheat proteins (prolamins and glutenins). However, other cereals also have proteins that have toxic effects on patients with celiac disease: toxic prolamins include gliadin in wheat, secalin in rye and hordein in barley. For a time, oats were excluded from the celiac diet because it was believed that avenin (a protein in oats) was also toxic to patients. In addition, the use of oats in gluten-free diets is still controversial due to possible cross-contamination with gluten containing cereals.
Coeliac disease is a chronic autoimmune disease caused by a persistent intolerance to gluten proteins. Many people think that celiac disease is more like a multisystemic immunological disorder than a disease confined to the gastrointestinal tract. The clinical symptoms of the disease vary widely and depend on the age of the patient and the duration of the disease. An important feature of the disease is the absence of enzymatic digestion of gliadin fragments in the gastrointestinal tract.
Wheat allergy is characterised by an IgE and non-IgE mediated immune response, which in some individuals results in an allergic reaction when touching or inhaling foods containing wheat. However, IgE cross-reactivity to other cereals is also possible in some individuals.
Patients with non-celiac gluten sensitivity (NCGS) are referred to as having neither autoimmune nor allergic disease. They have the same symptoms as celiac disease but test negative for it. Patients with coeliac disease should follow a strict gluten-free diet as they should avoid foods containing gluten, patients with wheat allergy should avoid contact with all forms of wheat and patients with NCGS should also follow a wheat/gluten-free diet [2].

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Wheat grains contain three main components, which are separated by milling: bran, germ and endosperm, which makes up 70-72% of the total grain and contains the toxic components. The storage proteins of cereals can be divided into two main groups: the ethanol-soluble fraction known as prolamins and the polymeric glutenins. The prolamins from different cereals are called differently, wheat prolamins are called gliadin, rye prolamins are called secalin, barley prolamins are called hordein and oats prolamins are called avenin [3][4]. The only effective and safe treatment for the disease is a strict gluten-free diet, which must be completely free of wheat, rye, barley and triticale. Ancient wheat varieties such as kamut and spelt should also be avoided as they are genetically similar to modern wheat and have a similar amino acid profile. The diet also includes the exclusion of potential cross-contamination. Many other crops are safe for people with celiac disease, the best known being rice and maize [5]. However, in recent years, interest in the gluten-free diet has increased dramatically and more and more people are following it, including those who do not suffer from any of the three diseases.

The list of cereals, grains, seeds, seeds, legumes and nuts that can replace gluten is quite long (including, for example, quinoa, millet, sorghum and chickpeas). These can all improve the diversity of a gluten-free diet, but they are rarely used, partly because of their higher cost and lower availability. Processed foods based on amaranth, quinoa and buckwheat are higher in protein, fat, fibre and minerals than those based on rice and maize, and can be good alternative ingredients for gluten-free products [6].
Individuals with coeliac disease tend to compensate for the restrictions of a gluten-free diet by consuming foods high in fat, sugar and calories, and therefore an overconsumption of total fats and saturated fats is observed in coeliac patients. For this reason, it is advisable to regulate their diet with the help of a specialist, who will provide guidelines on macro- and micronutrients. Intakes of complex and simple carbohydrates should account for about 55% of total calories. A wide range of pulses, alternative cereals and seeds are allowed. In recent years the nutritional composition of small cereals and pseudo-grains has been characterised and shown to be a good source of carbohydrates, dietary fibre, minerals and vitamins. They are also higher in protein content and of better quality than wheat. Dietary fibre is a complex mixture of plant materials that is resistant to digestion. Several studies have shown that a diet high in fibre can prevent many human diseases, such as colon cancer and diabetes. Protein intake should account for about 15% of total calories. The main dietary protein sources in a gluten-free diet are foods of animal origin such as meat, milk and dairy products, eggs and fish. Among plant-based raw materials, legumes, nuts, seeds and gluten-free cereals are useful sources of protein. Total fat intake should account for no more than 25-30% of total calories. Preference should be given to monounsaturated and polyunsaturated fat intakes. These can be found in foods such as vegetable oils, nuts, seeds and fish with higher fat content (e.g. salmon). In contrast, intakes of saturated fats, which are mainly found in foods of animal origin (red meat, poultry, dairy products), should be limited [2].

People who are allergic or intolerant to gluten can mainly eat foods that are naturally gluten-free (e.g. fruits, vegetables, meats). Since gluten eliminates many of the foods that play an important role for them, they replace them with gluten-free substitute foods (pasta, bread, cereals), in which wheat flour is replaced by gluten-free flours [7].
The popularity of pasta is growing worldwide, thanks to its convenience, taste and long and easy shelf life. In addition to the traditional pasta products made from durum wheat semolina, pasta is usually enriched with certain cereals (e.g. barley, rye), pseudo-grain (e.g. buckwheat, amaranth, quinoa) and leguminous flours (e.g. peas, chickpeas, etc.) to provide a source of fibre, minerals, antioxidants and polyphenols [8]. Leguminous flours are also excellent because they increase nutritional value by providing beneficial high protein, fibre and vitamin content, as well as having positive effects on glycaemic response and organoleptic properties [9]. In recent decades, a newer group of pasta products, gluten-free pasta, has been consumed not only by the growing number of people with celiac disease, but also by others who wish to exclude gluten-based products from their diet for health reasons or fashion. Currently, a wide range of products made from

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rice, corn and other gluten-free flours are available for people with gluten intolerance. Unfortunately, most of them have poor cooking quality, especially compared to their wheat counterparts. In addition, many gluten-free products are nutritionally inferior, i.e. poorer in minerals and biocomponents, than the wheat-based foods they are intended to replace. Pasta is one of the simplest grain-based products in terms of ingredients and processing. Both raw material characteristics and processing conditions play a key role in determining the quality of the final pasta product. The biggest challenge is therefore gluten-free pasta and bread, as gluten is their basic building block.
Among the gluten-free grains, amaranth, quinoa, teff and buckwheat are becoming increasingly popular, as they improve the nutritional content of gluten-free products in terms of their high fiber content, vitamins, minerals and other bioactive ingredients (polyphenols, phytosterols, etc.). Excellent sources of minerals, especially potassium, iron, calcium, zinc and phosphorus. Their vitamin content is also favorable regarding the B and E vitamin groups. Sorghum is also becoming more and more popular, as it is a good source of protein, starch and antioxidant compounds, which is why it can be used in addition to or as a substitute for corn and rice flours in the preparation of gluten-free foods [7,9].
Manufacturers may also use additives to improve the quality of the pasta. Examples include hydrocolloids, which are generally used because they can form a gel in small quantities, provide high consistency at room temperature and improve firmness. In addition, they can increase the rehydration rate of dough due to their water binding capacity. A wide range of hydrocolloids can be used, including for example xanthan gum, locust bean gum or carboxymethyl cellulose [6]. In addition to the properties mentioned above, these materials are also used as a kind of replacement for the gluten mesh in an attempt to improve the structure of gluten-free products.

The term functional food was first introduced in Japan in the 1980s, and since then it has been used more and more widely until today. This term is defined in several ways, one of which is accepted is that it refers to a processed food that contains ingredients that, in addition to nutrition, can also help certain functions of the body [10]. According to another generally accepted definition, this category includes any food or food ingredient that, in addition to its nutritional value, has a positive effect on an individual's health, physical performance or mental well-being [11].
In recent years, more and more consumers have become aware of functional foods, particularly in the hope that they may offer additional health benefits that can reduce the risk of certain diseases or promote optimal well-being [12]. Food manufacturers have recognised and started to adapt to these growing demands. As a result, functional foods have been developed in almost all food categories, even if they are not equally distributed across all segments of the food industry. As a consequence, consumer preferences may vary from market to market. Among the food markets, functional foods have emerged mainly in dairy products, confectionery, soft drinks, bakery products and baby food. These functional foods can also be classified into separate categories according to their type: there are foods fortified with additional nutrients (e.g. vitamins, minerals), there are fortified foods that contain ingredients not normally found in them (e.g. probiotics), and there are foods from which an ingredient considered harmful to the individual has been removed or reduced and thus makes life easier (e.g. lactose-free, gluten-free).

MATERIALS AND METHODS

The aim of our research was to create a new type of gluten-free pasta family, which have some functional characteristics. In addition to the usual reduced carbohydrate content among pastas, the specific aspect was the development of pasta enriched with protein and minerals. In terms of its base material, in addition to being gluten-free, it was important that it should not be made from rice and corn flour. For this, we turned to several types of different pseudocereals, such as millet, sorghum, quinoa, buckwheat and amaranth. In

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addition, we also used oats, teff and psyllium husk as auxiliary materials. These materials were examined from the aspects of shredding, wetting, and water absorption. We examined flour mixtures prepared in different variations for making pasta, which, in addition to the raw material, also involved many modifications of the proportions in the recipe [13]. The finished wet pasta was dried with several drying parameters, which were evaluated by sensory judges after cooking.
A questionnaire survey was also conducted to assess the gluten-free diet.

RESULTS AND DISCUSSION

Based on the results of the questionnaire survey, gluten-free pasta has a right to exist in Hungary and there are still market situations that can be exploited. As a result, the pasta is not only gluten-free, but can also be eaten by people following other diets.
Among the pre-shredding operations, wetting was not necessary in most cases, both because of the already hulled raw materials (e.g. millet) and because of the specific characteristics of the other materials. By varying the speed/time parameters during shredding, it was possible to determine the optimum values for all raw materials and their mixtures. By performing a sieve analysis, we were able to examine several grain sizes during dough production regarding the water absorption of the flours and the behavior of the dough. The ideal grain size was 160 μm, which is very rare for gluten-free flours, so we used a sieve with this coating. The pastas had to be designed to be compatible with a vegan lifestyle, so we used psyllium husk flour, because in this way we can avoid not only eggs, but also other hydrocolloids. Thanks to this, it turned out to be a special task to determine the right amount of psyllium husk flour, since it can thicken even a very small amount, regardless of the water temperature. The recipes for the pastas had to be created with this in mind, adapting all the other flours so that the end result was not a jelly-like mass. The adjustment of this was variable, as the pastas were made from different ingredients. The dry pastas were tested in an accredited laboratory to make sure that our fortification claims comply with current legislation. For the high in protein pasta, this was achieved using green pea protein, while for the carbohydrate-reduced pasta, bamboo fibre was used.

Figure 1: The new Easy Pasta product range

The basis of each pasta recipe was buckwheat, millet and teff flour, except for the low-carb version, as millet had to be omitted due to its high carbohydrate content. For mineral enrichment, selenium was used. We chose selenium because it is recognized as an essential nutrient for humans [14], and its intake varies greatly around

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the world, being lower in Europe and higher in the USA. Low levels of selenium have been linked to an increased risk of mortality, poor immune function and cognitive decline. Higher levels of selenium are antiviral and reduce the risk of autoimmune thyroid diseases [15]. Increasing your selenium intake may have long-term health benefits, particularly in reducing the risk of cancer. The initial links between selenium intake and cancer risk came from epidemiological studies that showed an inverse relationship between blood selenium concentrations and the risk of several cancers, primarily in men. In addition to these, selenium can also improve the immune response. It plays a role in supporting the development and expression of all components of the immune system, i.e. non-specific, cell-mediated and humoral immunity. Its deficiency reduces the immune competence, while its replacement to adequate level restores the immune functions impaired by deficiency. At an even higher intake, it increases the immune response [16].
The recommended daily intake value for selenium for adults is 55 µg. The dosage of selenium for the flour mixture was 0.01%, which corresponds to about 8 µg per serving. With this amount, it was possible to achieve that the recommended daily intake value of the selenium remaining in the dry pasta is approx. cover 15%.

CONCLUSIONS

During the research, many raw materials, which are excellent in their own right, were examined from a pasta production point of view, starting with the milling of the flour required for the production of the pasta. Throughout the production process, it was important that the product was gluten-free, so suppliers had to be selected. The raw materials are high-quality pseudo-cereals, from which pasta can be found on the market anyway. The developed pastas are unique in terms of their ingredients and selenium enrichment. Thanks to the technology used during milling, its quality is closer to fine wheat flour than its competitors. This new product range is called Easy Pasta, which also refers to their quick and easy preparation. Three pastas with different properties make up this product range: the high in protein, the carbohydrate reduced and selenium enriched pasta. In terms of their appearence, they are made in the form of fusilli and tagliatelle. These developed pastas are suitable for a wide range of uses and can be incorporated into a variety of diets, as opposed to the general gluten-free pasta, including many special diets. According to the growing trend that has occurred in recent years, there will continue to be a demand for these pastas, because of the increasing number of consumers who may be suffering from gluten sensitivity or other diseases.

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