CHAPTER 9

HEALTHY BAKERY PRODUCTS FOR THE COMPLETE NUTRITION OF THE POPULATION

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INTRODUCTION

Before the outbreak of World War I (1914), Ukraine did not have a baking industry; as a branch of the food industry, it was represented by numerous small enterprises. In 1913, the production of bread by bakeries did not exceed 2.3 kg per capita per year. After the revolution of 1917, the construction of bread factories and mechanized bakeries developed, and factories for the production of baking equipment were established. In 1925, the machine-building plants of the Melbud joint-stock company began producing equipment for sifting flour, dough-mixing and dough-processing machines, and mechanized ovens with retractable hearths. In 1925-26, the first mechanized bread factories in Ukraine were put into operation in the cities of Kharkiv and Donetsk. The number of bakeries grew from year to year, from 1928, when there were 14 bakeries and 24 mechanized bakeries, to 1940, the number of bakeries in Ukraine increased to 93, and mechanical bakeries to 192. At the end of the war, only 12% of the pre-war capacity of the bread-making base remained in Ukraine. In the post-war years (1945–1950), work was completed on the reconstruction of bakery enterprises, but also new bakeries with more progressive equipment and technology were built. In the 60s–80s, work continued on the construction of new powerful bakeries (there were about 80 of them) and the reconstruction of existing ones. The level of mechanization was increased at the enterprises, bulk flour storage warehouses were built, new designs of conveyor bakery ovens, tunnel ovens, continuous dough preparation units, dough-distributing and dough-forming equipment were built, and complex mechanized flow lines were created. The range of products was also enriched with new types of products. Such types of bread as Ukrainian, Ukrainian new, Darnytsky, table, Ukrainian palanytsia, Kyiv arnaut, student loaves, poppy seed bagels and other products were developed and introduced. The molded type was replaced by hearth types of bread. The creation of mechanized bread baking required highly qualified engineering personnel and technically competent bakery workers. In order

to train such personnel, factory-based training schools in bread baking were established in the cities of Kyiv, Kharkiv, Donetsk, Luhansk, Dnipropetrovsk, Odessa, and later in Lviv.

1. Bakery production, product classification and basic principles of technological processes

Today, the population of Ukraine is provided with bread by highly mechanized enterprises of Ukrkhlibprom, Ukoopspilka, Ukrprodspilka. In Ukraine, bakery products are made from rye and wheat flour – sown, peeled, broken varieties and wheat – top, first, second and broken varieties or their mixture. As additives in the production of certain types of bread, corn, oat, barley flour, as well as legume flour – soybean, pea, lupine. *Classification of Bakery Products,* Bakery products can be broadly classified into two main streams: by composition & technology and by functional purpose.

A. Classification by Composition and Technological Features: ***Yeast-Leavened Bread***: Standard wheat, rye, and mixed-flour breads that rely on yeast fermentation for crumb structure and volume; Unleavened and Flatbreads: Products made without biological leavening agents (e.g., tortillas, pita, lavash, crackers); ***Specialty & Artisan Bread***: Sourdough breads, long-fermentation loaves, and products utilizing ancient grains (spelt, einkorn); ***Frozen Dough & Semi-Finished Products***: Raw dough trimmings, par-baked loaves, and blast-frozen pastries designed for bake-off stations.

B. Classification by Functional and Health-Promoting Purpose: ***Dietary & Metabolic Support***: Formulations designed for clinical nutrition, such as Low-Glycemic Index (Low-GI) bread for diabetes management and carbohydrate control; Digestive & Gut Health: Products with enhanced prebiotic and probiotic profiles, heavily fortified with dietary fiber (bran, inulin) to optimize intestinal motility; ***Fortified & Enriched Bread:*** Standard baked goods enriched with micronutrients like Vitamin B-complex, Vitamin D, Iodine, and Iron to combat regional nutritional deficiencies; ***Target Population Nutrition*****:** Customized bakery goods tailored for specific demographics, including *children's bread* (high protein/calcium), *geriatric nutrition* (easy to digest, nutrient-dense), and *sports nutrition* (high-protein energy loaves).

Classification of Bakery By-Products (Co-Products), during the industrial bread-making process, various secondary streams are generated. These are classified based on the stage of production at which they occur: ***Dough-Stage By-Products:*** Raw dough trimmings, scrap dough from shaping machines, and defective batches that fail pre-baking quality checks; ***Post-Baking By-Products:*** Bread crusts, edges from sliced sandwich loaves, structural deformities, and underweight or over-baked loaves; ***Distribution & Retail***

***Returns*:** Stale bread, unsold inventory from retail networks, and over-production surpluses.

Industrial Applications and Recovery Routes instead of entering the waste stream, modern sustainable bakery management redirects these by-products back into the economy via three primary routes: ***Direct Food Upcycling (Human Consumption):*** *Re-fermentation*: Fresh dough trimmings are re-incorporated into new dough batches as a natural fermentation starter; *Crumb & Toast Production*: Defective or surplus bread is dried, milled, and processed into breadcrumbs or toasted croutons; *Culinary Ingredients*: Industrial staling components are converted into functional ingredients for the wider food sector (e.g., thickeners for puddings, sauces, and fillers for meat processing). ***Animal Feed Formulation:*** *Direct Feed Enrichment*: Surplus and stale bread is dehydrated and blended into high-energy feed mixtures for livestock and poultry, replacing a portion of raw grain. ***Industrial and Chemical Valorization:*** *Biotechnology Substrates:* Bread waste is an excellent carbon source. It is used as a fermentation substrate to cultivate microorganisms that produce enzymes, amino acids, and vitamins; *Bioenergy Recovery*: Severely degraded or contaminated waste is directed to anaerobic digesters for biogas production, closing the green energy loop within the facility[1, 2, 3].

The bakery industry is characterized by large-scale production and produces socially significant products and plays a leading role in the food industry of Ukraine. The share of bread products in the diet of the Ukrainian consumer is 15%, which confirms their status as a basic food product. Bread and bakery products traditionally occupy a special place in the structure of domestic consumption, since these products in Ukraine account for up to 40% of the total calorie content of the population's diet. In fact, the production of bread and bakery products can be attributed to the strategic sectors of the economy of our state, since the efficiency of the activities of bakery enterprises largely depends not only on food, but also on the national security of the country.

The dough preparation process involves the formation of dough (kneading) and leavening – this is the formation of a porous dough structure. It is achieved by adding leavening ingredients to the dough. Leavening agents are substances that can give the dough a porous structure. Depending on the nature of the leavening agents, the following methods of leavening dough are distinguished:

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[3] Костецька Н. І. Ринок хліба і хлібобулочних виробів України: стан і перспективи розвитку. *Галицький економічний вісник*. 2015. 48 (1). С. 26–31.

Fig. 1. Bakery products

Fig. 2. Classification and use of by-products of bread production

chemical, mechanical, biological. The chemical method involves the introduction of chemicals into the dough, which decompose at high temperatures to form volatile compounds that, when released, loosen the dough. The mechanical method involves loosening the dough with air or carbon dioxide, which are fed into the dough mixer during kneading under pressure or during dilution. The

biological method involves loosening the dough with carbon dioxide, as well as other volatile substances released as a result of the vital activity of yeast and lactic acid bacteria, which are introduced into the dough during mixing. The chemical method of dough leavening is used in the production of cookies, gingerbread and some other flour confectionery products. For this purpose, sodium bicarbonate $NaHCO_3$, ammonium carbonate $(NH_4)_2CO_3$ or their mixture in a ratio of 88:12 is used.

During baking, sodium bicarbonate decomposes with the release of CO_2, which loosens the dough blanks $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$. Sodium carbonate has an alkaline reaction, and alkalinity is regulated by regulatory documentation. Ammonium carbonate decomposes during baking with the formation of ammonia and carbon dioxide, which loosen the dough blanks $(NH_4)_2CO_3 \rightarrow NH_3 + H_2O + CO_2$. Ammonium carbonate, in the case of a significant dosage, gives the products the smell of ammonia.

The biological method is the only way to loosen bread dough. In this method, pressed, dried or liquid yeast, as well as wheat yeast starters, are used to leaven wheat dough. Rye starters are used to leaven rye dough. Yeast cells ferment dough sugars under anaerobic conditions with the release of carbon dioxide and alcohol, which act as leavening agents. $C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH + 117.3$ kJ. In rye dough, the main fermentation process is lactic acid, which is excited by homo- and heterofermentative bacteria. In the process of lactic acid fermentation, lactic acid, volatile acids, and a certain amount of carbon dioxide accumulate. Along with this, CO_2 is released as a result of alcoholic fermentation. The biological method is quite long – from 1 to 5 hours. During this time, the dough not only loosens, but also flavor and aromatic substances accumulate in it, which are by-products of fermentation.

Wheat dough is prepared by single-phase or multi-phase methods. In single-phase methods, the dough is prepared in one stage from the entire amount of flour and other raw materials specified in the recipe. In multi-phase, mainly two-phase, methods, the first phase is prepared from part of the flour and yeast, after ripening, the remaining flour and other raw materials according to the recipe are added to it and the second phase is kneaded – dough. The most common are all types of leavening methods, which are used in the manufacture of a wide range of bread, bakery, sweet, bagel, and rusk products[4]. The traditional single-phase method is the leavening-free method of dough preparation. It is used mainly in the production of bakery and sweet products, sometimes in the manufacture of bread. Accelerated methods of dough preparation are widespread in

[4] Сімахіна Г. О., Стеценко Н. О., Науменко Н. В. Біологічно активні речовини в харчових технологіях : підручник. Київ : НУХТ, 2016. 455 с.

small-capacity enterprises and bakeries. The method and equipment scheme of dough preparation are chosen depending on the range of products, production volume, available equipment, etc. For the leavening of wheat dough, baker's yeast, liquid yeast, and yeast starters are used. Unlike baker's yeast, liquid yeast and yeast starters are prepared directly in the bakery[5, 6]. Accelerated methods of dough preparation are widely used in small-scale enterprises and bakeries. The method and equipment scheme for dough preparation are selected depending on the range of products, production volume, available equipment, etc. For the leavening of wheat dough, baker's yeast, liquid yeast, and yeast starters are used. Unlike baker's yeast, liquid yeast and yeast starters are prepared directly in the bakery.

2. Obtaining bakery products with increased nutritional value

Bread is traditionally a staple food, and the creation of products with a given chemical composition allows for a significant and minimal impact on the health of the population. Scientists and workers in the baking industry are constantly improving and enhancing its quality. The protein, mineral and vitamin value of bread allows us to consider it one of the most valuable food products. However, bread has a constant deficiency of essential amino acids (lysine, threonine), macro- and microelements (calcium, iodine, iron, etc.), vitamins (B_1 and B_6). Therefore, the current tasks for bakers are not only to improve the quality of bread and preserve its freshness, but also to increase its nutritional value, in particular, enrichment with additional nutrients[7]. To solve this issue, additives from non-traditional plant raw materials have recently been increasingly used as a source of biologically active substances that have a positive effect on the human body. It is known that all biologically active substances (BAS) are necessary for the normal functioning of the body, come mainly with food and are absorbed as a result of their biotransformation, digestion and absorption. Transforming into structural and functional elements of the body's cells in the processes of metabolism, BAS ensure its physical and mental endurance, determine the state of health and working capacity. A lack of BAS in the diet inevitably leads to negative consequences – these are safe substances with precise physicochemical characteristics, for which a positive effect on improving and maintaining human health has been identified and scientifically

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[7] Лебеденко Т. Є. Аналіз сучасних технологій хлібобулочних виробів із пшеничного борошна та перспективи їх удосконалення. *Зернові продукти і комбікорми*. 2012. 2 (46). С. 38–43.

substantiated, and the daily intake rate in food products has been established and approved. They not only provide the human body with energy and plastic material, but also optimize physiological functions, thousands of biochemical reactions, contribute to maintaining and improving health, reduce the risk of diseases and accelerate the recovery process, provide protection of the body from adverse environmental factors. The range of bakery products produced in Ukraine is quite wide, but there are not enough products for dietary, therapeutic and preventive, special purposes for different groups of the population and their share in the total production does not exceed 3%. Along with food additives, non-traditional raw materials are able to give health-improving properties to bread: soy products, products from sprouted legumes (peas, beans), sunflower seeds, flax, fruit and vegetable powders, algae, malt extracts and other raw materials containing biologically active substances[8].

The works are devoted to the study of the use of non-traditional raw materials, characterize it as a promising source of vegetable proteins, active lipids, dietary fibers and balanced minerals, which indicates the feasibility of research aimed at studying the possibility of their use in baking. Despite the fact that more and more residents of the country strive for a healthy lifestyle and are struggling with excess weight, the popularity of innovative products is growing – bread of dietary and therapeutic and prophylactic direction, containing grain mixtures, bran, fructose, honey, nuts, vegetable and fruit additives. The share of such products is 5–7% of the total sales volume, therefore the development of new bakery products enriched with BAS, which would maximally meet the criteria of quality and safety, is quite relevant. It is necessary to introduce new products with useful, attractive organoleptic properties to the market. Today[9, 10, 11] the population shows increased interest in the chemical composition, nutritional value and the presence of functional ingredients in food products and is increasingly faced with the problem of unbalanced nutrition due to the consumption of refined, refined products. For healthy nutrition, a person needs dietary fiber, vitamins, trace elements, minerals, unsaturated fatty acids, etc. Since at least 30% of the daily requirement for nutrients is covered by bread in the diet, the functional purpose of this product should occupy a worthy place

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in the nutrition of the population. Improving the health of the nation through bread should be recognized in the country as one of the priority and most significant tasks[12]. The introduction of physiologically functional ingredients into bakery products allows not only to expand the range, but also to develop varieties aimed at supporting and improving the health of various population groups. Given the chemical composition and functional properties of certain ingredients, and especially their natural origin, it can be assumed that this will reduce the deficiency of certain components in the diet.

Bakery products are characterized by a large assortment in appearance, taste quality indicators, recipe, cooking technology and are for consumers an essential carrier of food, biologically active substances, improves the digestibility of food, and the aroma of fresh pastries is an effective means of increasing appetite and the emergence of a feeling of hunger. But thanks to their recipe diversity, these products can also be a source of a wide range of protective components that are so necessary for modern man. In recent years, for bread-baking enterprises, one of the ways to attract consumer interest in their products, along with adding special excellent taste and aromatic qualities, is becoming increasingly promising to increase the nutritional value of bakery products, the content of biologically active substances through the use of safe natural raw materials. For many decades, processed fruits and vegetables have been considered a promising source of biologically active substances: vitamins, minerals, phenolic compounds with antioxidant, antibacterial, fungicidal properties, and in recent years, special attention has been paid to spicy-aromatic and medicinal plants. The latter are characterized by a multi-vector nature of positive qualities, which makes them promising for the creation of functional food products, including bakery products[13]. In recent years, a new source of raw materials for the food industry has appeared on the world market – amaranth and its processed products, which have a valuable chemical composition, high nutritional and biological value, are safe and contain a wide range of functional food ingredients, which determine the prospects for their use in food production technology[14]. Amaranth grain and its processed products – flour, bran, oil – are a source of many physiologically active compounds. It has been established that

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[12] Матиящук О. В., Фурманова Ю. П., П'яних С. К. Використання амарантового борошна в технології виробництва бісквітних напівфабрикатів. *Науковий погляд в майбутнє*. 2017. 2 (6). С. 52–58.

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the fatty acid composition of amaranth oil differs in the content of such fatty acids as linoleic (41%) and arachidonic (16%), which are substances with high biological activity. Amaranth flour is a source of available vegetable protein (15%), has a valuable chemical composition: protein 3.8 times more than in wheat flour; lipids – 9.4 times; fiber – 17 times; minerals: sodium – 24 times, potassium – 4.2 times, calcium – 19 times, magnesium – 6 times, phosphorus – 5 times, iron – 36 times; vitamins: thiamine – 33 times, riboflavin – 74 times, niacin – 1.2 times. The energy value of amaranth flour is slightly higher than that of wheat flour due to the higher content of proteins and lipids. The amount of essential amino acids in the protein of amaranth flour is 17.6 g/100 g of protein, the total amount of amino acids is 37.7 g/100 g of protein. Therefore, amaranth flour has a more balanced amino acid composition compared to wheat flour, so it is advisable to use it in confectionery production together with wheat flour[15].

A technology for grinding and dividing amaranth grain into parts has been developed to obtain native products with high nutritional value. The cleaned amaranth grain is flattened, such flattened native amaranth grain (yield 95–98%) is divided into native amaranth flakes (53–56%) and native germ grits (28–35%). Next, native amaranth flour (82–88%) is formed from the flakes, and oil (6.5–7.5%) is extracted from the grits and a by-product is formed – semi-defatted germ grits (28–35%), which contains, respectively, semi-defatted protein bran (18–25%) and semi-defatted protein flour (75–82%). After a series of studies, it was found that amaranth protein flour is an effective protein enricher and technological improver in the production of bakery products from wheat flour. Native varietal flour significantly improves the quality of bakery products from a mixture of rye and wheat flour. Whole grain amaranth flour is produced from amaranth seeds, which has high nutritional value; varietal amaranth flour, including high-grade, which in terms of the quantitative ratio of components is close to wheat baking flour, contains a complex of physiologically active substances − squalene, minerals, dietary fiber, pectin, vitamins, as well as amaranthine, which can be used to enrich traditional products, create specialized products or new biologically active additives. The use of semi-skimmed amaranth protein flour as a new raw material for bread baking is promising, produced from semi-skimmed amaranth groats – a secondary product in the production of amaranth oil. The introduction of amaranth flour contributes to the increase in the biological value of bread by improving the amino acid composition and significantly eliminating the deficiency of essential amino acids in protein in

[15] Холобцева І. П., Серік М. Л., Самохвалова О. В. Вплив добавки білково-мінеральної на властивості клейковини борошна пшеничного. *Наукові праці Національного університету харчових технологій*. 27 (2). 2021. С. 129–139.

bread. At the same time, the degree of satisfaction of the daily human need for essential amino acids increases by 1.5–2 times, which also indicates the effectiveness of the use of amaranth flour[16]. The use of amaranth flour is promising for improving the quality of flour for bread, activating pressed yeast, intensifying the dough preparation process, improving the quality, nutritional and biological value of wheat bread. The introduction of amaranth flour in an amount of 10% to the mass of wheat flour provides an increase in the content of zinc and phosphorus by 1.2–1.5 times, calcium by 2.4 times compared to wheat bread without additives[17]. Amaranth flour was introduced in dry form in dosages of 1, 3, 5, 7 and 10% instead of wheat flour. It was found that the content of raw gluten decreases slightly when amaranth flour is introduced. With an increase in the dosage of the additive, the structural and mechanical properties of gluten change. The addition of amaranth flour contributes to increased gas formation in the dough. During the research, the effect of amaranth flour on the quality of wheat bread made by various methods was studied. The most optimal method of preparing bread when adding amaranth flour is the steam method with the addition of the additive directly into the liquid dough. The best quality of bread, taking into account its organoleptic indicators, is ensured by using activated pressed yeast prepared on a water-flour mixture containing up to 10% amaranth flour. The introduction of amaranth flour contributes to an increase in the biological value of bread by improving the amino acid composition and reducing the deficiency of essential amino acids in bread. The effect of crushed amaranth seeds on the baking properties of grade I wheat flour was studied, in particular, on the intensity of gas formation during dough fermentation. Crushed white and purple amaranth seeds were introduced with a replacement of grade I wheat flour in an amount of 5, 10, 15, 20, 25 and 30% and after baking at 180…190°C for 20–25 min. the results were compared with a control sample of wheat flour without the addition of amaranth seeds[18, 19]. It has been established that the introduction of 5% of crushed amaranth seeds has a positive effect on the gas-forming ability of the dough during fermentation, contributes to the improvement of the quality of bakery products and can be used in bread baking technology. Replacing up to 10% of rye flour with amaranth flour allows you to

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[18] Дорохович А. М., Божок О. С., Мазур Л. С. Тагатоза і мальтитол – інноваційна сировина при виробництві жувальної карамелі. *Харчова наука і технологія*. 2016. 1 (10). С. 43–48.

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obtain a new, quite tasty variety of bakery products – amaranth bread, which has good organoleptic characteristics and a more balanced amino acid composition compared to ordinary bread. The use of amaranth flour in the technology of bakery products in an amount of more than 50% is impossible, because it does not contain gluten, but at the same time, its introduction into bread recipes for enrichment and partial replacement of wheat flour is advisable. For this purpose, partially defatted amaranth flour from amaranth meal or flattened amaranth grains (amaranth flakes) is usually used. Whole grain amaranth flour contains a large amount of fat, which significantly reduces its storage capacity due to the rapid rancidity of the fat[20]. Due to its low moisture content, it makes sense to use amaranth flour as an additive to wheat flour, the moisture content of which exceeds the values allowed by the regulations. Due to the high acidity of amaranth flour, it is possible to reduce the duration of the fermentation process without the use of enzyme preparations. In terms of gas-forming ability, amaranth flour can be a good additive to wheat flour with strong gluten to improve the quality of semi-finished and finished products[21].

Due to its low moisture content, it makes sense to use amaranth flour as an additive to wheat flour, the moisture content of which exceeds the values allowed by the regulations. The high acidity of amaranth flour reduces the duration of the fermentation process without the use of enzyme preparations. According to the indicator of gas-forming ability, amaranth flour can be a good additive to wheat flour with strong gluten to improve the quality of semi-finished products and finished products[22]. The effect of amaranth flour addition on the baking properties of first and highest grade wheat flour and bread quality was studied.

The chemical composition of the technological additive is characterized by a higher content of carbohydrates (up to 72.5%), monosaccharides and disaccharides (up to 3.2%), fiber (up to 2.5%) and ash (up to 0.8%) compared to baking wheat flour. It has been established that the addition of amaranth cereal flour to the mass of wheat flour significantly improves the quality of bread. The volumetric yield of molded bread increases by 10.0–28.0% for high-grade wheat flour, by 3.0–10.0% for first-grade wheat flour; the specific volume of molded bread – by 8.0–26.0% for high-grade wheat flour and by 4.0–11.0% for first-grade wheat flour; shape stability of hearth bread (except for the dosage of 10.0%) – by 17.0% for high-grade wheat flour and by 8.5–12.8%

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[21] Буяльська Н. П., Гуменюк О. Л., Денисова Н. М., Челябієва В. М. Підвищення харчової цінності хлібобулочних і борошняних кондитерських виробів : монографія. Чернігів. 2020. 122 с.

[22] Дробот В. І., Іжевська О. П., Бондаренко Ю. В. Дослідження впливу шроту льону на якість хліба. *Зернові продукти і комбікорми*. 2015. 1 (57). С. 42–45.

for first-grade wheat flour. Organoleptic evaluation of bakery products from a mixture of wheat and amaranth cereal flour showed a significant improvement in its characteristics when introduced into the dough. The upper crust of the resulting products is more even, smooth and convex than in the control, golden in color. The porosity is more uniform with a small pore size, the crumb remains fresh longer, the skin is thin-walled. In bakery products made with amaranth cereal flour, the amino acid composition of proteins, their biological value and balance are significantly improved. The nutritional value of bread with the addition of amaranth cereal flour increases as a result of enrichment of products with proteins by 9.2%, fats by 28.2%, fiber by 1.5 times, organic acids by 1.3 times. The mineral composition of bread with the additive improves due to an increase in the mass fraction of potassium by 10.1%, calcium by 17.4%, magnesium by 12.1%, phosphorus by 22.6% and iron by 1.5 times, respectively. The vitamin composition of bread with the addition of the additive also improves: the content of thiamine increases by 2.3 times, riboflavin by 3 times, niacin by 1.1 times, respectively. The energy value of 100 g of bread with the addition of amaranth cereal flour increases by 16%[23].

3. Development of new technologies for health-promoting bakery products

A technology for the production of functional bread using amaranth cake and oil has been developed. Bread made from a mixture of wheat flour and amaranth processing products in a ratio of 97:3–85:15 has an increased protein content (by 3–10%), B vitamins, micro- and macroelements, a calcium and phosphorus ratio of 1:1.8 to 1:2.9, and an improved amino acid score of lysine and threonine. Adding 15% amaranth cake and 5% amaranth oil extract to the flour mass allowed to improve the organoleptic and physicochemical parameters of finished products, increase biological value by 24.5%, obtain bread with the most balanced amino acid composition, increase wetting and specific volume, and improve the digestibility of finished products. functional purpose[24].

The introduction of amaranth meal into the recipe of bakery products will solve the problem of the deficiency of essential nutrients in the population's diet. Studies of the effect of amaranth meal on the processes of gas formation and gas retention in dough showed that the introduction of amaranth meal intensifies the process of dough fermentation. When adding 5% amaranth meal, dough

[23] Дробот В. І., Приходько Ю. С., Бережна Г. О. Борошно сорго у технології безглютенового хліба. *Наукові праці Національного університету харчових технологій*. 2019. 25 (1). С. 208–214.

[24] Сова Н. А., Луценко М. В., Єніна Н. Ю., Васараб-Кожушна Л. Д. Насіння ненаркотичних конопель – перспективна біологічно активна сировина для харчової промисловості. *Зберігання і переробка зерна*. 2017. 9 (217). С. 16–19.

fermentation is reduced by 40%, 10% – by 45%, 15% – by 55%, 20% – by 75%. Probably, the intensification of dough fermentation is due to the fact that amaranth meal contains many nutrients: vitamins for yeast. It was found that when amaranth meal was added to the recipe of bakery products, the specific volume index decreased to 16.7%, porosity to 14% compared to the control sample without the additive. The acidity index, on the contrary, increased to 16% with an increase in the amount of the added additive from 5 to 20% to the mass of flour. According to the results of the conducted research, it was found that bakery products with the addition of amaranth meal in an amount of no more than 5% to the mass of flour were characterized by the best physicochemical and organoleptic quality indicators. When the additive was added to the mass of flour in an amount of more than 5%, the specific volume of the products, porosity decreased, and the surface condition, taste and smell deteriorated[25].

The effect of amaranth processing products (amaranth seed meal and crushed amaranth leaves) on the quality of fruit bagels was studied. The additives were previously ground to a powder state and added in amounts of 0.5; 1.0 and 2.0% by weight of flour. According to the results of the conducted studies of the effect of amaranth processing product additives on the quality of bakery products, namely fruit bagels, it was found that: with an increase in the amount of additives to 2%, the yield of raw gluten increases, while it becomes less extensible; due to the high activity of lipase and lipoxygenase of amaranth additives, flour gluten is strengthened; the introduction of additives increases the zymase and maltase activity of yeast, which accelerates the dough ripening process; the lifting force of yeast improves; the introduction of additives does not affect the moisture content of the dough; the moisture content of finished products decreases; the acidity of finished products with the use of additives increases. The additives in amaranth processed products do not have a significant effect on the organoleptic properties, the porosity of the products was the same, products with the addition of crushed amaranth leaves had a slight dark shade and a barely noticeable herbal flavor. Based on the conducted studies, the optimal dosages of additives to the flour mass were established: crushed amaranth leaves – 2.0%; amaranth seed meal – 2.0%[26]. The effect of amaranth flour on the adhesive properties of the dough, the effect of amaranth flour and gum arabic on the structural and mechanical properties of the dough for crackers, the effect of amaranth and flax flour of different qualities on the consumer characteristics and biological value of long-lasting,

[25] Фалендиш Н. О., Зінченко І. М., Блаженко М. С. Особливості виробництва органічного хліба з використанням конопляного борошна. *Харчова промисловість*. 2019. 25. С. 7–13.

[26] Кручаниця М. І., Миронюк І. С., Розумикова Н. В., Кручаниця В. В., Брич В. В., Кіш В. П. Основи харчування : підручник. Ужгород : «Говерла», 2019. 252 с.

sugary, buttery cookies were studied. Partial replacement of wheat flour with amaranth cake flour was proposed, which allows these products to be consumed by different groups of the population, especially those suffering from anemia. Muffin technologies have been developed with various types of gluten-free flour, including amaranth. Amaranth has also found application in the technology of biscuit products[27].

Cookies made from whole amaranth flour and wheat flour, preparation of composite cookies from amaranth, dry gluten-free mix for the production of cookies containing rice and amaranth flour, apple powder, powder containing pumpkin, beet, carrot or cranberry, white crystalline sugar, cooking salt, citric acid, baking powder. Researchers have developed a technology that ensures the preparation of the mixture by sequentially mixing amaranth flour, whole milk powder, cocoa bean husk powder, confectionery fat and caramel powder. The feasibility of adding amaranth flour in an amount of 25% for the preparation of a biscuit semi-finished product has been proven, which allows you to obtain a final product with a more uniform, thin-walled, elastic crumb. The use of crushed red and white amaranth grains in bread baking, previously soaked at (20±1)ºC, which were introduced into the recipe from 5 to 30% by weight of wheat flour, was investigated. Increasing the dosage of the additive above 15% led to uneven porosity, crumb sticking and the appearance of a foreign odor. It is more expedient to use amaranth, rather than crushed grains, which can be used as a BAS in other food products to increase biological value.

The optimal concentration of amaranth flour in the recipe of shortbread cookies and yeast cake was determined, which is 8% for cookies and 15% for cake. It was proven that adding fat-containing amaranth flour to wheat flour is advisable in an amount of up to 60%, which reduces the hardness of cookies and improves its organoleptic properties, while higher dosages (60–100% by weight of wheat) of flour worsen the consumer qualities of cookies. The use of amaranth flour for making cookies significantly improved the color of the products to golden brown, and considering the quality indicators, 25% replacement of wheat flour with amaranth was determined as optimal[28]. The effect of amaranth and flax flour of different qualities on the consumer characteristics and biological value of long-grain, sugar and shortbread cookies was investigated. To study the effect of amaranth flour on the quality of cookies, flour mixtures with a ratio of amaranth flour to wheat flour as 1:1, 3:5,

[27] Пахомська О. В. Науковий підхід до створення хлібобулочних виробів функціонального призначення. *Наукові праці НУХТ*. 2019. 25 (2). С. 276–283.

[28] Іоргачева Е. Г., Макарова О. В., Хвостенко Е. В. Використання іннуліновмістимої сировини в технології хлібобулочних і кондитерських виробів. *Нутриціологія, дієтологія, проблеми харчування*. 2010. 1 (10). С. 13–17.

1:3 and 1:7 were used. Sugar and shortbread cookies made with amaranth and wheat flour at a ratio of 1:1 and 3:5, respectively, are characterized by a golden brown color, a pleasant aroma and a nutty taste and are superior to traditional wheat cookies despite a slight decrease in the wettability of the products. It is advisable to introduce pre-hydrated flax flour in the recipe of sugar and shortbread cookies with amaranth flour in an amount of 5%, which additionally improves the shape of the products and increases their wettability. The biological value of the developed biscuit increases by 14–16%, the coefficient of the useful amino acid composition of the biscuit increases, in particular, due to the enrichment of the products with lysine, threonine, methionine, cystine[29]. The NUCT proposed a technology for a biscuit semi-finished product based on amaranth flour, the biscuit recipe is amaranth flour in an amount of 24.4–29.9%, which provides excellent organoleptic and physicochemical indicators of the finished products. The physicochemical indicators of amaranth biscuit are close to the main biscuit, which allows its introduction into production. It was found that the amount of essential amino acids, B vitamins, unsaturated fatty acids increased in amaranth biscuit, the final product has a more uniform, thin-walled, elastic crumb than in the control sample. An improved method of preparing a biscuit semi-finished product is proposed, in which, by introducing amaranth flour in a ratio of wheat and amaranth flour as 3:1, it provides an increase in the nutritional value of the finished product. The use of amaranth flour during the preparation of flour composite mixtures for the production of biscuit semi-finished products weakens the gluten of wheat flour and allows you to obtain a crumb with a well-developed porosity structure. An increase in the mass fraction of amaranth flour in the mixture of more than 25% leads to a decrease in the porosity and specific volume of the studied semi-finished products, which is associated with an increase in the mass fraction of lipids, the content of which in amaranth seeds varies within 7...10%, which leads to a decrease in the stability of the foam structure of the biscuit mass of this recipe composition.

Amaranth flour is used as a functional additive to increase the nutritional value of wafer sheets. The use of amaranth seed flour allows you to expand the range of wafer sheets. Its inclusion in the recipe increases the nutritional value of finished products, improves their structural and mechanical properties. According to the results of the research, analytical dependencies have been established that characterize the influence of recipe components on the quality indicators of the wafer sheet. The optimal proportion of amaranth seed flour

[29] Фомина О., Резникова Л. Цикорій прискорює бродіння тіста і збільшує газоутворення. *Хлібопекарська і кондитерська промисловість України*. 2007. 6. С. 18–19.

when used simultaneously in the recipe of wafer sheets is 8.0 and 4.0%, respectively, suggesting the improvement of the technology of bakery products using a preparation of dry amaranth leaves, crushed to a powder state, in a dosage of no more than 1%, as well as amaranth malt. The introduction of additives allows you to reduce the rate of sugar addition by half. If the amount of sugar is left within the recipe, then a significant reduction in the ripening period is possible. In addition, amaranth additives have a positive effect on the organoleptic properties of finished products. In Ukraine and the world, the population's interest in non-traditional types of oilseeds is growing, in particular chia seeds (Salvia hispanica) as a product that has certain beneficial properties for the human body[30]. When using wheat bread made with the addition of chia seeds in an amount of 10%, the human body will be additionally provided with calcium, phosphorus, copper, the amount of which increases by 2 and 10 times, respectively. Given the functional properties of amaranth and chia processed products, it is relevant to study the possibility of their use in the technology of bakery products, which, in turn, will contribute to expanding the range of health products. The use of amaranth flour and chia enriches bread with dietary fiber by 54% of the daily requirement, and also improves the amino acid composition of the product due to an increase in the content of leucine, valine, isoleucine, phenylalanine, threonine, lysine. Bakery products are an important component of the diet, they are well digested, as they have a loose crumb, in which proteins are optimally denatured, starch is gelatinized, sugars are dissolved, fats are emulsified, and shells are softened. This makes the components of bread easily accessible to the action of enzymes of the gastrointestinal tract. The appropriate composition and pleasant aroma of bread contribute to the secretion of digestive juices, stimulate appetite. Along with this, the physiological properties of bread need to be improved, since it does not contain enough physiologically functional ingredients, such as dietary fiber, a number of minerals (Ca, Zn, I, Se) and vitamins (B_2, B_3, A, tocopherol). Plant raw materials are recognized as a source of biologically active ingredients, since its components are in the form of natural compounds that are well digested by the body[31].

Flax seeds can be used as an additive (in the form of both defatted – meal and non-defatted flour – cake) to bakery products in order to increase their nutritional value. Flax seeds contain 3 groups of compounds characterized by specific biological action and functional properties: polyunsaturated ω-3 fatty

[30] Лебеденко Т. Є., Соколова Н. Ю. Аналіз сучасних технологій хлібобулочних виробів із пшеничного борошна та перспективи їх удосконалення. *Зернові продукти і комбікорми.* 2012. 2 (46). С. 38–43.

[31] Устинов Ю., Кот Г. Використання борошна із проса у хлібопекарському виробництві. *Хлібопекарська і кондитерська промисловість України*. 2014. 6 (115). С. 10–11.

acids, soluble dietary fiber in the form of mucilages and lignans, which have a phytoestrogenic effect. The protein content in flax seeds varies within 20...30%, and the proteins themselves are limited by lysine, but are characterized by a high digestibility coefficient (89.6%) and biological value (77.4%). A feature of flax seed proteins is also the high content of sulfur-containing amino acids – cysteine and methionine, which have antioxidant and geroprotective properties – protect the human body from the destructive effects of free radicals. The purpose of the research was to determine the chemical composition of flax seed meal and technological aspects of its use in baking production in order to give bakery products health-improving properties. The conducted studies have established that flax seed meal (FSM), which was used in the work, contains 32.6±0.3% protein, 10.5±0.25% total fat, 37.6±1.8% carbohydrates, of which 6.4±0.1% mucus. A comparative assessment of the chemical composition of FSM and first-grade wheat flour showed that FSM contains three times more protein; 7.7% fat; fiber 22.6 times than in flour. The ash content of SNL is 6.4 times higher, which correlates with a significantly higher content in it, compared to wheat flour, of potassium – 4.1; calcium and magnesium – 10; iron – 2.3; zinc – 3.2 times. SNL is able to enrich flour with B vitamins, the presence of folic acid and tocopherol in it, which is a natural antioxidant, is especially valuable. The composition of flour proteins is dominated by salt- and water-soluble protein fractions. SNL proteins have an amino acid score for lysine of 82, while wheat flour proteins only 44. The high content of hydrogen sulfide amino acids (with an amino acid score of 115) and aromatic amino acids (with an amino acid score of 128) is valuable[32, 33]. To establish the technological properties of SNL, its water absorption capacity, activity of amylolytic and proteolytic enzymes and coarseness were determined. It was found that SNL has a 3.25 times greater water absorption capacity than wheat flour of the first grade, and a 29% lower amylolytic activity. The activity of proteolytic enzymes was not detected by the casein determination method. In terms of particle size, SNL was close to the coarseness of wallpaper flour. In studies, it was found that it is advisable to replace wheat flour with flax meal in an amount of up to 5% in the bread recipe, a larger dosage of meal is accompanied by a deterioration in the organoleptic quality indicators of products, a decrease in their volume and dimensional stability. When developing product recipes using meal, it is necessary to include additional raw materials in their composition, which improves the consumer properties of bread. Given the content of such valuable

[32] Фалендиш Н. О., Бадрук Ю. В. Використання продуктів переробки конопляного насіння в хлібопеченні. *Хранение и переработка зерна*. 2016. 10 (206). С. 49–51.

[33] Федорова Т. Нетрадиційні види борошна в хлібопеченні. *Хлібопекарська і кондитерська промисловість України.* 2015. 6 (127). С. 9–12.

physiologically functional ingredients as unsaturated fatty acids, lignans and dietary fiber in flax and its processed products, bread with flax meal can be recommended for nutrition for people with diseases of the digestive system, cardiovascular system, diabetes, as well as for preventive purposes for a wide range of consumers. The effect of the degree of grinding of flax seeds on the quality of dough and wheat bread was studied. Flax seeds were ground in a laboratory mill and sieved through wire sieves[34]. The work used ground flax seeds (FLS), which passed through a wire sieve with a mesh size of 1.0 mm, 0.8 mm and 0.67 mm. Samples of ground flax seeds were divided by size – large, medium and small.

For the obtained samples of ground flax seeds, the water absorption capacity index was determined. It was found that ground flax seeds have a higher water absorption capacity than wheat flour due to the content of dietary fiber and mucus. Moreover, with a decrease in particle size, the water absorption capacity of ground flax seeds increases due to an increase in the area of the particles and more active interaction with water. This factor was taken into account when calculating the amount of water required for kneading the dough. To establish the effect of the size of ground flax seeds on the quality of bread, a test laboratory baking was carried out with its dosage of 20% to the mass of flour. The control sample was a dough sample without the addition of ground flax seeds. It was found that the use of ground flax seeds of different sizes slightly reduces the specific volume of finished products, however, it was noted that in the case of using a sample of small size, the products had a crumb that lost elasticity and was inelastic. In the case of a decrease in the size of the crushed flax seeds, a decrease in the lifting force of the yeast is observed due to a decrease in the maltase activity of the yeast. The addition of crushed flax seeds increases the spreading of the dough ball, compared to the control, after 60 min of fermentation, the more so the smaller its size. The results of the studies indicate a decrease in the gas-holding capacity of the dough with the addition of crushed flax seeds. It was noted that after 60 min of fermentation, compared to the control, the specific volume of the test samples decreases insignificantly, but after 120 and 180 min this difference increases, especially at the 180th minute of fermentation. Along with this, there is no noticeable difference between the samples with different sizes of crushed flax. The authors concluded that to enrich wheat bread with physiologically functional ingredients – crushed flax seeds – it is advisable to grind it to a particle size that passes through sieves with a mesh size of 1.0 or 0.8 mm. An increase in the degree of grinding of flax

[34] Фалендиш Н. О. Нові напрями збагачення хліба із застосуванням органічної нетрадиційної сировини. *Здобутки та перспективи розвитку кондитерської галузі* : матеріали МНПК. Київ. 2020. С. 62–63.

seeds leads to a deterioration in the structural and mechanical properties of the crumb of finished products. It was established that the duration of fermentation of dough samples using crushed flax seeds should be 120 min, which will allow to ensure maximum release of carbon dioxide at the stage of proofing of dough blanks, while ensuring sufficient gas-holding capacity of the dough and less swelling. These recommendations will allow to obtain products with crushed flax seeds of good quality[35].

Grain sorghum is a unique cereal plant in terms of its biological characteristics. Sorghum flour provides the human body with proteins, amino acids, fats and fatty acids, carbohydrates, vitamins, and trace elements. In turn, sorghum protein reduces blood cholesterol levels and normalizes the activity of the human digestive system. Sorghum fat contains many essential unsaturated fatty acids (83–88%), which are important for the prevention of atherosclerosis, heart disease and vascular diseases. Gluten-free raw materials include hemp flour, which is characterized by a significant content of unsaturated acids, glycerides, macro- and microelements, and amino acid composition. Due to the content of bactericidal substances, scientists recommend using it for the nutrition of patients with gastrointestinal diseases. Some studies indicate that hemp protein is equivalent to egg protein in terms of amino acid composition[36]. It has been established that out of 20 available amino acids, 9 are essential, that is, they are not synthesized by the body and are vital for normal functioning (histidine, phenylalanine, methionine, isoleucine, leucine, lysine, threonine, tryptophan, valine). The vitamin composition is no less rich, represented by fat-soluble (carotenoids, E, D, K) and water-soluble (groups B, C) vitamins. In terms of the content of minerals, the flour contains most of the necessary nutrients (zinc, magnesium, iron, phosphorus, manganese, sulfur, potassium, calcium, chlorine). Also in its composition, in an optimal ratio (1: 3), there are polyunsaturated fatty acids Omega-3 and Omega-6. The presence of these components provides anti-inflammatory, anti-stress effect, has a beneficial effect on the main systems of the body (nervous, cardiovascular, digestive, endocrine and reproductive)[37]. As a result of studies using hemp flour, which contains proteins balanced in amino acid composition, polyunsaturated fatty acids, dietary fiber, as well as vitamins and minerals, it was established that it is appropriate to use it in the production of organic bread from first-grade

[35] Горба О. О. Природно-ресурсний та енергетичний потенціали: напрями збереження, відновлення та раціонального використання : монографія. Полтава : Астрая. 2019. 279 с.

[36] Ярошевич Т. С., Ярошевич О. М. Сучасні тенденції у формуванні якості хлібобулочних виробів. *Товарознавчий вісник*. 2013. 6. С. 258–262.

[37] Овсієнко С. М., Науменко О. В. Використання біологічно активних речовин у хлібопеченні. *Продовольчі ресурси.* 2021. 9 (17). С. 107–118.

wheat flour. The introduction of 10…20% hemp flour helps to intensify the dough ripening process and reduce the duration of the technological process by 8–20 minutes[38]. Consumption of bread containing 10 % hemp flour provides an increase in the coverage of the daily human body's need for proteins by 9.5%, fats and fiber by 5.5 and 13.6%, respectively, and also increases the human body's supply of ω-3 and ω-6 fatty acids by 37 and 29%. In bread containing hemp flour, the content of B vitamins and minerals (phosphorus, magnesium, calcium, iron) increases.

Bird cherry flour is of interest to the food industry. This raw material contains tannins, flavonoids, phytoncides, antioxidants that can neutralize the action of free radicals, reduce the risk of malignant formations, help strengthen the walls of blood vessels, and have an active antimicrobial effect. Bird cherry flour contains a significant amount of essential amino acids (leucine, valine, phenylalanine), therefore it is a promising raw material for the production of bakery products[39]. A new raw material for bakery production is green buckwheat flour. The difference from the usual one is that it is a product made from thermally untreated buckwheat grains, which contain an expanded set of nutrients, including: fiber, calcium, magnesium, sodium, potassium, phosphorus, chlorine, sulfur. It also contains a significant amount of vitamins. It is worth noting that the bioavailability of vitamins from green buckwheat is significantly higher than that of regular buckwheat. This is an indicator of how quickly and to what extent the vitamins of this product are absorbed. To ensure a balanced diet, it is necessary to develop new food products that have increased nutritional and reduced energy value due to the reduced content of sugar, fat and other high-calorie recipe components and the introduction of components with functional properties into the recipe. Bakery products made from wheat flour of the highest and first grades contain a high amount of easily digestible carbohydrates. To reduce the energy value of such products, structural polysaccharides of plant cells (dietary fibers, pectin substances, hemicellulose, etc.) are introduced into their composition[40]. By replacing part of the fat, sugar and eggs with boiled and pureed vegetables (cabbage, carrots, beets, pumpkin), bakery products are enriched with vitamins, mainly beta-carotene, and their calorie content is reduced. To enrich bakery products with vitamins, organic acids, sugar, mineral and pectin substances, in Ukraine, products of fruit

[38] Олійніченко О. В., Жукова Я. Ф., Копилова К. В. Класифікації харчових полісахаридів за хімічною природою та функціональним призначенням у молочних продуктах. *Продовольчі ресурси.* 2016. 6. С. 181–193.

[39] Інноваційні технології харчової продукції функціонального призначення : монографія. / за ред. О. І. Черевка, М. І. Пересічного. Харків : Харк. держ. ун-т харчув. і торгівлі, 2017. 940 с.

[40] Даценко А. О Способности пектинов к студнеобразованию. *Хлібопекарська і кондитерська промисловість України.* 2015. 7–8. С. 56–58.

processing (apples, quince, grapes, black currants, etc.) and vegetables (carrots, beets, tomatoes, pumpkin, etc.) are used. These include juices, purees, candied fruits, jams, powders, etc.[41]. Bakery products play a special role in the diet of the population, as they are consumed daily, and therefore their nutritional value is of significant importance. The intake of proteins, fats, carbohydrates and other components with food products should be accompanied by the introduction of an appropriate amount of ballast substances. In this regard, in recent years, more and more attention has been paid to the issue of including dietary fiber in recipes [42]. The effect of adding nettle meal in an amount of 3% to the mass of flour on organoleptic indicators (crust color, crumb elasticity, taste and aroma of bread) has been studied; at the same time, the process of slowing down staling is noted, the content of vitamins C, P and K, β-carotene and minerals increases[43].

CONCLUSIONS

The worldview function of bioethics is to determine the scope of certain "universal" moral norms in different cultural contexts. In most so-called traditional societies, "universal" principles are known, but have specific features in the scale and areas of their application. For example, in a traditional society, there may be moral equivalents of ideas about the "value of the human person" and corresponding codes of conduct. But such codes have significant limitations and exclusions in relation to different contingents of people based on ethnicity, place of residence, social status, gender and age. Bioethics as a special worldview is open to change. Historically, Potter's survival ethics gave birth to pragmatically oriented South American principledism. That, in turn, initiated European bioethics, biolaw and global ethics as a combination of medical and environmental directions. In Ukraine, the formation and development of bioethics is additionally influenced by processes related to the tasks of creating a market mechanism of the economy and the formation of a society inclined to the ideals of democracy and humanism. Medicine and healthcare in our country are becoming one of the priority areas of public life. The modification of doctor-patient relations is significantly influenced by the increase in medical awareness of the population, the understanding that the

[41] Крапивницька І. О., Перцевой Ф. В., Омельчук Є. О. Наукові та практичні аспекти пектину і пектинопродуктів : монографія. Суми : Сумський національний аграрний університет, 2015. 314 с. С. 251.

[42] Перцевой Ф. В., Камсуліна Н.В., Дроменко О. Б., Діхтярь А. М., Котляр О. В., Омельченко С. Б. Харчові технології : навчальний посібник у 2-х ч. Харків–Суми : ХДУХТ, 2020. 208 с.

[43] Іоргачова, К. Г., Лебеденко Т. Є. Хлібобулочні вироби оздоровчого призначення з використанням фітодобавок : монографія. Київ : К-Прес, 2015. 464 с.

health of a person and his children is primarily the subject of his own concern and responsibility. A scientific worldview helps solve practical problems. The worldview function of bioethics contributes to the protection, preservation and sustainable development of life using ethical mechanisms and principles. In the modern world, GM products are an integral part of the economy of most countries in the world. At the same time, there is no unified scientific, social and legislative framework in this area, which dictates the need for further intensive research aimed at improving technologies for obtaining GMOs and a comprehensive study of the biology of transgenic plants.

The main reason for the decrease in the production of bakery products by Ukrainian bakeries in recent years (from 1990 to 2010) is their rational use, which can be considered a progressive phenomenon. With a balanced diet, an adult in our country needs 120–125 kg of bakery products per year, or 350–360 g per day. Rye flour bread should account for approximately a third of the total consumption of bakery products. Bakery products are the most important food product for people in most countries of the world, and for a long time there has been a tendency to reduce their consumption. Over the past 50–60 years, global consumption of bakery products has decreased by approximately two to three times. In Western European countries, bread consumption is much lower than in Ukraine. It does not exceed 120 g per person per day, or 43–45 kg per year (in Germany – 80–83 kg). Through the trade network of officially registered enterprises that carry out retail trade, bakery products worth UAH 1.8–2 billion are sold annually. It is worth noting that today in Ukraine there are many private small bakeries that successfully compete with bakeries. These enterprises produce high-quality products and are as close to the consumer as possible. In recent years, many bakery products have been produced at home, especially in rural areas. This is facilitated by the cultivation of grain by farms and the presence of a large number of minimills.

SUMMARY

Bread and bakery products are one of the main human food products. Preservation of health and working capacity of the population, increasing longevity and improving the quality of life are the priority tasks of the state. The strategic goal of today's world is the creation of “healthy” food, the main direction of which is to reduce the consumption of saturated fats, sugar, salt and increase the consumption of dietary fiber, minerals, vitamins, antioxidants, etc. Of particular importance is the development of recipes for functional flour products, maximally balanced in terms of basic nutrients, as well as enriched with various additives of animal and plant origin, which give flour products adaptogenic, biostimulating, antioxidant and other functions. In the food

industry, bread baking is the main industry that produces various varieties of bread, bakery and bagel products, medicinal and dietary bread products, butter and plain crackers. The bakery industry is an important component of the food complex of Ukraine. Modern baking production is characterized by a high level of automation and mechanization of technological processes, the introduction of new technologies and the expansion of the range of bakery products.

The extremely important and exceptional role of bread has led to the formation of a special attitude towards this product in society, and has given strategic importance and social responsibility to enterprises in the industry. On the one hand, this has become a guarantee of stable demand in the market for bread products, and on the other, since their price and quality, physiological properties and safety, assortment and production volumes are in the center of constant attention not only of industry specialists, but also of the population, government bodies and the media, increased control and attempts at external regulation have led to a significant complication of the work of bread factories, aggravation of problems and the need to solve a number of tasks. Firstly, rapid changes in the life of modern man, a decrease in the health indicators of Ukrainians make it urgent to formulate more stringent requirements for indicators of nutritional value, physiological properties and safety of bread products, the content of synthetic additives, potentially harmful substances and allergens. Secondly, taking into account the significant natural potential in adjusting the nutritional status, the mass and constant consumption of bread, nutritionists note the relevance of studying world experience and activating domestic developments of product technologies capable of strengthening and protecting human health in modern conditions, preventing the spread of non-communicable, "environmentally caused" and occupational diseases. Thirdly, in the context of Ukraine's integration into the world community, for domestic baking enterprises, the preparation of bread at which is characterized by higher energy, material, and labor costs, with a disparity in the growth of prices for cost components and products, the issue of increasing the efficiency and investment attractiveness of production is extremely important. Solving tasks and overcoming problems in the industry are significantly complicated by the peculiarities of the organization and the multifaceted nature of the technological process, the uniqueness of the characteristics of flour systems. The preparation of bread products is the result of a complex of interdependent and coordinated physical, colloidal, biochemical, microbiological and other processes, the formation of product quality depends on many objective and subjective factors, primarily the properties of raw materials, technological process parameters, which are characterized by dynamism, a certain uncertainty, and the random nature of changes. All this, combined with the decrease in the quality of raw

materials, the inclusion of non-traditional functional ingredients in recipes, the increase in prices for energy carriers, equipment, etc., significantly complicates the development of measures to regulate the properties of flour systems, manage processes that ensure the transformation of biopolymers and biologically active substances, adjust the species composition, activity of the microflora of semi-finished products, the ultimate goal of which should be a comprehensive improvement in product quality and giving it physiological properties. The innovative dynamic development of the baking industry requires an integrated approach, development and implementation of technological solutions that will ensure a balance in the formation of all product quality criteria from the modern positions of consumers, nutritionists and manufacturers.

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