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ACTUALITY AND IMPORTANCE OF THE GLUTEN-FREE BAKING GOODS PRODUCTION, CHOICE OF RAW MATERIALS

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Abstract: *This paper reviews the actuality and necessity of the production of gluten-free baking goods and the most commonly used raw materials for this production. A description is given of the nature and characteristics of gluten, in order to understand its value and structural role in the production of baked goods. A review of the pathology and epidemiology of the celiac disease shows the importance of this specific production. A review from 2015, collecting and analysing all the articles on the topic in the last 55 confirms that scientists are becoming more conscious about the gluten-free production. An analysis of the basic types of raw materials is done, with a comment of the technological role played by each of the three - primary, secondary and additional. A special attention is paid to the most commonly used primary raw materials such as rice, corn, potato, quinoa, sorghum etc. and their technological and nutritional value. An important point stated is the possible double benefit from the use of some specific flours e.g. chickpea and buckwheat - not only as sensorial, but also as structural agents.*

Keywords: *Gluten, Celiac disease, Baking goods, Raw materials, Flour.*

INTRODUCTION

Wheat flour is the main raw material used in the production of bread, pastry and confectionery products worldwide. It is vastly appreciated for its structural and technological properties, a part from the sensory one's, dues mostly to the presence of the gluten protein complex, that assures the development of the viscoelastic structure in dough (Hatta, E., Matsumoto, K. & Honda, Y., 2015). The use of wheat flour, as well as the other gluten containing cereals such as rye and barley is however restricted in the case of people suffering from celiac disease. This autoimmune disease consists in immune reaction to gluten exposure, that affects the small intestine villi, which become flattened and inflamed and the result is malabsorption of nutrients. The only possible treatment for this disease is adherence to a gluten-free diet, which in the cases of the congenital form of the disease must be lifelong (Lee, A., Newman, J., 2003). This imposes the need to produce baked goods based on gluten-free raw materials. The variety of cereals, pseudo cereals, legumes and nuts that are used for the purpose is abundant, but the flours deprived of gluten often present other technological challenges (Torbica, A., Hadnadev, M., & Dapcevic, T., 2010.).

EXPOSITION

Gluten characteristics and specifics of the celiac disease

According to the definition, gluten (from latin - *glue*) is an elastic and viscous protein mass that remains after the humid extraction of the wheat starch. It represents a mix of different protein fractions, most generally divided in two groups - prolamins and glutenins. The group of prolamins is the one toxic to the people suffering from celiac disease and their presence in some cereals is

estimated to around 50%. The specific proteins that provoque irritation are as it follows - in wheat □-gliadins, in barley - hordenines and in rye - secalins. Avenins, the oat prolamins are present in much smaller quantities and are supposed to be tolerated by the people suffering from celiac disease. Some authors still remain sceptical about it's application and the hardness to create a separated production line for one particular cereal culture makes its application restricted (Fayet, L., Guex, E. & Bouteloup, C., 2011).

The gluten intolerance (acquired) or gluten enteropathy a.k.a. celiac disease (congenital) are autoimmune health conditions, where the intake of gluten containing foods provoques immune reaction via anti-transglutaminase antibodies. The resulting incomplete gluten ingestion leads to stocking in the small intestine of peptides, toxic for the villi. This causes their structural damage and inflammation, represented with various intestine symptoms - bloating, diarrhea, hemorragia etc. This condition affects around 1% of the population of Europe and the USA, affecting mostly the caucasian type of subjects (Malamut, G., Cellier, C., 2010). The only possible therapy is adherence to a gluten-free diet that requires a complete change in the person's eating habits and lifestyle. This brings up the importance of the production of gluten-free products to ensure a large variety of foods substitutes.

Current evaluation of the research techniques in the production of gluten-free baked goods

A vast review of the gluten-free bread making research is conducted by a team of belgian scientists in 2015 (Masure, H., Fierens, E., & Delcour, J.), exploring and analysing the scientific results in the Web of science database from 1961 until 2015. The distribution of the 399 articles per year is shown on the figure below (Fig. 1)

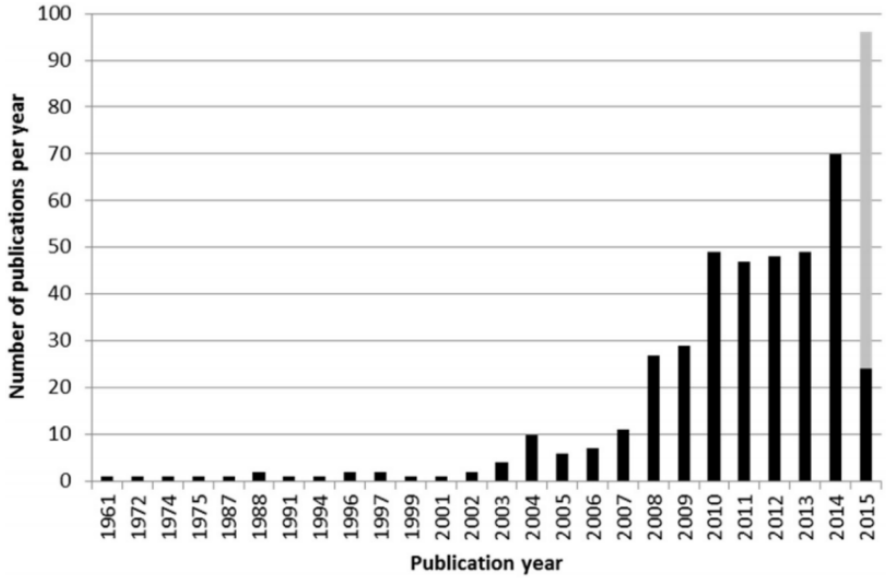

Fig. 1. Distribution of the related articles from 1961 to april 2015. The estimation for 2015 is shown in grey, based on the first 3 months activity. (Masure, H., Fierens, E., & Delcour, J, 2015.)

This repartition shows firmly how important this topic has became in the last decade and how many scientists are investing their efforts in the research of gluten-free baked goods production. The market need of quality bread and pastry substitutes of the traditional gluten containing products is about to distinguish the gluten-free production a separate branch in food technology.

Raw materials - a technological choice

Despite the vast variety of gluten-free raw materials, they all must be coherent to some basic rules. A part from being gluten-free, the raw materials must have high nutritional value to ensure the balance and the quality of the product. The second important condition is for the combination of materials to create a technologically valuable and stable mixture (Topuzova, Y., Karadzhov, Gr., Chonova, V., 2012).

As a whole, the raw materials can be divided in three big groups according to their percentage of inclusion and their technological purpose in the recipe - primary raw materials, that are incorporated in the biggest percentage and that attribute to the product its basic characteristics, secondary raw materials, that are added in small proportion to improve mostly the sensory characteristics of the product, but sometimes also the technological aspect and additional raw materials, such as additives, preservatives, emulsifiers, that grant a better formulation and management of the product.

As a leading raw material, with the biggest proportion and main structure role is the flour, or more generally said, the source of starch. In this group are included many derivatives of cereals, pseudo cereals, legumes such as rice, corn, potatoes, soja, buckwheat, quinoa, sorghum, millet, chickpea, chestnut etc. that assure the amidon content (Mancebo, C., Rodriguez, P., & Gomez, M., 2015).

Rice flour and rice starch are one of the most commonly used raw materials. Because of their light colour and bland taste they are widely appreciated in the pastry and confectionery production, even though they contain less proteins and fats than wheat (Kim, J., & Shin, M., 2014).

Along with rice, ***corn*** is one of the most vastly cultivated plants. ***Cornmeal and starch*** are a good source of proteins and fats which increases the nutritional value of the products. From the technological point of view it is not as widely applicable as rice, because of its specific characteristics, but is still in an important use (Vangelov, A., 1983).

Potato flour and potato starch contain almost no protein and are used as a source of carbohydrates. They are often applied in combination with other flours such as rice, due to the specific structure they attribute to the central part of some products (Sarabhai, S., & Prabhasankar, P., 2015).

In pastry and confectionery ***soya flour and soya starch*** are used as this culture is the most abundant in proteins which brings an important nutritional value to the baked goods (Park, J., Choi, I., & Kim, Y., 2015).

Buckwheat flour contains high amount of proteins with very balanced amino acid content. Some researches suggest that the high amount of polyphenols and flavonoids in buckwheat can have a positive antioxidant health effect, along with the important mineral content of cuprum, iron, potassium, magnesium etc. (Torbica, A., Hadnadev, M., & Hadnadev, T., 2012).

Quinoa is a pseudo cereal with minimal or no prolamin content which makes it suitable for the purpose of gluten-free baked goods production. Its protein content is of high quality and quantity with a diverse amino acid composition, that improve the nutritional value of the products (Turkut, G., Cakmak, H., Kumcuoglu, S., & Tavman, S., 2016).

Sorghum and millet flours are widely used in the wheat substitution. Sorghum is rich in carbohydrates and fatty acids, whereas millet contains high quantities of proteins, fibers and minerals such as zinc, iron, potassium and vitamins (Gull, A., Prasad, K., & Pradyuman, K., 2015), (Ferreira, S., et al., 2015).

Chickpea flour is rich in proteins and carbohydrates, fibers, folic acid and some minerals in traces - iron, molibden, manganese. Some researches show that chickpea proteins have good emulsifying properties, which are very important in the formulation of the gluten-free products (Aguilar, N., Albanell, E., Minarro, B., & Capellas, M., 2014).

The chestnut flour contains many indispensable amino acid proteins, fibers and vitamins, phosphorus, potassium and magnesium. The addition of chestnut flour not only improves the

nutritional and organoleptic value of the product, but can increase the shelf-life of the products (Paciulli, M., et al., 2016).

As the main structural element of baked and pastry goods - the gluten is missing, the choice of structural additives is indispensable. Some of the most widely used structural agents are hydrocolloides such as hydroxypropyl methylcellulose (HPMC), carboxymethylcellulose (CMC) or methylcellulose (MC), carrageenan and gelatin. A variety of gums is in use - arabic, guar, xanthan also pectin, inulin and and other type of fibers (Masure, H., Fierens, E., & Delcour, J., 2015).

But a part of the use of these classical structure agents, the use of flours as the buckwheat, carob, tigernut, chickpea or chestnut is a promising technique in the production process. What is of a big technological interest are exactly these dual properties of some of the specific flours, issued from legumes and other cultures. On one hand their value as a flour for the nutrition and sensory profile of the product, and on the other - their supplementary technological value - as emulsifiers, preservatives or structural agents, which allows the structure to be modified, without the possible influences and deteriorations of the sensory quality of the baked product.

CONCLUSION

The production of gluten-free baked goods is now an important part of the bread, pastry and confectionery production, as the awareness of the gluten-caused health issues is raising. The aim in the field of gluten-free technology research is to deepen and increase the knowledge about the use of alternative gluten-free substitutional raw materials. The conscious combination and use of raw materials, according to their specific properties can assure the production of healthy, high-quality, balanced in nutritional and sensory profile baked goods, that can serve as an absolute substitute of the traditional ones in a gluten-free diet.

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