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SPECIFIC GLUTEN-BASED FLOURS RECOMMENDED IN THE GLUTEN-FREE DIET

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Abstract

The bakery industry is based on the unique properties of gluten proteins from wheat and some other cereals flour. Those unique viscoelastic properties are responsible for the specific characteristics of different wheat flour foods. Porosity, elasticity, texture and structure of these products are attributes that make bakery products based on wheat flour more attractive for consumers. Unfortunately, the incidence of gluten intolerance or celiac disease among the Romanian population is increasing in the last few years and the only treatment of the disease is in fact a very strict control of the diet in order to eliminate any source of gluten from the diet. In this regard, developing of new, gluten-free bakery products ensures a wider range of product for ill people and at the same time to ease their life by providing industrial products which make the meal preparing time more efficient spent. The present paper presents the gluten-free alternatives to wheat flour products for baking industry.

Key words*: alternative flours, celiac disease, gluten-free diet, gluten-free flour.*

INTRODUCTION

Consumers, food producers and health professionals are uniquely influenced by the popularity of the gluten-free diet. These consumer demands and expectations have led food manufacturers to continually adapt and improve the processing formulas and techniques used to make gluten-free products.

In this paper, we aim to provide a clear picture of the current motivations behind using gluten-free diets, as well as the technological and nutritional challenges of the diet as a whole. the characteristics of alternative flours, hydrocolloids, stabilizing substances and fiber sources have been shown to play a complex role in imitating the functional and sensory effects of gluten in gluten-free products.

However, the quality of gluten-free alternatives is often inferior to gluten-containing products.

The bakery industry is based on the unique properties of gluten proteins present in wheat and some other cereals.

The unique viscoelastic properties are responsible for the characteristics of different wheat flour foods. The processing of wheat flour products is based on the ability of protein substances to develop and form the gluten network. Gluten-based protein substances are important in the properties and behavior of the dough, the bread volume and structure, the making of pasta.

Among the urban population, in recent years, the incidence of gluten intolerance has increased from year to year. Celiac disease is an autoimmune disease triggered by the ingestion of gluten in genetically predisposed individuals. The only treatment is based on a strict, gluten-free diet for life.

As the prevalence of celiac disease is increasing, it is urgently necessary to have a better knowledge of the foods recommended for this diet.

MATERIALS AND METHODS

In this paper, I would like to present alternatives to wheat flour used in bakery.

The impact of celiac disease on people's daily lives, especially health-related quality of life, has been regularly investigated. Some research shows that a gluten-free diet can significantly improve the quality of life after the diagnosis of celiac disease.

RESULTS AND DISCUSSIONS

What is intolerance? Symptoms of food intolerance cause problems especially in the gastrointestinal area. These appear after a large time lag from the table, even after 72 hours. This "incompatibility" is actually indigestion, because the aggressor is a food ingredient that the body cannot properly and fully handle. (eg lactose intolerant)

What is cross allergy? Extremely bizarre, for some patients what manifests as a food allergy is actually the fever of the fan. For example bee pollen contains common choices with certain foods.

The gluten problems

Celiac disease (CD)

Celiac disease is a severe autoimmune disease, and it can damage a person's digestive system. It is vital for people to be aware that celiac disease only affects around 1 % of the population. The only treatment for celiac disease is a strict gluten-free diet (Health Canada, 2012).

Gluten intolerance or non-celiac gluten sensitivity (NCGS)

Gluten sensitivity is not an autoimmune disorder, nor does it cause damage to the small intestine. NCGS or gluten sensitivity is defined as "*a clinical entity induced by the ingestion of gluten leading to intestinal and/or extra-intestinal symptoms that improve once the gluten-containing foodstuff is removed from the diet, and celiac disease and wheat allergy have been excluded*". Symptoms are highly variable, and are often similar to those of celiac disease, making diagnosis a challenge (Pulse Canada, 2011). Some estimates put the prevalence of gluten intolerance at between 0.5 % and 13% of the population. Treatment is adherence to a gluten-free diet. (Market and Markets Gluten-Free Products Market by Type, 2018)

Should gluten be reduced or eliminated?

People need to be aware that celiac disease affects only 1% of the world's population and is transmitted hereditary. The most frequent incidents are found for the sensitivity to non-celiac gluten, which according to some estimates have prevalence between 0.5% and 13% of the population.

Gluten intolerance is a condition that can be very difficult to identify and easily associated with other conditions. To combat these conditions a gluten-free treatment is recommended. It's just that there is a wave of opinions that suggest that gluten has negative health implications. This new tendency to remove gluten from the total diet for both sufferers and healthy people is not beneficial for any party (consumer and industry).

Also, there is very little research that suggests that excluding gluten from a diet will benefit the health of people who do not have a condition such as celiac disease or gluten intolerance.

Reducing gluten intake from the diet

Gluten is completely reduced in the diet of people with celiac disease as soon as a doctor has diagnosed the condition, but for people who suffer from gluten intolerance it is gradually reduced and total elimination is not recommended.

It may not be beneficial for everyone with gluten intolerance to completely remove their gluten from their diet, as people's symptoms may vary depending on their severity.

It is possible that some people may consume small amounts of gluten without symptoms.

Most people with gluten intolerance want to eliminate gluten from their diet, but this must be done gradually. (Sainsbury et al., 2011; Biagi et al., 2009).

New trend - gluten free products contained a lot of products with less gluten; gluten-free products; dietary fiber-rich products; using unconventional ingredients, etc.

In the processing of cereals, gluten is the combined fraction of gliadin (prolamine) and glutenin (glutelin) of wheat.

The protein fraction of gluten is represented as a three-dimensional network, extremely important in food processing. Gluten from wheat flour forms a three-dimensional protein network, based on proper hydration and mixing. These network forming properties are used in kneading to create viscoelastic dough matrices.

Since gluten is the essential structure-building protein in wheat-based foods, its elimination presents a major challenge for formulators.

Gluten-free options currently in use include: flours (rice, sorghum, quinoa, amaranth, teff, soy, buckwheat, pea, bean, chickpea, lentil, protein insect); starches (tapioca, corn, potato, arrowroot); whey powder and egg; gums; emulsifiers and dough conditioners.

Rice flour is found under different types, depending on variety and granularity. Following the milling and processing of the rice, a powder with different granules of rice is obtained. It is recommended to combine it with other types of flour, up to 50%, especially those that are rich in protein to balance the texture and to obtain a proper structure. The rice flour is finer and softer; dough is extremely malleable, easy to process. It is not recommended to get bread from 100% rice flour because it results in granulated products and a crumbly texture. Partial replacement of rice flour with chestnut flour results in lower hardness, increased specific volume, and better color and sensory properties. High chestnut flour recipes had low quality. In pastry-confectionery is used to obtain products for diabetics, biscuits, sticks, creams, home-made sweets, tarts, cakes, puddings, caramel or syrup expanded in chocolate, various garnitures etc.

Corn flour. Corn seeds are milled to a corresponding degree of crushing. It has a yellow-golden or orange color, sometimes even whitish, with a non-uniform grain which, in mastication, produces a characteristic, sweet, hazelnut taste. It is a flour rich in fiber, vitamins and mineral salts (riboflavin, niacin, folic acid thiamine and iron). In bakery, corn flour is mixed with other gluten-free meals (under 25%), preferably rice and sorghum, buckwheat or amaranth, for consistently baked products. It borrows an excellent product texture. It is used for making meat-based fillers, mixed with other flours for various assortments of bread and pastries, tortillas, waffles, pancakes, bread and various desserts.
Notes: Appetizer biscuits with corn flour, cookies, pizza

Hemp flour does not contain gluten substances and forms consistent dough, so it is recommended to use it in mixtures with other types of flour, except for sticks, cakes or biscuits. It is an excellent source of protein, it contains all the essential amino acids, rich in dietary fiber. It gives a pleasant hazelnut flavor to bread products, muffins, cakes and pancakes. Hemp seed meal (protein powder) can be used in any kind of dough for making bread, noodles, pasta, gnocchi, cakes, biscuits, etc., culinary products, desserts. It is ideal in the vegan diet and can substitute for meat.

Millet flour is obtained by grinding millet seed. Milled seeds are very small and can be yellow, white, gray or red. It is a flour rich in vitamin B complex, mineral salts (magnesium, iron, potassium, phosphorus) and is a good source of fiber and protein. The millet flour has a light beige or yellow color, a discrete taste, similar in texture to rice flour.
Millet flour is recommended to be used, in one meal, in a ratio of max. 25%. As a gluten-free meal, it is indicated both in children's diet and in special diets. Bread with millet has a delicate taste, and is easy to digest, is rich in protein and minerals, but can have a slightly sweet taste. Bread must be freshly eaten as it hardens very quickly. It can be used to thicken sauces and soups, for bread and pastry specialties, desserts, pancakes, biscuits, cakes, etc.

Sorghum flour. The sorghum meal has a finer texture, but it is recommended that it be combined with other gluten-free flours. It has high protein, iron and fiber content, as well as antioxidants. The red and white flour is found on the market, has a slightly sweet taste and gives a whole wheat appearance to baked products. It is used in mixtures of 25-30% with other gluten-free flours, for making cakes, biscuits or gluten-free bread. Various bakery products, both leavened and uncooked, soups, popcorn, can be used in the preparation of fermented beverages or can be cooked in the form of flakes, wholly or syrupy extract.

Konjac Flour or Konjac Powder is a product obtained from the root of the Konjak plant, *Anorphophallus Konjac*, is a perennial plant originating in the subtropical and tropical areas of East Asia, Japan and China to the south in Indonesia. Konjac flour is a natural product with a taste close to neutral (most frequently is associated with the taste of salty), non-

allergenic main component of the fiber of *glucomannan* (about 40%), which absorb a lot of water and eliminate the feeling of hunger. This type of flour has a high fluid absorption capacity, rich fiber content, creates a satiety feeling and has a zero caloric content. It can be used as a gelling agent or thickening agent (sweet or salted, sauces), and desserts (creams, soups, puddings and jellies). The way of use is as simple as that of starch or other similar ingredients.
It is used for making cakes, improves dough texture, pearled pasta, replacing couscous or rice.

Amaranth flour. It is made from amaranth seeds, rich in protein. Amaranth flour is characterized by a protein content nearly twice as high as wheat (up to 19%), but with a very balanced protein composition. The flour has a strong nutty taste, a complex and very dense flavor, difficult to work with. Amaranth meal is recommended to combine with moist ingredients such as eggs, butter and dairy products. It is suitable for mixtures containing brown sugar or maple syrup. Because of the distinct taste, moderately, about 10-20% of a flour mixture is used. It is not recommended to get bread from 100% amaranth meal, because the baked products may have a bitter taste and may get too early. It is used in the preparation of bread by direct method, cakes, tops (Alencar, 2017, Machado Alencar, 2015).

Quinoa seed and flour. This cereal is benefic in balanced diet and is excellent source of protein. Quinoa flour increases loaf volume and yields a more homogeneous crumb structure, while not affecting product taste (Alencar, 2017; Machado Alencar, 2015). Quinoa flour does not contain gluten and can be used to make dough and cakes. This flour is a specific flavor that can be contoured by the addition of walnut, cinnamon or cardamom.

Chia seed and flour It is made from Chia seed from the *Salvia hispanica* plant, the super nutrient rich in nutrients, especially Omega 3, fiber, calcium and protein, and absorbs a large amount of water. More often used chia seeds are used. Chia flour does not adversely affect loaf volume and crumb firmness (Miñarro, 2012; Moreira, 2013).

Buckwheat flour or sarazin black wheat (popular name in Eastern Europe). Buckwheat (common buckwheat *Fagopyrum esculentum*, tartar buckwheat, bitter *Fagopyrum tataricum*) is not a proper grass, but is part of the *Polygonaceae* family, and the bean is shaped like a small pyramid. Buckwheat beans have a triangular characteristic of tetrahedron and have a dark brown or black peel. Decorated they are brown or light green.
Buckwheat beans may be whole or may be ground as flour. The milling results in a very fine, soft touch to the touch, pleasant taste and a special flavor. When processing, it absorbs a large amount of water. It is a very grainy cereal, a strong nutty taste, bitter, slightly sweet, easy to digest. It is usually used in combination with other types of flour.
In the buckwheat is also a toxic substance, *phagopyrin*, which causes some people the phenomenon of photosensitisation.
Buckwheat flour can be prepared as such or mixed in varying proportions with wheat flour. The dough is flavourful and savory. (Mariotti, 2013) Dehulled buckwheat flour improved the baking performance of commercial mixtures, whilst puffed buckwheat flour had a clear effect on water availability and the interaction between the matrix biopolymers. Buckwheat flour is recommended for the preparation of: pancakes, thickening of sauces, blending (15-25%) with other types of flour for the preparation of various types of bakery products, biscuits, pancakes, noodles, jelly production.

Chestnut flour. Chestnut provides two distinct products of chestnuts paste and chestnut flour, which are used in the food industry. Chestnut meal is a light brown sweet flour, obtained by drying and fine grinding of edible chestnuts. Chestnut flour is ideal for thickening pudding sauces, and in flour mixes it is used for bread, muffins, cake tops or various desserts. It is used to make chalva, chocolate, cakes and candies, even bread (mixed with wheat flour); it can replace, if necessary, potato (chestnut purée). Chestnut meal can be prepared with butter and milk to successfully replace potato purée. A 20% chestnut flour is used in a basic mixture.

Added in a too high percentage, chestnut flour, print the products an unpleasant taste of earth (Paciulli, 2016).

Coconut flour is made from fresh coconut pulp in dry and skimmed pastry and then finely crushed. The texture is very similar to that of wheat flour. Coconut has a low carbohydrate level, ideal for making bread and pastries. Coconut is rich in fiber, about 38.5% fiber, which is the highest percentage of other flour. Coconut is hypoallergenic. Up to 15-25% of coconut meal is used in mixtures, but other preparations can be obtained at a ratio of 100%. Coconut is gluten-free, has a great flavor and is perfect for baking, but it should be taken into account that in large quantities, it requires additional liquid ingredients (Trinidad, 2006).

Carob flour. The carob flour is obtained from the fruits (the carob tree) of the *Ceratonia siliqua* tree, spontaneously grown or grown in the Mediterranean and the Near East. The carob meal is obtained by drying and fine milling of the pods. It has a subtle color and taste of caramel, somewhat similar to cocoa. Rich in pectins, quality soluble fiber, and sugars with thickening properties, carob powder has the ability to regulate intestinal transit, recommended both in constipation and diarrhea. In addition, carob sugar is slowly absorbed and causes a steady, beneficial glycemia for the body. The carob meal is very suited to cocoa powder, is naturally sweet, flavored and ideal in sweet foods, being one of the natural and healthy additives in bakery products, ice cream, salad dressings and other foods. Carob germ flour loaves have the lowest volume Carob germ flour is a good alternative to wheat flour to produce viscoelastic dough and high quality gluten-free bread (Smith, 2012). It is an important ingredient for pastry products, successfully replacing cocoa. Being naturally sweet and thickening, the cinnamon powder can be used to prepare cakes and other sweets, especially when it is desirable to reduce the amount of sugar or to increase the consistency of the creams (Miñarro, 2012).

Teff flour. It is obtained from *Eragrostis tef* or Ethiopian millet. It is marketed as ground, whole or prepared flour (Campo, 2016).

Teff has a unique nutty flavor, easy to molasses. Teff flour contains a form of starch that helps regulate blood sugar levels, helping to maintain weight. It is combined with other types of flour, but not more than 25% of any flour mixture. Teff meal can be consumed just like any other grain: as a main course, with berries at breakfast, it offers a pleasant taste of hazelnut cookies, cakes, pasta, pancakes and waffles.
In Ethiopia flour is fermented 1-3 days to make "Injera", a sour-dough-type flat bread.

Vegetable flour. Chickpea flour yields the highest volume and the softest crumb. Soy flour alters the textural properties and color of the bread.

One of the *additives* often used as a processing aid and/or quality-improving minor ingredient, is dietary fiber. The addition of dietary fiber does not only compensate for the nutritional loss of dietary fiber when excluding wheat flour or whole meal from the product recipe, but it also introduces an ingredient with excellent water-binding, viscosity-increasing, and even gel-forming capacities. As a result, product thickening and texturizing characteristics are re-introduced in the gluten-free process (Korus, 2015; Martínez, 2014; Pastuszka, 2012; Sciarini, 2017).
Hydrocolloids are polymers that display thickening properties through the binding of water. As a result, the viscosity of the gluten-free "dough/batter" is enhanced and gas is better retained in the "dough" matrix, which increases bread loaf volume and improves loaf crumb structure. (Demirkesen, 2010; Dizlek, 2016; Hager, 2013; Morreale, 2018; Prakriti Jnawali, 2016). The most popular hydrocolloids are xanthan gum, hydroxypropyl methyl cellulose (HPMC), and the same pectin, guar gum, locust bean gum, agarose, tragacanth gum, cress seed gum, and carboxymethyl cellulose (Cappa, 2013; Demirkesen, 2010; Lazaridou, 2007; Liu, 2018; Moreira, 2013; Naji-Tabasi, 2014; Nicolae, 2016).

CONCLUSIONS

Celiac disease is an increasingly common autoimmune condition that affects the intestine

and has multiple systemic manifestations. Despite the increase in rates of diagnosis, most people with celiac disease remain undiagnosed.
A concern of the food industry is finding new ingredients to get these products.
It is extremely easy to recommend the replacement of gluten as an essential ingredient in many products. But it is not enough just to replace a gluten-free ingredient in a recipe, because there are technology problems, requirements for improving sensory characteristics, and the quality of gluten-free products is not adequate compared to the concern for a gluten-free diet.
Restaurants should include gluten free products as an option for this special category of consumers.
Specialists in gluten-free products have to be formed.

REFERENCES

Alencar, N.M.M., de Morais, E.C., Steel, C.J., Bolini, H.M.A. (2017). Sensory characterisation of gluten-free bread with addition of quinoa, amaranth flour and sweeteners as an alternative for coeliac patients. *Int. J. Food Sci. Technol.*

Arendt, E.K., Moore, M.M. (2006) *Gluten-free cereal–based products*, in: Y.H. Hui (Ed.), Bakery Products: Science and Technology, USA: Blackwell Publishing House, 471–496.

Biagi F, Andrealli A, Bianchi PI, Marchese A, Klersy C, Corazza GR. (2009) *A gluten-free diet score to evaluate dietary compliance in patients with coeliac disease*. Br J Nutr. 2009; 102: 882-887

Campo, E., del Arco, L., Urtasun, L., Oria, R., Ferrer-Mairal, A. (2016). Impact of sourdough on sensory properties and consumers' preference of gluten-free breads enriched with teff flour. *J. Cereal Sci*., 67, 75–82.

Cappa, C., Lucisano, M., Mariotti, M. (2013) Influence of Psyllium, sugar beet fibre and water on gluten-free dough properties and bread quality. *Carbohydr. Polym*., 98, 1657–1666.

Demirkesen, I., Mert, B., Sumnu, G., Sahin, S. (2010) Utilization of chestnut flour in gluten-free bread formulations. *J. Food Eng*.

Dizlek, H., Ozer, M.S. (2016) The Impacts of Various Ratios of Different Hydrocolloids and Surfactants on Quality Characteristics of Corn Starch Based Gluten-free Bread. *Cereal Res. Commun*., 44(2), 1-11.

Dubravka, V., Amidžić, D., Rić, K.L.A., Dragojević, I.V. (2010) Nutritional and Functional Properties of Certain Gluten-Free Raw Materials *Czech J. Food Sci*., 28(6), 495–505.

Gambus, H., Gambus, F., Pastuszka, D., Wrona, P., Ziobro, R., Sabat, R., et al. (2009). Quality of gluten-free supplemented cakes and biscuits. *Int. J. Food Sci.Nutr*., 4, 31–50.

Gibson, P.R., Muir, J.G. (2013). Not all effects of a gluten-free diet are due to removal of gluten. *Gastroenterology*.

Hager, A.S., Arendt, E.K. (2013) Influence of hydroxypropylmethylcellulose (HPMC), xanthan gum and their combination on loaf specific volume, crumb hardness and crumb grain characteristics of gluten-free breads based on rice, maize, teff and buckwheat. *Food Hydrocoll*., 32, 195-203.

Korus, J., Witczak, T., Ziobro, R., Juszczak, L. (2015). Linseed *(Linum usitatissimum L.)* mucilage as a novel structure forming agent in gluten-free bread. LWT. Food Sci. Technol.

Lazaridou, A., Duta, D., Papageorgiou, M., Belc, N., Biliaderis, C.G. (2007). Effects of hydrocolloids on dough rheology and bread quality parameters in gluten-free formulations. *J. Food Eng*., 79, 1033-1047.

Levent, H., Bilgich, N. (2011). Effect of gluten-free flours on physical properties of cakes, *J. Food Sci. Eng*., 1, 354–360.

Liu, X., Mu, T., Sun, H., Zhang, M., Chen, J., Fauconnier, M.L. (2018) Influence of different hydrocolloids on dough thermo-mechanical properties and in vitro starch digestibility of gluten-free steamed bread based on potato flour. *Food Chem*., 239, 1064-1074.

Machado Alencar, N.M., Steel, C.J., Alvim, I.D., de Morais, E.C., Andre Bolini, H.M. (2015). Addition of quinoa and amaranth flour in gluten-free breads: Temporal profile and instrumental analysis. LWT *Food Sci. Technol*., 62(2), 1011-1018.

Malcolmson, L., Boux, G., Bellido, A.S., Frohlich, P. (2013). Use of pulse ingredients to develop healthierbaked products. *Cereal Foods World*, 58(1), 27-32.

Mariotti, M., Pagani, M.A., Lucisano, M. (2013). The role of buckwheat and HPMC on the breadmaking properties of some commercial gluten-free bread mixtures. *Food Hydrocoll*., 30(1), 393-400.

Market and Markets Gluten-Free Products Market by Type (Bakery Products, Pizzas & Pastas, Cereals & Snacks, Savories, and Others), Source (Oilseeds & Pulses, Rice & Corn, Dairy & Meat Products, and Other Crops), & by Region Global Trends & Forecast to 2020. [(accessed on 31 July 2018)]; https://www.marketsandmarkets.com/Market-Reports/gluten-free-products-market-738.html.

Martínez, M.M., Díaz, Á., Gómez, M. (2014*).* Effect of different microstructural features of soluble and insoluble fibres on gluten-free dough rheology and bread-making. *J. Food Eng*., 142, 49-56.

Mezaize, S., Chevallier, S., Le Bail, A., De Lamballerie, M. (2009) Optimization of gluten-free formulations for French-style breads. *J. Food Sci*., 74(3), E140-146.

Miñarro, B., Albanell, E., Aguilar, N., Guamis, B., Capellas, M. (2012). Effect of legume flours on baking characteristics of gluten-free bread. *J. Cereal Sci., 56(2), 476-481.*

Moreira, R., Chenlo, F., Torres, M.D. (2013) Effect of chia (*Sativa hispanica* L.) and hydrocolloids on the rheology of gluten-free doughs based on chestnut flour. *LWT—Food Sci. Technol*., 50, 160-166.

Moreira, R., Chenlo, F., Torres, M.D. (2013). Effect of chia *(Sativa hispanica L.)* and hydrocolloids on the rheology of gluten-free doughs based on chestnut flour. LWT. *Food Sci. Technol*.

Morreale, F., Garzón, R., Rosell, C.M. (2018). Understanding the role of hydrocolloids viscosity and hydration in developing gluten-free bread. A study with hydroxypropylmethylcellulose. *Food Hydrocoll.* doi: 10.1016/j.foodhyd.2017.11.004

Naji-Tabasi, S., Mohebbi, M. (2014). Evaluation of cress seed gum and xanthan gum effect on macrostructure properties of gluten-free bread by image processing. *J. Food Meas. Charact*., 9(1), 110-119.

Nicolae, A., Radu, G.L., Belc, N. (2016). Effect of sodium carboxymethyl cellulose on gluten-free dough rheology. *J. Food Eng*., 168, 16-19.

O'Neil, J.O. (2010). Gluten-free foods: Trends, challenges, and solutions. *Cereal Foods World*, 55, 220.

Paciulli, M., Rinaldi, M., Cirlini, M., Scazzina, F., Chiavaro, E. (2016). Chestnut flour addition in commercial gluten-free bread: A shelf-life study. LWT. *Food Sci. Technol*., 70C, 88-95.

Pastuszka, D., Gambuś, H., Ziobro, R., Buksa, K., Sabat, R., Augustyn, G. (2012). Impact of oats β-glucans on properties of gluten-free bread. *J. Microbiol. Biotechnol*., 1, 972–979.

Prakriti, J., Vikas, K., Beenu, T. (2016). *Celiac disease: Overview and considerations for de Borsuk Y, Arntfield S, Lukow OM, Swallow K.*

Sainsbury K, Mullan B. (2011) *Measuring beliefs about gluten free diet adherence in adult coeliac disease using the theory of planned behavior*. Appetite. 2011; 56: 476-483.

Sciarini, L.S., Bustos, M.C., Vignola, M.B., Paesani, C., Salinas, C.N., Pérez, G.T. (2017). A study on fibre addition to gluten free bread: Its effects on bread quality and in vitro digestibility. *J. Food Sci. Technol.*, 54(1), 244-252.

Smith, B.M., Bean, S.R., Herald, T.J., Aramouni, F.M. (2012). Effect of HPMC on the Quality of Wheat-Free Bread Made from Carob Germ Flour-Starch Mixtures. *J. Food Sci*., 77(6), C684-689.

Trinidad, P.T., Mallillina, A.C., Valdeza, D.H., Loyolaa, A.S., Askali-Mercadoa, F.C., Castilloa, J.C., Encaboa, R.R., Masab, D.B., Maglayac, A.S., Chuac, M.T. (2006). Dietary fiber from coconut flour: A functional food. *Innovative Food Science & Emerging Technologies*, 7(4), 309-317.