MANUFACTURING FUNCTIONAL BAKERY PRODUCTS

Curricula addressed to the specialist in dietary food technologies and nutritionists

Material edited within the project

„Let's produce new functional bakery products for people with digestive disorders“

(FBforPDD)

Project Reference: 2019-1-RO01- KA202-063170

CURRICULA DESCRIPTION

Name of project: „Let's produce new functional bakery products for people with digestive disorders“ (FBforPDD)

Project Reference: 2019-1-RO01- KA202-063170

Curricula addressed to the specialist in dietary food technologies and nutritionists

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Objectives	Curricula presents aspects regarding the types of digestive disorders and the diet required as complementary therapy in the management of these diseases. Curricula establishes cognitive skills and abilities necessary to develop bakery products destined for people with digestive disorders. The technical and scientific knowledge obtained will be presented to the trainers in order to know the ingredients, processes, tools and transformations occurred during the processing of bakery products recommended in digestive disorders.
Cognitive skills	Necessary skills belonging to medicine, nutrition and food technology disciplines in order to develop functional foods with positive impact on digestion.

	Capacity to select the technical conditions and the optimal ingredients needed to obtain bakery products destined to people with digestive disorders.
Professional skills	- ability to manage the recommended functional products depending on the digestive disorders in order to promote and maintain good health of the people; - ability to identify optimal raw materials to ensure nutritional intake and avoid irritant factors in digestive diseases; - ability to develop novel functional bakery products with high nutritional and low digestive irritant proprieties; - capacity to optimize the technological bakery process in order to obtain functional products destined for people with digestive disorders.
Competence units	- the knowledge of different types of digestive disorders; - the knowledge of the recommended raw materials, i.e. prohibited in the digestive disorders; - the obtaining of functional products based on cereal, leguminous or fruit matrices and their characterization from the nutritional and physic-chemistry point of view.
Elements of innovation	The elements of innovation are due by the complementarity of the competencies that are intended to be implemented to the learners in term of medical, nutritional and technological aspects.

Activities hours

Total hours	Theoretical	Practical
32	**23**	**9**

	No of hours	Obs
Chapter 1. The importance of consuming functional bakery products 1.1 Functional foods and their role in human health 1.2 Cereals and cereal derivatives - nutritional value, consumption recommendations 1.3 The role of cereals in maintaining and promoting health 1.4 Role of dietary fibres in the diet	4	- 2 hours theoretical part
Chapter 2. Types of functional bakery products 2.1.Functional bakery products in Romania 2.2. Functional bakery products in Ireland 2.3. Functional bakery products in Hungary 2.4. Functional bakery products in Italy	4	- 2 hours theoretical part
Chapter 3. Newly developed functional bakery products depending on the digestive disorders 3.1 Functional bakery products with digestive disorders: - Gastroesophageal reflux - Celiac disease - Ulcerative colitis - Indigestion - Ulcers - Irritable bowel syndrome 3.2 Newly developed functional bakery products produced in present depending on the digestive disorders	6	- 2 hours theoretical part -3 hours practical part
Chapter 4. Manufacturing technology for bakery products with added soluble fibre - Fortification with fibre concentrate - Manufacturing technology for bakery products with EMULGOLD	6	- 3 hours theoretical part - 4 hours practical part
Chapter 5. Technology for the manufacture of bakery products with the addition of probiotics for the regulation of the digestive system - The role of intestinal microbiota	6	- 3 hours theoretical part

- Technology for the manufacture of bakery products with GanedenBC30		4 hours practical part
Chapter 6. Technology for the manufacture of bakery products with low sugar and fat content	6	- 3 hours theoretical part 4 hours practical part
Evaluation methods and assessment for the certification of competencies:		-
Assessment for the certification of competencies will be done by means of tools and evidence developed in accordance with the provisions regarding the cognitive and professional skills, taking into account the performance criteria and the conditions of its applicability. The evaluation tools will be able to take into account the integrated assessment of multiple competencies acquired in the course. At the end of the trening the participants evaluation will be achieved through a test and the graduates will receive diplomas. The evaluation highlights the extent to which key competencies, general technical skills and specialized technical skills are shaped.		-
List of teaching materials: The theoretical parts and also the practical parts will be exemplified by texts, pictures and videos, and the final teaching method will take into account the level of the target group to whom it addresses.		-

EXTENDED CURRICULA

CHAPTER 1. THE IMPORTANCE OF CONSUMING FUNCTIONAL BAKERY PRODUCTS

1.1 Functional foods and their role in human health

Balanced diet adapted to the body's needs should be accomplished in order to maintain body development, growth and maintenance, to improve the state of well-being and health and to reduce the risk of diseases.

Functional foods are natural or processed foods that contain biologically active compounds, proven to have a specific health benefit (Bultosa, 2016; Ashwell, 2002) [1].

The concept of „functional food" is originated in the early 1980s in Japan and further being developed in the United States and Europe (Siro, 2008)[3].

There are several categories of functional foods:

- natural foods in which one of the components has been naturally enhanced through special growing conditions;
- foods to which a component has been added to provide benefits (e.g. the addition of selected probiotic bacteria with proven health benefit characteristics to improve gut health);
- foods from which a component has been removed so that the food has less adverse health effects (e.g. the reduction of saturated fatty acids, reduction of sugars);
- foods in which the nature of one or more components has been chemically modified to improve health (e.g. the hydrolyzed protein in infant formulas to reduce the likelihood of allergenicity);
- foods in which the bioavailability of one or more components has been increased to provide greater absorption of a beneficial component;
- and any combination of the above possibilities.

Several important functions of human physiology are influenced by functional foods (Ashwell, 2002; Wu et al., 2017; Green et al., 2020)[2]:

• Early development and growth;

•Regulation of basic metabolic processes (energy balance and obesity, diabetes, insulin resistance syndrome);

• Defence against oxidative stress;

• Cardiovascular physiology (lowering the blood pressure, blood lipids, homocysteine levels);

• Gastrointestinal physiology (promoting gut health);

• Cognitive and mental performance, including mood and alertness;

• Physical performance and fitness.

1.2 Cereals and cereal derivatives – nutritional values , consumption recommendations,

Cereal derivatives are basic aliments for the whole world population and represent an important nutrients source. They assure 30-50% of the energetic values of the human body through their large content of carbohydrates and proteins. Along these important macronutrients, these alimentary products represent a good source of micronutrients (vitamins and minerals), alimentary fibers, polyphenols and phytosterols.

In the technological process, by eliminating the exterior layer of the cereal grains, an important part of the nutritive substances contained is eliminated, therefore the health benefit of the processed products (ultra-processed) is more reduced.

From a nutritive point of view, cereal derivatives distinguish themselves through:

a) **Important carbohydrate content**

Digestible carbohydrates vary between 40 and 78% (40% in black bread, 50% in brown bread, 75-78% in wheat and cornmeal flour, 77% in rice). From these carbohydrates the starch is best represented, found in 95-98%, the rest are carbohydrates with small molecules (monosaccharides and disaccharides) with an important role in alcohol fermentation.

Indigestible carbohydrates are represented especially by cellulose, pentosanes, lignin. They are found in the peel of the beads. This is why, if the product is too processed (decorticated or with few brans), most fibers disappear. In white bread, the quantity of fibers can be of 2-6 times lower than in whole wheat bread. In oats and barley important quantities of soluble fibers called beta-glucans can be found. These fibers are known for their antiatherogenic effect having the role of reducing cholesterol absorption.

b) **Proteins source**

Proteins from cereal derivatives have a nutritional value lower than animal proteins because they contain limiting aminoacids (lysine) or they do not contain all the essential aminoacids, as in the case of corn (zein, the main protein in corn is poor in tryptophane, isoleucine, lizin and valine) (Li et al, 2016) [6]

In cereal grains, proteins are especially found in the aleuronic layer and in sprouts. From this reason, the processing will also cause the reduction of proteins, in white flour we find 10,33% compared to 13,7 % in whole wheat bread (USDA Food Composition Data).

c) **Cereal lipids** are concentrated in the embryo (therefore they are found in smaller quantities) and are represented by unsaturated fat acids (oleic, linoleic and linolenic) with antiatherogenic effect. Lipids can be especially found in corn sprouts. In sprout oil large quantities of vitamin E can be also found.

d) Mineral elements are concentrated in the peel and are represented by potassium and phosphorus. Phosphorus can be found in approximately 70% (in the complete bead). Calcium is almost inexistent. Sodium is found in reduced quantities. They also contain some oligo elements such as Cu, Zn, Mn, etc. Cereal can bring a substantial infusion in assuring the mineral balance.

Phosphorus is present in cereal derivatives as salt of phytic acid (myo-inozitol-hexaphosphate); phytic acid reacts with divalent cations (calcium, zinc, iron) to form insoluble salts, therefore reducing their absorption (Couzy F et al,1998) [8]. The greatest part of the phytic acid is found in the peel and in the embryo, so the greater the percent of bran in the flour, the richer it is in phytates. In bread manufacturing the phytates content decreases because of the action of the phytase in the flour, which becomes active under the influence of warmth and dampness.

Cereal derivatives are acidifying elements.

e) **Vitamins**

The peel and the aleuronic layer are rich in the vitamin complex B except vitamin B_{12} (cyanocobalamin), practically having no vitamin C, vitamin A and vitamin D.

The scutellum is the richest tissue in nature in vitamin B_1 (thiamine), and the sprout is rich in vitamin E, representing the main source of vitamin B_1 for a great part of the population.

Consumption recommendations

Cereals assure 30-50% of the caloric needs of the body through their high content of carbohydrates and proteins. White flour and bread have fewer proteins, vitamins and minerals, but digestion and absorption coefficient are better.

Because cereal proteins do not have a great biological value, it is indicated for the daily ratio not to be exaggerated. Pregnant women and children can take from cereals maximum 20-30% of daily calories, and an active adult, maximum 50-60%.

Whole wheat bread has a large content of fibers, but also proteins and especially thiamine (vitamin B1) and tocopherols (Piironen, V et al, 2009 [13], Bucsella, B.et al, 2016[14]). It is recommended for inactive people, with obesity, dyslipidemia, constipation. Although many people consider whole wheat bread to have fewer calories than the cereal derivatives, the calories from whole wheat bread are almost equal to those from white bread. Therefore overweight and obese people must not abuse, even though it is true that the fibers, found in a greater quantity in whole wheat bread, reduce the degree of digestive use of bread caloric principles.

Brown bread, with a medium level of fibers and a great content of vitamins, is considered the bread which should be normally consumed by teenagers and adults (Andersson, A.A.M. et al, 2013)[15].

White bread, with no fibers, but also vitamins, is considered the "diet" bread; therefore it is indicated to people with various digestive diseases. It is recommended for those with gastritis, ulcer, enteritis, colitis; they should consume one day old white bread, without irritating fibers for digestive mucosa (Costin GM et al, 1999)[16].

1.3 The role of cereals in maintaining and promoting health (Poutanen,K et.al.[29], 2014; Thies,F, 2017[30]; Vetrani, C et.al, 2016[31])

Some of the most important advantages of cereal consumption are:

1. They represent the most important source of energy and carbohydrates covering 30-50% of the caloric need. Cereal carbohydrates have starch as main representative, they are preferred to sugar products which contain simple carbohydrates.
2. Indigestible carbohydrates represent a sub layer for the development of intestinal microbiota.
3. Indigestible carbohydrates such as cellulose, pentosanes and lignin, more numerous in black bread, stimulate the peristalsis and carry over a part of the intestine cholesterol; therefore it reduces the absorption coefficient of caloric substances being indicated in hipocaloric diets for overweight people.
4. White bread is recommended to children and pregnant women due to the lack of phytates excess.
5. White bread is also indicated to people with diseases with intolerance to fibrous material such as gastritis, gastric and duodenal ulcer, enterocolitis and hemorrhagic ulcerative colitis.
6. During cereals germination, phytohormones are synthetized, they are demonstrated that, within an atherogenic diet they have the ability to reduce the level of hypercholesterolemia and prevent atherosclerosis (Andersson, A.A.M. et al, 2014) [15].
7. Alimentary fibers brought in the diet by cereals have a proven role in preventing obesity, diabetes mellitus and metabolic syndrome (Karl, J.P.et al, 2014[11], Giacco, R et al, 2014)[12].
8. For people with a vegan diet, bread is an important source of protein and vitamin B1 (especially wholemeal bread).

1.4.The role of dietary fiber in the diet

Numerous epidemiological studies have highlighted the important role of diet in maintaining health and preventing chronic non-communicable diseases such as cardiovascular disease, type

2 diabetes, obesity and cancer. among the dietary factors, dietary fiber plays a particularly important role.

According to the Global burden of disease study in 2017, diet is an important risk factor for the occurrence of chronic non-communicable diseases, being attributed to 20% of deaths (GBD 2017 Risk Factor Collaborators, 2018)[17]. The results of the study show that, in general, the diet is poor in vegetables, fruits, legumes, whole grains, these being the main sources of dietary fiber.

Dietary fiber is a non-digestible form of carbohydrates, due to the lack of the digestive enzyme in humans required to digest fiber.

The beneficial effects of dietary fibers consumption have been highlighted since the second half of the twentieth century by Ebsen Hipsley (1953), Burkitt and Trowell (1970) (Kendall et al, 2010)[18].

The Institute of Medicine of U.S.A classified fiber in 2002 as follows (Position of the American Dietetic Association, 2008):

- dietary fibers represented by indigestible carbohydrates (non-starch polysaccharides - NPS) and lignin, which are found intact in plants. These include wheat and oat bran.

- functional fibers are isolated indigestible carbohydrates, which have physiological effects in the human body (resistant starch and fructooligosaccharides).

Depending on the solubility in water, dietary fibers can be classified into soluble (pectins, gums, mucilages, soluble polysaccharides, β-glucans, algae polysaccharides, bacterial polysaccharides, fructo-polysaccharides - inulin, fructo-oligosaccharides - oligofructose, resistant starch) and insoluble (cellulose, hemicelluloses, lignin) (Fernandez-Banares et al, 2006[20], Gidley et al, 2018[21]). Solubility is an important property of dietary fibers imprints their physiological and systemic effects.

Soluble fibers have been shown to lower blood cholesterol by several mechanisms. Water-insoluble fibers have rapid gastric emptying, and as such may decrease the intestinal transit time and increase fecal bulk, thus promoting digestive regularity. In addition to dietary fiber, functional fiber have been shown to induce beneficial health effects when added to food during processing (Ghada A. Soliman, 2019)[22].

In the intestinal tract, dietary fibers play a number of functional roles in digestion and absorption, motility, colonic microbiota and immunity, all of which contribute to the systemic effects of these food components.

Dietary fiber metabolism and their physiological effects (Nitescu M si colab, 2019)

Indigestible carbohydrates are not degraded in the body, they give volume and consistency to the fecal bowl, thus regulating intestinal peristalsis. Dietary fiber components are by definition resistant to hydrolysis and absorption in the small intestine. They cross the upper gastrointestinal tract and enter the colon unchanged [Nedelescu M et al, 2017)[23].

In the digestive tract, dietary fiber has many effects, depending on their physical and functional properties.

Effects of dietary fiber on digestion and absorption

Water-soluble dietary fibers delay the emptying of the stomach and increase the viscosity of the intraluminal content, causing a decrease in the rate of absorption of nutrients (glucose, fatty acids, cholesterol), being used for the prophylaxis and treatment of obesity or dyslipidemia (Brownlee, I.A., 2011)[24]. In addition, low postprandial glucose uptake results in a reduced insulin response, so the ability of the pancreas to maintain glucose homeostasis is not altered. It has been shown that the effect on carbohydrate metabolism does not depend on the total amount of fiber ingested, but on their cellular structure (Goff, H.D.et al, 2018)[25].

Glucans and pectin, for example, can alter the blood glucose response and total cholesterol and LDL cholesterol levels by interfering with the digestion and absorption of glycemic carbohydrates and cholesterol and / or bile acids, respectively (Chater, P.I.et al, 2015)[26].

Inhibitory effects on the absorption of minerals, ie iron, zinc and calcium, have been attributed to complexing compounds associated with fiber, especially phytic acid from cereals, dried legumes and seeds (Brownlee, I.A., 2014)[27].

Effects of dietary fiber on intestinal motility

Some dietary fiber, generally insoluble, provides the effect of loading the intestinal lumen, increasing the mass of the fecal bowl, alleviating constipation and improving the regularity of stools. The increased weight of the stool is due to the physical presence of dietary fibers, as well as the water retained inside the fibrous matrix. In addition, the muscles of the digestive

tract are stimulated, with favorable effects not only for constipation, but also for other diseases (hemorrhoids, colonic diverticulosis)(Gill, S.et al, 2018)[28]

Effects of dietary fiber on colonic microbiota

The very diverse and numerous microbiota in the colon ferments unabsorbed carbohydrates, ie dietary fibers that have resisted digestive enzymes in the small intestine (mainly resistant starch), turning them into short-chain fatty acids: acetic, propionic and butyric acid, but also into by-products. such as hydrogen, carbon dioxide and methane.

These short-chain fatty acids are a source of energy for colonic mucosa cells and play many roles in maintaining colonic mucosal integrity and metabolic health.

Fermentable components in dietary fiber, including oligosaccharides often referred to as "prebiotics," increase the population of Bifidobacteria and Lactobacilli that produce short-chain fatty acids

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CHAPTER 2. TYPES OF FUNCTIONAL BAKERY PRODUCTS

The primary role of diet is to provide sufficient nutrients to meet the nutritional requirements of an individual. There is now increasing scientific evidence to support the hypothesis that some foods and food components have beneficial physiological and psychological effects over and above the provision of the basic nutrients.

Today, nutrition science has moved on from the classical concepts of avoiding nutrient deficiencies and basic nutritional adequacy to the concept of "positive" or "optimal" nutrition. The research focus has shifted more to the identification of biologically active components in foods that have the potential to optimize physical and mental well being and which may also reduce the risk of disease. Many traditional food products including fruits, vegetables, soya, whole grains and milk have been found to contain components with potential health benefits. In addition to these foods, new foods are being developed to enhance or incorporate these beneficial components for their health benefits or desirable physiological effects.

The concept of functional foods was born in Japan. In the 1980s, health authorities in Japan recognized that an improved quality of life must accompany increasing life expectancy for the expanding number of elderly people in the population if health care costs were to be controlled. The concept of foods that were developed specifically to promote health or reduce the risk of disease was introduced.

Functional foods have not as yet been defined by legislation in Europe. Generally, they are considered as those foods which are intended to be consumed as part of the normal diet and that contain biologically active components which offer the potential of enhanced health or reduced risk of disease. Examples of functional foods include foods that contain specific minerals, vitamins, fatty acids or dietary fibre, foods with added biologically active substances such as phytochemicals or other antioxidants and probiotics that have live beneficial cultures.

As interest in this category of foods has grown, new products have appeared and interest has turned to the development of standards and guidelines for the development and promotion of such foods.

Consumer interest in the relationship between diet and health has increased substantially in Europe. There is much greater recognition today that people can help themselves and their families to reduce the risk of illness and disease and to maintain their state of health and well being through a healthy lifestyle, including the diet. Ongoing support for the important role of foods such as fruits and vegetables and wholegrain cereals in disease prevention and the latest research on dietary antioxidants and combinations of protective substances in plants has helped to provide the impetus for further developments in the functional food market in Europe.

Functional foods include :

• **conventional foods** (whole grains): fruits, vegetables, nuts, hazelnuts, dark chocolate, yogurts

• **modified foods**: fortified (iodized salt, added orange juice); enriched (bread enriched with folate); with intensifiers (nutrient bars, yogurts, tea, foods with bioactive ingredients such as lutein, fish oils, ginko biloba)

• **medical foods**: products intended for enteral nutrition under medical supervision, used for the nutritional approach specific to a disease (eg products without phenylalanine for patients with phenylketonuria)

• **foods for special diets**: preparations for children, for weight loss, gluten-free (for celiac disease) or lactose-free (for those with lactose intolerance) (1,4)

1. Among these concepts, 'technological processes' refer to:

i) the development of functional foods by optimizing traditional food processing technologies, e.g. fortification of foods with dietary fiber;

ii) technologies designed to prevent the deterioration of active ingredients, e.g. microencapsulation;

iii) technologies aimed to design personalized functional foods, e.g. application of nutrigenomics; 3D food printing. To simplify, functional foods can be defined as modified food or food ingredients that can provide health benefits to the consumers beyond its basic nutrients.

Functional foods introduced into the market include for example beverages, dairy products, confectionery products, bakery products and breakfast cereals 2. The category of functional bakery products is newer and received increasing attention in scientific studies.

Bakery products are not only nutritious plant-based foods containing macronutrients (e.g. starch and dietary fibre) and micronutrients (e.g. antioxidants and minerals), the transportation and storage of bakery products is also less demanding compared to liquid-form products such as yoghurt. In addition, the worldwide consumption of baked goods on a daily basis makes these products interesting to serve as potential vehicles to deliver health-promoting ingredients to the human diet.

The main active ingredients supplemented to bakery goods include probiotics and prebiotics (dietary fibres), antioxidants and phenolic compounds.

Other functional ingredients are oils and lipids, minerals and salts, and vitamins.

Among these ingredients, probiotics and prebiotics are important in human nutrition because of their influences on the gastrointestinal (GI) microbiota. Probiotics are defined as 'live microorganisms which confer a health benefit on the host when administered in adequate amounts'

In case of bakery products, a series of functional food products including biscuits, cereal, cereal bars and beverages has launched in recent years. In the case of bakery product development, the main trends are:

- Allergen-free products,
- Enriched products,
- Products with reduced content (Szabó P. Balázs, 2017) [9]

In the development of functional bakery products (including bread), it is important to realize that achieving functional food quality does not simply involve delivering the active principle at the appropriate level for physiological effectiveness, but also supplying a product

which meets the consumer's requirements in terms of appearance, taste and texture (Alldrick, A. J., 2007)[1].

1. Allergen-free products

Allergens are all substances, products that cause an allergic reaction in our body. When manufacturing allergen-free bakery products, the amount of gluten as an allergen is reduced to the minimum available level. Gluten is a complex form of flour's water insoluble proteins, gliadin and glutenin. Product is defined as "gluten-free" in case the gluten content does not exceed 20 ppm or is called "gluten-reduced" for products with a gluten content not exceeding 100 ppm.

Allergenic baking products are mainly designed for the needs of gluten-sensitive or celiac consumers. In both cases, the symptoms are similar, but more severe in the case of celiac disease (https://glutenerzekeny.hu/akkor-mitol-puffadok-gabonaallergia-glutenerzekenyseg-coliakia/)[12]

. During the disease, small intestine is damaged, resulting in diarrhea, abdominal distension, weight loss, digestive and nutritional abnormalities. In the latter case, the disorder of absorption of fat-soluble vitamins, bone metabolism disorder, and anemia occur.

Gluten sensitivity, also known as gluten intolerance, often occurs after a digestive disorder, during which the permeability of the intestinal wall increases, so a certain amount of gluten is no longer tolerated (https://glutenerzekeny.hu/akkor-mitol-puffadok-gabonaallergia-glutenerzekenyseg-coliakia/) [12].

Gluten sensitivity can be treated with individualized gluten-free diet. Celiac disease, also known as gluten-sensitive enteropathy, is a multifactorial autoimmune response in which antibodies are produced against cereal gluten proteins and mainly involve gastrointestinal symptoms and nutrient absorption disorders (https://glutenerzekeny.hu/akkor-mitol-puffadok-gabonaallergia-glutenerzekenyseg-coliakia/) [12].

Celiac disease cannot be cured, but the intestinal flora can be remedied by specially tailored gluten-free diet to treat the symptoms.

In allergen-free baking products, wheat and rye flour are replaced by flour of soy, maize, rice and other grains (https://glutenerzekeny.hu/mit-ehet-es-mit-nem-egy-glutenerzekenyosszefoglalo-tablazat/) [13].

2. Enriched products

Enriched bakery products are, overall, functional foods that have proven beneficial health effects along with their basic nutritional effects. It is important during nutrition that the process does not affect the basic organoleptic properties of the product (Markovics E., 2007)[3].

For baked goods, basic nutrients (e.g. proteins, carbohydrates), auxiliary nutrients (e.g. vitamins, minerals), and accompanying substances (e.g. fibers) are added to the food to increase nutrition.

- **Vitamin-enriched products**

Vitamins are vital biological compounds that are essential for the body [6]. By vitamin enrichment, the amount of vitamins, essential to the human body in that food, is increased. For baking products, vitamins B, such as vitamins B1, B2, B3, B6 and B9 are added. B-complexes are most commonly used for this purpose (Markovics E., 2007)[3].

Determination the right dosage ratio for vitamin is a complicated task, due to the recommended daily value, stability of the vitamin, and the vitamin loss during storage. On the basis of practical experiences, it can be stated that these vitamins generally require a 10–20% additional dose that the product contains the intended quantity up to the shelf-life (Markovics E., 2007) [3]. The amount of added vitamin is generally low, so it is advisable to mix and disperse the dough with a carrier such as starch and sucrose. In the technology, it must be borne in mind that the vitamins are highly reactive and therefore unstable, furthermore certain vitamins have characteristic organoleptic properties and possibel side effects (Markovics E., 2007)[3].

- **Products enriched with minerals**

Minerals in our body promote the proper functioning of enzymes and stimuli transmission processes. Baking products are often enriched with minerals such as Fe, Ca and P. The essential amount of iron in human is small but evitable for hemoglobin, cytochrome, peroxidase and catalase enzymes (https://www.news-medical.net/health/What-is-Phenylketonuria-(PKU).aspx)[14]. The daily intake of Ca and P is 800 mg, which is the highest of the minerals (Markovics E., 2007) [3]. The Ca: P ratio is optimally 1: 2 (Fenyvessy J., Forgács J., 2000)[2]. The dosage levels of minerals apply to the same rules as for the enrichment with vitamins.

- **Protein-enriched products**

Proteins are our basic building materials, help to water catchment, nutrient transfer, participate in metabolic processes, and are important energy source (Markovics E., 2007)[3]. The appearance of protein-enriched products among bakery products is nowadays extremely fashionable and necessary.

Most of the plant-derived proteins are not complete because the amino acids essential to the human body are less or absent, so their exclusive consumption causes deficiency disease (Markovics E., 2007)[3]. To prevent this, more and more often, technological processes are used to complete the protein content of the products. Completion may be carried out with amino acid preparations or with natural proteins having a favorable amino acid set-up, most often preferring the latter (https://glutenerzekeny.hu/mit-ehet-es-mit-nem-egy-glutenerzekenyosszefoglalo-tablazat/)[13]. As a plant-derived supplementary additive, mainly different soy preparations are used, as it contains lysine and threonine.

Most commonly, milk protein is used as an animal supplement, but in other experiments, blood serum protein is also being dosed. The biological value of baking products can be further increased by using whole eggs in the product because the nutritional value determined on the basis of the protein content and the amino acid composition is the highest among all foods besides breast milk.

It should be noted that by increasing the content of the protein, the carbohydrate content is reduced.

- **Carbohydrate-enriched products**

Carbohydrates, including mono- and disaccharides, are an important source of energy for our body system due to their easy and fast digestibility (https://www.news-medical.net/health/What-is-Phenylketonuria-(PKU).aspx)[14]

The enrichment of bakery products with carbohydrates is of great importance in patient nutrition and in the feeding of phenylketonuric patients. During exercise, carbohydrates are source of rapid energy utilization. Phenylketonuria (PKU) is a genetically inherited disease in which phenylalanine, an essential amino acid dissociating phenylalanine hydroxylase enzyme, is absent, resulting in the amino acid accumulating in the blood and then in the brain, causing severe and often irreversible brain damage. (https://www.news-medical.net/health/What-is-Phenylketonuria-(PKU).aspx) [14]

. The disease currently has no cure, only further damage can be avoided. Because of brain damage due to disease, carbohydrate-enhanced foods have a higher glucose content in the brain's energy needs.

- **Fiber-enriched products**

Food fibers (e.g. cellulose, hemicellulose, pectin, and other stored polysaccharides) are complex, non-digestible carbohydrates. Digestion of cellulose in high fiber-content foods helps to intensify the intestinal movement, thereby reducing the time it takes to pass through the intestinal tract.

The fibers are useful in prevention of several diseases and abnormal conditions. The blood cholesterol levels might be reduced, blood glucose stabilized, and some fibers play significant role in colon cancer prevention, obesity and constipation. (https://www.news-medical.net/health/What-is-Phenylketonuria-(PKU).aspx) [14]

As a result, fiber intake is essential for the body in order to facilitate its normal operation. To support balanced nutrition, fiber-enriched products have appeared in the baking industry. Due to their high fiber content and their economics, apples and oats are used most often to increase fiber content. The technology must take into account that the use of dietary fibers affects the water absorption capacity of the dough.

3. Products with reduced content

Foods with reduced content are functional foods in which a quantitative reduction of substances with excessive intake has a detrimental effect on health. In the baking industry carbohydrate-reduced, salt-reduced or low-fat foods have appeared for this purpose.

- **Carbohydrate-reduced products**

- Carbohydrate-reduced products are favored primarily by consumers with carbohydrate metabolism problems, but dieters also prefer it.

The most severe form of carbohydrate metabolism disorder is diabetes, where we distinguish between type 1 and type 2. (https://cukorbetegseg-inzulin.hu/cukorbetegseg-fajtai)[10]
Insulin, produced by the pancreas in the body, helps integrate glucose units from the blood plasma into cells.
As blood glucose levels decrease, the release of insulin is also reduced. The normal range of blood glucose levels is provided by the liver. In the case of diabetes, this process does not

function properly, therefore the sugar accumulates in the blood. In the case of Type 1 diabetes, the pancreas does not produce enough insulin to maintain normal blood glucose levels, while Type 2 diabetes causes cells to become resistant to insulin. (https://cukorbetegseg-inzulin.hu/cukorbetegseg-fajtai)[10]

Type 1 is presumably due to genetic predisposition, so it cannot be cured and can only be treated.

By contrast, type 2 diabetes is triggered by some other disease and risk factors, thus it can be cured by resolving diabetes-causing health issues or reducing the risk factors (e.g. obesity). In the latter case, diabetes can be treated with an individualized diet, which limits and minimizes carbohydrate intake.

A carbohydrate-reduced product is considered to be a baking product if carbohydrate-content is lowered at least 30% (Markovics E., 2007)[3]. In practice, this is mostly achieved by protein filtration. For technology, it should be taken into account that the quantitative reduction of carbohydrates will have a techno-functional effect and the water absorption capacity of the dough will decrease. To remedy this, hydrocolloids are used in the industry, such as guar gum, locust bean flour.

- **Salt-reduced products**

Salt reduction has become a national program in Hungary today, with the main purpose of inhibition of excessive salt intake of the population, thus reducing the prevalence of hypertension in the population, thus the risk of stroke and heart attack https://www.ogyei.gov.hu/stop_so_nemzeti_socsokkento_program/ [11].

In reducing the sodium chloride content of bakery products, it should be taken into account that the salt has technofunctional properties and it will affect the structure of the dough.

- **Fat-reduced pastries**

Fats provide our body with energy and the essential chemical compounds to maintain the structure of the membranes, building materials for hormones and vitamins (Fenyvessy J., Forgács J., 2000)[2]. Excessive intake will accumulate in our body that can lead to obesity and its complications. To prevent this, today's fashionable fat-reduced products have appeared. In the baking industry, the manufacture of these kinds of products is still in the experimental stage.

2.1 Functional bakery products in Romania

According to Euromonitor International the market value of organic packed food products in Romania increased in the last years.

This evolution is due to the increasing concern for health in general and the incidence of conditions due to lifestyle, like cardiovascular diseases, obesity, osteoporosis and diabetes, all these determining consumers to orient in their daily diet to natural alternatives.

Also, this increasing was correlated to the growing number of retail shops that offer a large range of products, and that contributed to a larger visibility of this type of products.

In Romania, there are several types functional bakery products on the market of which we mention:

a) Allergen free products
b) Enriched products
c) Products with reduced content

a) Allergen free products

- ***gluten free products***

Examples

- Gluten free premix
- Gluten free biscuits
- Gluten free sponge cake with cocoa
- Gluten free sponge cake with candied fruits
- Gluten free sponge cake – simple
- Gluten free cookies with gem
- Gluten free cookies with nut
- Gluten free cookies with raisins
- Gluten free cookies – simple
- Gluten free pasta
- Gluten free croutons
- Gluten free crackers

• Gluten-free bread

- ✓ Gluten-free peasant bread
- ✓ Gluten free bread with flax and sesame
- ✓ Gluten-free bread with fiber

Gluten-free bread is rich in vegetable fiber due to the content of psyllium bran, ground flax seeds, sesame seeds, rice flour and millet. Fiber reduces the risk of diabetes, heart disease and cancer. Fiber bread keeps it from being satiated for a longer period of time after a meal, helping the intestinal transit, favorable in weight loss, relieves constipation.

Fiber supplements the amount of vitamins A, B, D, E, minerals Ca, Mg, Cu, Zn, Mn, folic acid, healthy fats. (Http://noglutensugar.ro/produs/woo-single-4/)[20].

- ✓ GLUTEN-FREE FLOUR BREAD - with seeds

Buckwheat flour, psyllium bran, potato starch, rice leaven, salt, sunflower seeds, sesame, flax and pumpkin. We do not use baking powder, yeast, baking soda, loosens, substances that are usually used in gluten-free flour breads to make them rise or bind the dough.

The composition is a pain for a special diet - gluten-free - but the nutritional benefits are for everyone. Gluten-free flours provide a good digestion of bread, without discomfort in the gastrointestinal system and without the risk of triggering allergies. Thanks to pork, MamaPan gluten-free bread behaves like a normal, non-crumbly bread, and the special taste of the flours used is complemented by that of consistent seeds (https://mamapan.ro/produs/paine-din-fainuri-fara-gluten/)[15].

- ✓ BREAD WITH RICE AND ALMOND FLOUR

Almond flour bread is low in carbohydrates and rich in nutrients. The biggest benefit of this pain is that it contains a high dose of vitamin E, which is a powerful antioxidant. Almond flour is low in sugar and high in protein, being much healthier than white flour bread.

Ingredients: wholemeal rice flour, almond flour, wholemeal rice leaven, potato starch, psyllium bran, 0.8% salt (https://mamapan.ro/produs/paine-cu-faina-de-orez-si- almonds / [16]

).

- ✓ BREAD WITH RICE AND HEMP FLOUR

Bread with rice flour and hemp is a "medicine" bread used to treat various ailments or in very strict diets. It is a bread with a bitter taste due to hemp, but also moist inside. Due to analgesic properties, hemp can be administered in severe gastric disorders, gastric ulcers, respiratory diseases - asthma, emphysema or chronic bronchitis https://mamapan.ro/produs/paine-cu-faina-de-orez-si-canepa/) [17]

- ***Hypoglucidic products***

Hypoglucidic bread –the controlled intake of carbohydrates and dietary fiber offered by this range is a real help in the diet of patients known to grade II diabetes but also for overweight people, without diabetes, who follow the diet.

- ***salt free products***

examples:

3 Salt free bread

4 ”Pufuleti” salt free

- ***products for fenilketonuria (PKU)***
- ***sugar free products***

b) Enriched products

5 **Rye bread** –- a trifunctional bread, in addition to cholesterol-lowering effect, has a high content of fiber, which helps to regulate intestinal transit and at the same time, has a low carbohydrate content making it suitable for persons who have diabetes.

6 Biscuits

- BISCUITS WITH CEREALS, RAISINS, ORANGE AND LEMON JUICE
- BISCUITS WITH CEREALS, RAISINS, APRICOTS AND APPLE
- BISCUITS WITH OAT
- BISCUITS WITH CINNAMON
- BISCUITS WITH RASPBERRY, COCONUT CRANBERRY

Flour: TOTAL GRIST DIET WHEAT FLOUR

2.2 Functional bakery products in Ireland

The current focus in the global functional foods market is in heart, bone, and gut health and immune system enhancement. There had been considerable innovation in the market but many market failures. Functional foods are complex products to develop, market and communicate.

Successful functional products need to fit into existing behaviour and lifestyles and satisfy food consumption drivers. A thorough new product development approach is required to consider consumer need target, selection of bioactive ingredient, consideration of processing factors, and sensory attributes.

There are also many issues regarding whether the consumers will recognise the association between the product category and the claimed functional benefits.

Functional food available on the EU market include those with added cholesterol lowering plant sterols and stanols, as well as those containing live bacteria (probiotics) that allegedly enhance the quality of the human gut microflora.

While functional food is rapidly emerging as a distinct food category it is still a ”virtual category” in terms of food law.

Functional food is not defined in EU or Irish food legislation and is regulated through existing food legislation.

Prior placing a new food on the EU market, specific authorization must be obtained through the process set out in the Novel Food Regulation (EC No. 258/97). The Regulation came into force on May 15, 1997 and defines novel food as ”foods and food ingredients which have not hitherto been used for human consumption to a significant degree within the Community”. (Functional Food Leaflet - EFSA Ireland)[20].

As examples of functional food products that can be found on the market in Ireland:

1) **Products with added fiber**

- Crackers with rye – savoury biscuits, crackers – high content of fibers
- Multigrain Rye Cakes – high content of fibers, low fat – benefits for immune system
- Carrot & Cumin Crackers – high content of fibers, reduced content of saturated fat
- Lightly Salted Rye Cakes – high content of fibers, reduced content of salt

2) **Products with reduced sugar content**

Irish Round Buttermilk Soda Bread

The product has reduced sugar content and high content of fibers.

2.3 Functional bakery products in Hungary

In the baking industry, continuous development of products is required because consumers with different nutritional needs are pushing for new requirements for foods. Along with the low caloric content, there is growing attention to the functional effects of foods. Foods for particular nutritional uses, as a result of their special composition and the special procedure used to product them, meet the specified nutritional purposes.

In Hungary, the available gluten-free products are belonging to brands Schär, Gullon, Balviten, Cornito, Éden and Mester. The available foods are shortcakes, breads, bread roll, crescent roll, wafer and cookies. Several of them offer in chain stores, such as Aldi, Lidl, Auchan and Tesco.

There are bakeries affording their products nationwide, e.g. Lipóti, Ceres, Félegyházi. Among their products mainly whole grain bakery products (bread, raised products) can be found.

Gluten-free bakery products

"Enjoy free" product line

- Gluten-free flat bread
- Toast bread (sliced)
- White bread
- White bread roll
- Mini potcake
- Chocolatey cocoa swirl

"Free from" product line

- Sliced bread (multi grain and white bread)
- Wafer
- Snack with wood garlic or cheese

- Milk chocolate digestive biscuits
- Dark choclate ginger
- Triple chocolate cookies
- Cookies
- Biscuit with cocoa and cream
- Digestive biscuits

2.4 Types of functional products in Italy

Functional baked products produced in Italy includes:

- Gluten-Free products (which must be notified to the Ministry of Health) for people with celiac disease. (Gobbetti et al., 2018)[6]. Up to now, most of the research available to produce gluten-free bread is based on substituting wheat flour with flours obtained from gluten-free cereals. Recently patented protocols based on fermentation have been developed by a private company (Giuliani) supported by University research to produce gluten free bread from wheat flour (Patents No. **9560854 B2** and No. **10240139B2**) which led to a marketable wheat flour-based bread for people suffering coeliac disease (https://giulianipharma.com/en/product/giusto).
- High-fiber products with a low glycemic index, rich in fibers (thus helping to reach the recommended daily intake of fibers to maintain a normal bowel activity within a varied diet). (Gobbetti et al., 2019)[5].
- Protein-Free products for people suffering Chronic Kidney Failure, a condition that leads to a gradual reduction of renal function. The disease complications can be avoided by following a low-protein diet.

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CHAPTER 3. NEWLY DEVELOPED FUNCTIONAL BAKERY PRODUCTS DEPENDING ON THE DIGESTIVE DISORDERS

3.1 Functional bakery products for digestive disorders

➢ **Celiac disease (gluten intolerance or gluten enteropathy)** is a chronic digestive disease caused by gluten ingestion, which prevents the absorption of nutrients, vitamins and minerals by the intestine. [Sugai, 2006].

In people with celiac disease, gluten ingestion causes an abnormal immune response in the small intestine. This reaction not only destroys gluten, as if it is dangerous to the body, but also attacks the lining of the small intestinal mucosa. Inflammatory substances end up destroying the intestinal villi, which allow the nutrients absorption. Thus, despite a healthy diet, people with celiac disease suffer from malnutrition.

Injuries to the small intestine affect the normal absorption of nutrients, especially fats, calcium, iron and folate (malabsorption syndrome). Celiac disease is also called celiac sprue, gluten

sensitive enteropathy, gluten enteropathy or non-tropical sprue. Although celiac disease cannot be prevented, a gluten-free diet can prevent the appearance and evolution of intestinal lesions. Celiac disease is the most common genetic disease in Europe. It is estimated that more than 1 million Europeans suffer from this condition.

Due to the fact that the symptoms of the disease can appear even in the traces of gluten in food, people diagnosed with gluten intolerance must give up everything that means bread, pasta, semolina, biscuits, snacks, chips.

- **Gastroesophageal reflux**

Whole-wheat products made by using at least 60% wholemeal flour (wheat, rye or spelled) and up to 40% other wheat, rye or spelled meal (typically flour) according to the Hungarian Food Book. If used as a carrier, other types of flour are acceptable too up to a maximum of 1%. The technology can be implemented by using a sourdough or sourdough substitute (dough making, shaping, proofing, baking).

Bran bread is made by using at least 10 kg of table bran made from cereals or the corresponding legumes per 100 kg of total flour. The starch content of the table bran used must not exceed 15% of the dry matter content, as required. In the case of table bran with a higher starch content, the application rate must be adjusted. The technology using a sourdough or a sourdough-replacement composition can be used at here, too.

Graham bread is made by using at least 90% wheat Graham flour and up to 10% other wheat or rye meal (typically flour).

Increasing fiber content: Apples, peas and oats are most often used ingredients to increase the fiber content because they have high fiber content and they are economical. During the technology we should take into account that dietary fibers affect the water absorption capacity of the dough.

Fortification with vitamin: The amount of vitamin to be added is usually small, so it is advisable to mix it with a carrier such as starch or sucrose before mixing it into the dough. During the technology must take into account that vitamins are extremely unstable substances due to their high reactivity.

Among the **low-fat pastries**, pastries made of water-based and milk-based dough are recommended.

➢ **Celiac disease**

Gluten is an elastic and viscous protein mass that can be found in most cereals. Responsible for leavening of bread and other bakery products, gluten serves as a food binder. Gluten is found in the grains of many cereals, including wheat, barley, oats and rye.

The diet is the only treatment for celiac disease. Even if the principle of the regime seems simple, it is not easy to put into practice.

All over the world, cereals are the basis of the diet, and the exclusion of bread, pastries, semolina and sweets is difficult, especially for children.

Due to the fact that the symptoms of the disease can appear even in the traces of gluten in food, people diagnosed with gluten intolerance must give up everything that means bread, pasta, semolina, biscuits, snacks, and chips.

Cereal products and flour foods for this segment of the population are obtained from cereals whose proteins are not gluten-generating, especially from millet, corn and rice. The patients can also eat potatoes. Especially for this people, can be found gluten-free products in the markets [Stanescu, 2006][1].

Other gluten-free products:

- gluten-free pasta obtained from rice flour mixed with maize flour;
- gluten-free biscuits obtained from rice flour with addition of fruit.

Noncompliance to diet has long-term dramatic consequences.

In addition to growth disorders, malnutrition, risk of osteoporosis, noncompliance to gluten-free diet can cause infertility, lymphoma and small bowel adenocarcinoma over time. Unfortunately, there are many situations in which non-compliance of the regime can be fatal to the patient [www.fara-gluten.ro][23].

Without gluten the baked products have low nutritional value, low volume, bad texture, bland flavor and lower shelf life. Hence, formulation of high -quality gluten free baked products is technological task.

“The Codex Alimentarius”, in nexus with WHO and FAO, redefined gluten free food as “A dietary food stuff made from one or more ingredients but which does not contain more than 20 ppm (20 mg / kg) in total gluten based on the food as sold or distributed to the consumer of ingredients from any member of the wheat (triticum) family, rye, barley or their cross breeds”.

Gluten-free: A product is called gluten-free if its gluten content does not exceed 20 ppm or it is called gluten-reduced for products with a gluten content exceeding 100 ppm. In allergen-free baking products the wheat and rye flour are replaced by soy, maize, rice and other grains flour.

In the manufacture of these products, it is important to achieve an appearance (i.e. shape, volume and intestinal properties) similar to that of gluten-containing products.

Use of oily seeds: Bread made with oil seeds consists of at least 8 kg of oily seeds in the name of the bread per 100 kg of total flour. The technology using a sourdough or a sourdough -replacement composition can be used at here too. After the dough making, the production process is the normal (shaping, proofing, baking).

High fat products: Such products are puff pastries and pastries made of friable dough friable which have at least 20% fat content. Pastries made of friable dough are typically solid, inflexible, friable breaking fine bakery products. Examples of such products are the Bratislava crescent roll, the cottage cheese pie, the buttered scone, and the scone made with greaves. Puff pastries can be salty or sweet flavoured for example cocoa roll, ragged crescent and Tyrolean cherry strudel.

Olive oil and sun flower oil are used in bakery products as a dough improver. It was observed that addition of these two shortenings decreased the water absorption, viscosity and storage module of dough and has health benefits.

- **Ulcerative colitis**

Low fat products:

Matzo: Matzo is thin, perforated bread dough made using only water and wheat flour. The technology is a short-term process that requires a great deal of attention, during which the goal is to avoid the occurrence of various fermentation and other processes in the dough. Manufacturing process: we make dough out of the wheat flour and water, and then we immediately form it into balls, which we stretch. We punch the prepared sheets with a knife in several places. The sheets thus prepared are baked in an oven preheated to 220 °C for 2-3 minutes. The whole technology takes 16-18 minutes.

- **Indigestion**

Low fat pastries: Such products are pastries made of water-based and milk-based dough. Pastries made of water-based dough are made from cereal grains, yeast, salt, water and, where appropriate, food additives and other ingredients by dough making, shaping, fermentation and baking (CAH 1-3/16-1). This type of dough does not contain any additive that is why a loose structure characterizes these products. Watery buns are typically made from water-based dough. Pastries made of milk-based dough are made from cereal grains, yeast, salt, at least 3% skimmed

milk powder or equivalent type of milk powder, and milk, edible fat, sugar, water, and where appropriate, food additives and other ingredients by dough making, shaping, fermentation and baking (CAH 1-3/16-1). The milky crescent, the Kaiser Roll and challah are typically made of milk-based dough.

Artificial sweeteners: The case of carbohydrate reduction is when, instead of classic carbohydrate reduction (using hydrocolloids, replacement of flour), the added sugar in the products is replaced. The placing on the market of these products requires an official permit. More popular products use sorbitol or the replacement of bigger part of the wheat flour with gluten-free flour for reducing carbohydrate content. When using sugar substitutes, it is a problem that they do not participate in Maillard reactions, and it can be difficult to reach the right sweet taste. For these products, caramelization (skin coloring) and flavor formation must be addressed in a different way. This means, that most of the intense and bulk sweeteners differ from the characteristic taste profile of sucrose, thus often causing off-flavors in the product. Such substances are sugar alcohols, which, due to their hygroscopic properties, reduce the water activity of the products, furthermore soften and moisturize the dough. In the baking industry, attempts are being made to use the sorbitol, the mannitol and xylitol, as well as lactitol, which one of the sugar alcohols that is not hygroscopic.

Natural sweeteners that can be used in the baking industry are beet sugar (sucrose), fruit sugar (glucose), grape sugar (fructose), malt sugar (maltose), invert sugar (a mixture of glucose and fructose), milk sugar (lactose), and starch syrup and honey. Also included are the glycyrrhizin, which is an extract of licorice root.

- **Ulcers**

The **white bread** is made of 100% white wheat bread flour (BL80) by technology using a sourdough or a sourdough replacement composition with dough making, shaping, proofing and baking. The **semi-brown bread** is made by using 85% half-white wheat bread flour (BL112) and 15% light rye flour (RL90). For both products, it is important that the maximum salt content could be 2.35% (m/m), the formal ratio could not be more than 2.2, and they must have a shiny, crunchy crust and a soft and elastic structure.

Of the **biscuits**, household biscuits are typically low-fat products. The quality of the flour is important in these products, they made of biscuit flour, which is a special purpose flour, which results in a weaker structure due to its low gluten content. During the technology, after dissolution and emulsification, the suspension is prepared in two phases: intensive kneading

takes place with 50% of the flour used in the first phase and then with all the flour in the second phase. This is followed by a special shaping, then baking and finally cooling.

Different fats improve the structure of the dough by improve flexibility and inhibit the activities of enzymes and yeast cells. Coating the starch granules, they reduce the aging of the product (retrogradation). The consistency of fats in the technology is important because liquid fats inhibit the water absorption capacity of the flour granules, thereby negatively affecting dough formation.

- **Irritable bowel syndrome**

Among the artificial sweeteners, the use of acesulfate-K and sucralose may be considered because they are heat-stable, as opposed to aspartame and saccharin, which is the latter, will have a bitter taste when exposed to heat. According to some experiments, the negative aftertaste of saccharin in bakery products may be masked by cyclamates.

In addition, sugar alcohols are heat stable, do not brown on heat treatment, and they are similar in volume and weight to sugar, which make them being excellent substitutes. When using them, the specifics of each sugar alcohol, such as cooling effect and digestive effect, should be taken into account when determining the dosage amount.

Of the natural sweeteners, the greatest potential lies in the use of taumin because it is sufficiently heat-stable to withstand the baking temperature.

Its negative effect on the formation of the dough is manifested in the fact that they prevent water absorption by surrounding the flour granules, thus inhibiting the formation of the gluten web. Liquid fats useful in such baking include olive oil, soybean oil, sunflower oil and rapeseed oil.

3.2 Newly developed functional bakery products produced in present depending on the digestive disorders

- **GLUTEN FREE BREAD BASED ON RICE, MILLET, FLOUR AND MIX OF SEEDS**

Product description: Gluten free bread based on rice flour, millet, flax and seed mix is an assortment of bread that is part of the range of gluten-free products, intended for people suffering from celiac disease, but also for those who want to adopt a healthy lifestyle.

Raw and auxiliary materials: Millet flour, rice flour, flax flour, xanthan gum, dry yeast, sea salt, cane sugar, olive oil, flax seeds, chia seeds, sunflower seeds.

(https://www.usab--tm.ro/utilizatori/tpa/file/student%20fest/2019/catalog%20student%20fest%202018%20final.pdf) [18]

- **GLUTEN FREE MUFFINS WITH RICE FLOUR, ALMONDS AND BLUEBERRIES**

Product description:

Gluten free muffins with almond and blueberry flour are included in the wide range of products specially designed for people with gluten intolerance, for diabetics, but can be eaten just as well by all those who want to adopt a healthy and balanced diet from a nutritional point of view.

Raw and auxiliary materials: Almond flour, rice flour, blueberries, maple syrup, almond oil, eggs, baking powder, starch.

(https://www.usab--tm.ro/utilizatori/tpa/file/student%20fest/2019/catalog%20student%20fest%202018%20final.pdf) [18]

- **GLUTEN FREE MUFFINS WITH RICE AND QUINOA FLOUR, WITH ADDATION OF SWEET POTATO, SPINACH AND BEET**

Product description:

Gluten free muffins made from rice and quinoa flour with the addition of sweet potato puree, spinach and beets are gluten-free pastries obtained from the desire to be consumed by as many people as possible: from people who are forced to excludes gluten from the diet and young children (who are more sensitive to food allergens), up to people who want to adopt a nutritionally balanced lifestyle.

Raw and auxiliary materials: rice flour, quinoa flour, coconut oil, agave syrup, eggs, baking powder, sweet potato puree, spinach puree, beet puree.

https://www.usab--tm.ro/utilizatori/tpa/file/student%20fest/2019/catalog%20student%20fest%202018%20final.pdf [19]

- **GLUTEN FREE DESERT BASED ON FLAX FLOUR, OATS AND RICE, WITH BANANA AND CRANBERRY PUREE.**

Product description:

The gluten-free diet is currently the only effective therapy that guarantees celiacs a perfect state of digestive health, characterized by the disappearance of clinical symptoms, normalization of test results and restoration of the normal structure of the intestinal mucosa membrane.

Raw and auxiliary materials: rice flour, oatmeal, flaxseed meal, carob powder, unrefined raw sugar, bananas, cranberries, coconut oil, soy milk, eggs, baking powder.

https://www.usab--tm.ro/utilizatori/tpa/file/student%20fest/2019/catalog%20student%20fest%202018%20final.pdf [19]

- **GLUTEN FREE COOKIES BASED ON ALMOND FLOUR AND RICE FLOUR**

Product description

Gluten free biscuits based on almond flour and rice flour are a filling and healthy dessert that anyone can eat. These biscuits have a low caloric content and are recommended in the diet of people suffering from celiac disease also called gluten intolerance.

Raw and auxiliary materials: almond flour, rice flour, butter, egg, stevia sweetener, coconut oil, baking powder, cranberries

https://www.usab-tm.ro/utilizatori/tpa/file/student%20fest/2017/catalog%20student%20fest%202017.pdf [22]

- **GLUTEN-FREE BREAD**

Product description:

Gluten-free bread is a natural product obtained from 100% natural ingredients, has a well-formed crust, dense core, slightly moist.

Ingredients: rice flour, corn flour, buckwheat flour, corn starch, psyllium bran, yeast, salt, water.

https://www.gustusor.ro/paine/p%C3%A2ine-%C8%9B%C4%83r%C4%83neasc%C4%83-f%C4%83r%C4%83-gluten.html) [17]

- **GLUTEN-FREE BREAD WITH FLAX AND SESAME**

Product description: Gluten-free bread with quinoa and tartar flour has superior nutritional qualities, and flax and sesame seeds increase the intake of minerals in the body.

Ingredients: quinoa flour, tartar flour, rice flour, flax and sesame seeds, tapioca and corn starch, xanthan gum, yeast, sunflower oil, himalaya salt, water.

http://noglutensugar.ro/produs/paine-fara-gluten-proaspata-cu-in-si-susan) [11]

- **GLUTEN-FREE BREAD WITH FIBER**

Product description:

Gluten-free bread is rich in vegetable fiber due to the content of psyllium bran, ground flax seeds, sesame seeds, rice flour and millet. Fiber reduces the risk of diabetes, heart disease and cancer. Fiber bread maintains the feeling of satiety for a longer period of time after meals, helping the intestinal transit, favorable in weight loss, relieves constipation.

Fiber supplements the amount of vitamins A, B, D, E, minerals Ca, Mg, Cu, Zn, Mn, folic acid, healthy fats.

Ingredients: rice flour, millet flour, ground flax seeds, sesame seeds, psyllium bran, yeast, sunflower oil, Himalayan salt, water.

http://noglutensugar.ro/produs/woo-single-4/) [12]

- **GLUTEN-FREE FLOUR BREAD - with seeds**

Product description:

Buckwheat flour, psyllium bran, potato starch, rice leaven, salt, sunflower seeds, sesame, flax and pumpkin. We do not use baking powder, yeast, baking soda, loosens, substances that are usually used in gluten-free flour breads to make them rise or bind the dough.

Ingredients: whole rice leaven, whole buckwheat flour, potato starch, psyllium bran, salt, flax seeds, sunflower seeds, pumpkin seeds, white sesame seeds.

https://mamapan.ro/produs/paine-din-fainuri-fara-gluten/) [16]

- **BREAD WITH RICE AND ALMOND FLOUR**

Product description:

Almond flour bread is low in carbohydrates and rich in nutrients. The biggest benefit of this bread is that it contains a high dose of vitamin E, which is a powerful antioxidant. Almond flour is low in sugar and rich in protein, being much healthier than white flour bread.

Ingredients: wholemeal rice flour, almond flour, wholemeal rice leaven, potato starch, psyllium bran, 0.8% salt.

https://mamapan.ro/produs/paine-cu-faina-de-orez-si-migdale/) [15]

- **BREAD WITH RICE AND HEMP FLOUR**

Bread with rice flour and hemp is a "medicine" bread used to treat various ailments or in very strict diets. It is a bread with a bitter taste due to hemp, but also moist inside.

Due to its analgesic properties, hemp can be administered in severe gastric disorders, gastric ulcers, respiratory diseases - asthma, emphysema or chronic bronchitis Ingredients: brown rice flour, brown rice leaven, hemp flour, potato starch, bran of psyllium, salt.

https://mamapan.ro/produs/paine-cu-faina-de-orez-si-canepa/) [14]

- **GLUTEN-FREE CRISPY BREAD**

Product description:

Gluten-free crispy bread is a bread substitute. Due to the high content of fiber, vitamins, minerals and other beneficial substances, it is ideal for diets or as part of a healthy lifestyle. This type of bread was originally made from wholemeal rye flour, salt and water

Ingredients: Potato starch, rice flour, amaranth flour, rapeseed oil, cane fiber, lactose-free skimmed milk powder, sugar syrup, sugar, dry rice yeast (rice flour, water), emulsifier: mono- and fatty acid diglycerides; yeast, table salt, thickener: guar gum; fennel, anise, cumin.

https://gymbeam.ro/paine-crocanta-fara-gluten-wasa.html?gclid=Cj0KCQjwtZH7BRDzARIsAGjbK2YbnVsx_ZI0kuo_upyhBguOgYH4J8_OlCeIZTHlQuf5Jp_lusllHRgaAjdbEALw_wcB#36169) [13]

- **GLUTEN-FREE EXTRUDED BREAD WITH PUMPKIN**

Ingredients: cornmeal (37%), pumpkin cream (18%), vegetable oil (palm, shea), whey powder, maltodextrin, millet (8%), cheese,, buckwheat flour (1%), salt, soy lecithin.

http://noglutensugar.ro/produs/paine-extrudata-fara-gluten-cu-crema-de-dovleac-abonett-26g/) [10]

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CHAPTER 4. MANUFACTURING TECHNOLOGY FOR BAKERY PRODUCTS WITH ADDED SOLUBLE FIBER

Traditionally, fibre are chemical components, such as cellulose, hemicellulose, pectin, and lignin. Currently the many countries relies on an 'analytical approach' to determine what is or is not considered fibre for purposes of listing fibre content on food labels (Weibiao Zhou, Y. H. Hui.2014) [16].

Dietary Fibre, according to Codex Alimentarius Commission (ALINORM 09/32/A from2009)[18], means carbohydrate polymers with ten or more monomeric units, which are not hydrolysed by the endogenous enzymes in the small intestine of humans.

Dietary fibres can be categorized into three groups, **insoluble dietary fibre, soluble dietary fibre and resistant starch**. Soluble dietary fibre has been widely used as thickener, emulsifier, stabiliser, fat replacer, suspending and gelling agents, etc. in food and pharmaceutical industry.

Dietary fiber is a very important ingredient in bakery products today. The popularity of fiber in bakery products stems from the growing interest in the development of healthy foods, especially bread, which are currently used as vehicles for dietary fiber. The main soluble fibers used in bakery product industry are: **β –Glucans, Arabinoxylan, Gum Arabic, Konjac glucomannan, inulin and polydetrose.** (Weibiao Zhou, and Y. H. Hui 2014) [16]

β -Glucans are soluble polysaccharides that occur in the subaleurone and endosperm cell walls of the seeds of wheat,oats, barley, and rye.

The level of β -glucan in cereals varies from as low as 0.5–1% in whole wheat to 3–11% in barley. β -Glucans are homopolysaccharides which only have a single sugar unit, β - D - glucopyranose (Cui and Roberts, 2009) [5].

β -Glucans have very good fat replacement capacity; water- holding, emulsifying, and film forming capacity in bakery products, but is very sensitive to different processing parameters. (Weibiao Zhou, Y. H. Hui 2014) [16]

The viscosity of β -glucan in solution is mainly controlled by concentration, molecular weight distribution and structure The effectiveness of oat β -glucan in controlling postprandial glucose and insulin levels in the blood is dependent on its viscosity (Cui and Wang, 2009);[6]

Also, is believed that β -glucan has an important role in lowering plasma cholesterol being associated with its viscosity in the human intestine (Wolever et al., 2010)[17]. Therefore depolymerisation and degradation of the polymer adversely affect the functional properties of cereal β -glucan.

β **–Glucan** is the most sensitive soluble dietary fiber to different processing parameters. The viscosity of β-glucan in solution is mainly controlled by concentration, molecular weight distribution and structure) (Andersson *et al.*, 2009) [2].

Endogenous enzymes in flour work quickly when hydrated and lead to a decrease in the polymer molecular weight. Because the endo β-glucanases present in cereals act randomly, the molecular weight of the polymer decreases very rapidly. For example, within 11 + 6 minutes fermentation during the production of oat rye fibre crisp bread, was observed a 73% decrease in the molecular weight of β-glucan.(Andersson et al. , 2009)[2].

During bread- making can occur a huge loss of the long chain fraction of β -glucan A comparison of the distribution profiles of rye flour and breads demonstrates the degradation and shift towards low molecular weight of β -glucan during bread- making. The flour has a unimodal distribution profile, while the bread has a bimodal distribution with a shift into a population of low molecular weight chains during processing (Weibiao Zhou, Y. H. Hui 2014) [16]

Dough mixing and fermentation result in a significant decrease in the molecular weight of β – glucan.

Reducing the β -glucanase activity in dough can help to maintain β -glucan molecular weight and thereby the nutritional value of the bread(Andersson et al., 2004)[2].

During processing, grain texture has an important role in determining the fate of β –glucan. Partly milled or crushed grains or bran with coarse particles when included in the bread maintain β -glucan molecular weight and content better than finely milled flour.

The use of ingredients and processing parameters that minimise the degradation of extractable β -glucan, such as short fermentation and dough mixing time during bread- making and the incorporation of bran with large particle size, is recommended. (Åman et al. , 2004) [1] The technological process of bread also affects the extractability of β-glucan.

The polymer becomes more extractable during processing, probably due to the decrease in molecular weight, and therefore short-chain molecules are easier to extract. The increase of β -glucan solubility is dependent on processing conditions (Vasanthan et al. , 2002)[15]

The high extractability of β-glucan is generally a positive aspect of processing if degradation can be minimised. Rakha et al., 2010 compared the extrability of β-glucan in crispbread (29%) and soft bread (35%), and found that soft bread has an increased amount of extractable β-glucan, but relatively more degradation of β –glucan.

A sample of extruded crispbread had the highest extractability (47%) and maintained molecular weight better than the other soft breads and crispbreads studied. The extractability was found to increase with increasing temperature and moisture content during baking so the β -glucan extractability and molecular weight have a nutritional importance and can be manipulated by physical, thermal and enzymatic treatment (Rakha et al. , 2010)[11].

Arabinoxylans can be found in all major cereal grains such as rye, wheat, barley, oats, sorghum, maize, millet, psyllium, fl axseed, pangola grass, bamboo shoot and rye grass. The highest content of arabinoxylan is found in rye, followed by wheat, barley, oats, rice and sorghum. Arabinoxylans form a major dietary fibre source in the diet.

As a food ingredient, arabinoxylan can affect water- holding capacity, dough rheology or starch retrogradation. Arabinoxylans have important effects on cereal processes such as milling, brewing, and breadmaking quality. They can also be used as fi lm-forming agents, cryostabilizers and surface active agents in various food products (Delcour Jan A. and Poutanen Kaisa,2013)[7].

Bread is a staple food worldwide, being a great source of energy, protein, dietary fibre, minerals, vitamins and many other bioactive compounds. The use of refined flour in bread decreases its content of dietary fibre and associated bioactive compounds.

Therefore wholemeal flour, bran, composite flour, fructo-oligosaccharides resistant starch or fibre concentrates have been added to bread to enrich it with dietary fibre. These ingredients can modify the dough and the bread properties, so the bread- making process has to be adjusted to achieve wanted products.

Many processes can result in the loss of functionality and positive health effects of the soluble dietary fibre components, an important aspect to consider when creating innovative products (Rakha et al. , 2010)[11].

Fortification with fibre concentrate

Commercial fibres from wheat, maize, oats and barley containing high amounts of soluble dietary fibre are available and can be incorporated to produce high fibre bread (Sabanis et al. , 2009a)[13]. Nutrim and UltraTrim, Glucagel, OatWell and Viscofibre are some examples of isolates/concentrates rich in β -glucan.

Other sources of soluble fibers, (gums, mucilages, pea fibre, pectin, potato skin), can be incorporated into bread.

Other potential sources are synthetic fibres such as polydextrose and chemically modified fibres from non- woody lignocellulosic. Some of these fibre isolates or gums are added for technological purposes to impart favourable characteristics to the bread. Other fibre concentrates carry specific dietary fibre components and provide certain health benefits.

Gluten- free products are produced for the population suffering from coeliac disease, which is an autoimmune genetic disorder that arises by inclusion of gluten in the diet.

It is caused by a prolamin protein sequence specific to wheat (gliadin), rye (secalin) and barley (hordein) and affect about 1% of the global population (Delcour Jan A. and Poutanen Kaisa,2013)[7]

Gluten removal is a challenge for bakers to produce acceptable gluten free breads. Since wheat, rye and barley flour are mainly replaced by gluten- free starch in gluten free bread, the coeliac population generally does not meet the recommended daily intake of dietary fibre (Lee *et al.* , 2009)[9].

To rectify this deficiency of fibre in coeliacs, gluten free breads can be supplemented with commercial fibre made from oat, rice or maize bran. The addition of fibre can bring favourable properties to the bread, as incorporation of 3% maize fibre in gluten free bread usually produces higher loaf volume and softer crumb compared with non- fibre GF bread (Sabanis *et al.* , 2009a)[13]. Sabanis et al., 2009 optimised gluten free bread formulation, adding 6.5% maize fibre which led to 5.2% dietary fibre content in bread loaves.

The addition of maize fibre to bread resulted in a better overall acceptability score compared with non- supplemented bread.

Other non- cereal fibre sources have potential to increase the dietary fibre level in bread. Inulin can be incorporated into breads to enhance soluble dietary fibre. Incorporation of 8% inulin into

wheat starch- based bread enhanced the dietary fibre content from 1.4% in the control to 7.5% (Gallagher *et al.* , 2004)[8].

When inulin is incorporated into bread, can lead to better dough stability and increased loaf volume, also an improved crust colour and crumb texture. Tenderness of bread can be affected adversely by addition of inulin and the effect is more pronounced with long crust coloration and crumb hardness. However, with a shorter baking time (17 min instead of 20 min for normal bread), a bread containing up to 5% inulin can be obtained, with a general acceptability similar to that of white bread. The shorter cooking time is also energy efficient (Poinot *et al* , 2010)[10].

Different processing parameters: mixing, temperature, fermentation, pH, endogenous enzymes, and others can result in significant degradation of major dietary fibre components during baking (Åman *et al.* , 2004[1]; Andersson *et al.* , 2009;[3]).

Higher temperature is reported to break the glycosidic linkages in dietary fibre polysaccharides, resulting in depolymerisation (Selvendran and Robertson, 1994[14]). The extent of this effect is dependent on the intensity of heat treatment.

In a study regarding the dietary fibre content of rye products, was found huge differences attributed to variations in ingredients and processing conditions In the studied food products, the dietary fibre content in soft breads ranged from 7.9 to 17.5% (average 12.6%), while that in crispbreads ranged from 13.0 to 19.8% (average 17.8%). (Rakha et al. , 2010)[11].

Arabinoxylan

Bread- processing results in increased soluble arabinoxylan content (Andersson *et al.*, 2009)[3]. Mixing, fermentation and baking influence the solubilization of arabinoxylan molecules. (Cleemput *et al.* , 1997)[4]. In another study after dough kneading, more than 10% of the water-unextractable AX became soluble and at the end of fermentation about 25% became soluble, in the absence of added enzymes (Rouau *et al.* , 1994)[12].

The baking process can decrease the solubilisation degree of arabinoxylan molecules, as the bread crumb has less soluble arabinoxylan than the dough.

Manufacturing technology for bakery products with EMULGOLD

EmulGold Fibre is a natural, GMO-freesource of soluble dietary fibre (> 90% on a dry weight basis) produced from the highest quality gum acacia.

Properties:

- Low caloric value and no sugar
- Well tolerated at intake levels as high as 40 g/day
- Acid and heat stable

- Tooth friendly - no cariogenic effect
- Light colour, tasteless, non-hygroscopic and low viscosity powder
- Instant solubility in cold or hot water
- High degree of functionality in bakery applications

As a fibre, EmulGold Fibre is not hydrolysed in the small intestine and hence has a Glycemic Index of virtually zero

• When added to a product containing 100g glucose, EmulGold Fibre, at 20g, produced a significant decrease in plasma glucose (16.1%) and serum insulin (11.2%) at 90 minutes.

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CHAPTER 5. TECHNOLOGY FOR THE MANUFACTURE OF BAKERY PRODUCTS WITH THE ADDITION OF PROBIOTICS FOR THE REGULATION OF THE DIGESTIVE SYSTEM

The origin of the consumption of probiotic foods for their health benefits dates back to the early twentieth century. In 1908, researcher Elie Metchnikoff received a Nobel Prize for her work in immunology, arguing that the consumption of fermented dairy products can prolong life. Since then, probiotics have been the subject of thousands of FAO / WHO scientific research and have defined probiotics as living micro-organisms which, when ingested in adequate quantities, provide the body with numerous health benefits. (Côté, J., et al., 2013)[3].

5.1 The role of the intestinal microbiota

The intestinal microbiota evolved with human physiology, and this symbiotic process left the human intestine full of bacterial cells, located mostly in the colon: about 100 trillion cells in total, representing over 1,000 species of bacteria (Eckburg, P.B., et al., 2005). This intestinal flora, also called this internal microbiological activity, plays an important role in maintaining health.

The intestinal flora forms a "barrier effect" by forming and maintaining normal mucosal immunity and the presence of these beneficial bacteria in the intestinal tract helps prevent colonization of the intestine by pathogens and therefore gives the body immunity against infections (Zoetendal, E.G., et al., 2006)[11].

The microbiota in the colon is also involved in completing the digestive process by fermenting substances such as dietary fiber, oligosaccharides, fructose and lactose that are not digested in the stomach or small intestine. Fermentation of carbohydrates produces short-chain fatty acids, especially butyrate, which is the primary source of energy for the cells that line the colon. When butyrate levels are low or absent, inflammation characteristic of ulcerative colitis may result (Côté, J., et al., 2013)[3].

In the intestinal flora there is a constant flow, and the delicate balance between microbes can be disturbed by food, alcohol, antibiotics, stress and digestive disorders. The altered composition of the microbiota (dysbiosis), such as an increase in the number of pathogenic bacteria or a decrease in beneficial bacteria, can reduce the barrier effect and contribute to

various digestive disorders, including bloating, intestinal disorders, constipation, dyspepsia, allergies, etc. (Collins, M.D. and Gibson, G.R.,1999)[2].

These conditions, in turn, can lead to the development of more serious conditions, such as ulcerative colitis, irritable bowel syndrome, Crohn's disease, type 1 I and type 2 diabetes, obesity and celiac disease (Nicholson, J.K., et al., 2005)[7].

5.2 Technology for the manufacture of bakery products with *Bacillus coagulans GBI-30*

Consumers are evolving in their behavior by taking a proactive approach to health and wellness.

- At a high-level, consumers are evolving in their approach to health and wellness.
- They are becoming much more proactive verses the quick fix/reactive approach in the past (health condition mgmt / dieting)
- And, consumers are using foods, beverages, supplements (as well as exercise) to accomplish health & wellness goals.

The spore-forming nature of probiotics such as *Bacillus coagulans GBI-30, 6086* provides superior viability compared to other probiotic strains

- Highly viable cells
- Survives most manufacturing processes
- Requires no refrigeration
- Long shelf life (up to three years)
- Survives against acidity and bile salts
- Safety is irrefutable (over 7 billion individual doses sold – not a single reported adverse reaction)

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CHAPTER 6. TECHNOLOGY FOR THE MANUFACTURE OF BAKERY PRODUCTS WITH LOW SUGAR AND FAT CONTENT

Fats provide our body with calories, energy and the structure of the membranes, building materials for hormones and vitamins. Excessive intake will accumulate in our body that can lead to obesity and its complications.

To prevent this, today's fashionable fat-reduced products have appeared. In the baking industry, the manufacture of these kinds of products is still in the experimental stage.

The experiments use low-fat margarine, usually with 40-60 % fat content. Low-fat content is a particular problem in manufacturing of shortbreads and puff pastries, where fat plays a significant role in shaping the structure.

In conventional manufacturing technology, the fat forms a hydrophobic coating on the flour granules, thus forming the characteristic structure of said products, but during fat content reducing this is only partially achieved. For these products, the use of fats with a favourable fatty acid composition may be a solution, as the consumption of unsaturated fatty acids has favourable physiological effects.

Carbohydrate-reduced products are favoured primarily by consumers with carbohydrate metabolism disadvantages, but dieters also prefer. A carbohydrate-reduced product is considered to be a baking product if, given the original product, the food contains at least 30% less carbohydrate.

In practice, this is achieved by increasing the protein content or using artificial or natural sweeteners.

The replacement with sweeteners is the most often used method in practise because reducing the sugar content significantly affects the taste of the product, but these substances significantly reduce this effect.

However, the modifications must take into account that sugar has a technofunctional effect, so reducing its quantity will have a negative effect on the water absorption capacity of the dough and the intensity of Maillard reactions on the surface of the product.

In selecting the appropriate sweetener, in addition to the above, their sweetening ability, heat sensitivity and, in the case of intense sweeteners, their ADI must be taken into account.

Technology for the manufacture of bakery products with Tastesense™ Range and Biobake Range

The products is based on fruit and vegetable extracts and it interacts with the taste receptors of the mouth modifying the overall taste perception.

Tastesense reduces sugar up to 30% without compromising the taste and it also improves mouthfeel & flavour impact in products with reduced sweetness.

The effect is larger in combination with a high intensity sweetener like sucralose.

It can also be labelled like natural flavouring.

Technology for the manufacture of bakery products with low sugar and fat content

Fat reduction

In the baking industry, several types of fat are used to make different products. Egg-enriched products are made with 11% margarine per kilogram of flour, according to the Hungarian standard.

Control product

Material	Calculated on total flour %		
BL55 flour	100	Margarine	11
Yeast	5	Milk powder	3
Salt	1	Eggs	1,5
Sugar	10	Additive	0,5

Production technology for fine plaited cakes

This type of product is characterized by the fact that they are of different weights but similar composition and are made from dough prepared using the same dough method as in the production of egg-enriched brioche. The fine scones are made in 0,25 kg, 0,50 kg and 1,00 kg units using 4 or 6 twigs and different spinning techniques. This subheading also includes festive cakes made up of two or more twigs of braided strands placed one on top of the other. A fine plaited loaf weighing 0,25 kg is made from 4 branches of 280 g of dough by plain plaiting. Fine plaited cakes of 0,50 kg and 1,00 kg can be made with 4 or 6 branches using the plain or window plaiting technique. The 0,50 kg loaf is made from a total dough weight of 560 g and the 1 kg loaf from a total dough weight of 560 g. The pieces of dough, formed using the appropriate spinning technique, are risen and baked on a baking tray.

Fat content reduced to 8 %
Material Calculated on total flour %

BL55 flour	100
Yeast	5
Salt	1
Sugar	10
Margarine	8
Milk powder	3
Eggs	1,5
Additive	0,5

Technology:

Preparation of raw materials:

- sifting, weighing and mixing flour
- weighing, dissolving and filtering salt
- measuring, weighing, measuring, weighing, weighing, weighing
- adjusting and measuring the temperature of water

Preparing the dough:

Measuring the raw materials into the kneading machine, then the kneading machine mixes the dough.

- Adding water during kneading
- Kneading time: 10 minutes
- dough temperature: 26-28 °C

Dough processing:

The dough is removed from the kneading bowl, given up, rested and then shaped.

- dispatch weight: 2,10 kg
- resting time: 15 minutes
- stretching, dividing the dough with a dividing machine
- rest for about 10 minutes
- shaping the divided dough into lengths
- spinning the dough sticks into a 4-strand loaf

Rising:

Brush the surface of the kneaded scones with egg wash and place them in the properly rolled out mould. Place the moulds on plates and then on a baking trolley.

- On a baking trolley in a baking chamber
- Rising time: 70 minutes
- temperature: 30-35 °C

- humidity: 80-100 %.

Baking:
The baking trolley is placed in a properly heated rotary oven. No steam is required, as the surface has already been treated.
- Oven temperature: 200 °C
- Baking time: 17 minutes

Replacing fat with oil

Wafer products
Technology:
Preparation of suspensions:
The liquid intermediate, wafer suspension, is a heterogeneous dispersion system, the dispersion medium is water, the solid particles of flour are suspended in an aqueous solution of the raw materials. When the flour particles are mixed with water, they swell strongly, but since the water is present in excess and separates the individual flour particles from each other, the swollen flour particles do not come into contact with each other and a coherent flour skeleton cannot form. The temperature of the prepared suspension is 18-20°C. In view of the technological conditions of wafer production, the viscosity of the liquid suspension must be of great importance for pump transport and uniform dosing. The viscosity of a suspension prepared using flour of the same concentration and temperature can vary over a wide range. The viscosity is determined primarily by the protein content of the flour and its swelling capacity. A constant viscosity can be achieved by adjusting the water content of the suspension to the different flour types and qualities. T paddle or turbo mixers are used to produce liquid wafer suspensions. In addition to intermittent mixers, continuous vibratory mixers have recently become more common. Experiments with continuous mixers show that combining mechanical and vibratory mixing is preferable. Vibratory mixing allows the different components to be well distributed and at the same time prevents the different materials from sticking to the mixing blades.
Screening:
It is extremely important to filter the wafer suspension before it enters the baking chamber to ensure accurate dosing. This operation should not be omitted from any technology; it is a prerequisite for good quality and the continuous operation of the wafer production line.
Frying waffles:
The shape of the wafer layer is formed in a mould of the appropriate shape in the baking equipment. The suspension is pumped through the pipe system to the dosing tank. The dosing is done by an automatic feeder. Two simultaneous processes, drying and baking, are typical of the heat-solidification of thin wafers. The water transfer process is characterized by a decreasing speed phase. This is explained by the fact that the suspension with a high water content heats up suddenly on direct contact with the baking tray and that there is an intense heat exchange in the contact layer, which only decreases during the subsequent vapour formation. It follows that, in view of the intense heat transfer, the heating is greater in the first stage of the operation. The water bound by absorption is removed in the second half of the baking operation, so the temperature of the baking sheets must be reduced at this stage.
During the baking process, the temperature difference between the outer and inner layers of the wafers tends to decrease, reaching a minimum at the end of the process. The temperature of the wafer suspension during baking can be varied significantly by changing the temperature of the baking surface.
Experience has shown that, with one-sided heat transfer, wafers of optimum quality can be produced in about two minutes (at a temperature of about 170°C) with continuous operation.

With double-sided heat transfer, both sides of the wafer sheet will have approximately the same water content at the end of the operation, so that the wafer sheets do not deform during storage, which is an inherent feature of single-sided heat transfer. A further advantage of two-sided heat transfer is that the baking time is reduced by about 10%.

Ingredients: Control product
Flour (BL-55): 1 kg
Powdered sugar: 0,5 kg
Margarine: 0,45 kg
Milk: 1 l

Before baking, the dough is light yellow in colour, shiny on the surface, slightly runny, sticky and dense. It bakes in 2-2,5 minutes. After baking, it is uniformly golden brown in colour. It crumbles easily, is crispy and has a delicate sweet taste typical of the product. Does not stick to the baking tray during baking.

Made with 100% Olive oil
Flour (BL-55): 1 kg
Powdered sugar: 0,5 kg
Olive oil: 0,45 kg
Milk: 1 l

It is darker in colour, has a glossy surface, and forms a fluid and homogeneous dough. It takes less time to bake and burns faster. Same colour as the control, with an oily feel.

Sugar reduction

1. **Partial replacement of sugar by honey**

Honey is the oldest known sweetener suitable for human consumption and, due to its high carbohydrate content, it also provides significant energy (1385Kj/100g).
Long-life cakes made from honey dough are called gingerbread.

Technology:

- Preparing the basic honey pasta
- Making the basic sugary dough
- Mixing the honey and sugar dough
- Shaping the dough
- Baking
- Cooling
-

Honey/sugar ratio Ingredients (kg)	100% sugar	75% sugar: 25% honey	50% sugar: 50% honey	25% sugar: 75% honey	100% honey
Flour	0,1	0,1	0,1	0,1	0,1
Sugar	0,1	0,75	0,5	0,25	-
Honey	-	0,25	0,5	0,75	0,1
Loosening agent (alkali)	0,0015	0,0015	0,0015	0,0015	0,0015
Flavouring (mixed spices)	0,0015	0,0015	0,0015	0,0015	0,0015

2. **Sugar substitution**

Presentation of sponge cake production technology
Sponge cake (sponge cake pudding): a dough made from wheat flour, sugar and eggs, leavened with egg white foam. It can be round or square, cut into sheets, and flavoured with a variety of additional ingredients. (Hungarian Food Guide 2013)
Sponge cake is very easy to make, but it is also a type of dough that requires a lot of attention. A basic mistake is to make a dough that collapses and does not have a light consistency. The method of preparation of the bakery product will be discussed in the following lines. The most

important ingredient in this bakery product is the egg. The secret of sponge cake is the light consistency of the foam, which is obtained by the air that is introduced into the dough. This process takes place when the egg whites are beaten into stiff peaks and when the yolks are mixed with the whites. When beating the egg whites, care must be taken not to incorporate any egg yolks. The egg yolks should always be added to the beaten egg whites while mixing them with the sugar until homogeneous. The lightness of the dough is enhanced by the flour. This is measured out during the preparation. It is measured out very accurately using a balance. The flour is then sieved to remove foreign matter and make it more homogeneous. The sifting process introduces air between the flour particles, which plays an important role in increasing the volume of the sponge cake during baking. Finally, the flour is carefully added to the protein mixture, taking care not to allow air to escape from the dough. Stir the whole dough in a semi-circular arc clockwise. Then place the finished dough on a baking tray lined with baking paper, place in a preheated oven and bake.

Ingredients	**Erythritol sponge cake**	**Xylitol sponge cake**	**Stevia sponge cake**
Flour (g)	80 g	80 g	80 g
Egg (piece)	6	6	6
Sweetener (g)	120 g	80 g	0,27 g

- Erytritol sponge cake
- Xylitol sponge cake
- Stevia sponge cake