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ANALYSIS OF THE CHEMICAL COMPOSITION OF WHEAT GERM AND OILSEED FLAX SEEDS

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ANNOTATION

Bakery products are made on the basis of refined raw materials and have an unbalanced composition of nutrients. The aim of the work was to develop recipes and technologies for bread with biological value from a multicomponent mixture (MS) of dry components using vegetable raw materials. The work was performed at the Namangan Institute of Engineering and Technology. Bread formulations have been developed, which include: wheat flour, baking yeast, table salt, persimmon powder, wheat germ (PP) and oilseed flax (SL). A technology for making MS bread is proposed, which provides the most complete binding of liquid vegetable oil with prescription components. The results of determining the organoleptic and physico-chemical quality indicators, changes in the storage process, the degree of satisfaction of the average daily need for nutrients and energy when using a single serving of bread from MS with wheat germ (PP) and oilseed flax (SL) are presented. The developed bread contains polyunsaturated fatty acids and tocopherols (vitamin E) in quantities that allow them to be classified as functional foods.

Key words: bakery products, bread, functional ingredients, mixtures of dry ingredients, natural additives, wheat germ, oilseed flax seeds.

Introduction

One of the main directions of food production development is the introduction of innovative technologies, increasing the production of new enriched, dietary and functional food products. This is due to the need to preserve and strengthen the health of the population, prevent diseases caused by inadequate and unbalanced nutrition, etc. Despite the efforts of the state and some positive trends in the nutrition of the population, the incidence of chronic diseases, the development of which is largely due to the alimentary factor, remains quite high. The diet of the majority of the population does not comply with the principles of a healthy diet, which contributes to the growth of overweight and obesity, increasing the risks of developing diabetes mellitus, diseases of the cardiovascular system, etc. In this regard, an urgent task is the development and implementation of recipes and technologies for bread products enriched with physiologically functional ingredients and sensory-adequate to traditional consumer characteristics [1]. The expansion of the range of bread products is achieved not only due to different ratios of raw materials. A sufficiently high consumption of bakery products makes it possible to consider them important products in the diet of the population of Uzbekistan, especially children and youth.

The purpose of this work was to develop recipes and technology of the national bread Obi-non, prepared on the basis of a multicomponent mixture (MC) of dry components using liquid vegetable oil. Currently, special attention is paid to the use of natural fortifiers in the production of bread and bakery products of the therapeutic and preventive direction. One of the ways to solve this problem is the use of cereal germs and oilseeds.

MATERIALS AND METHODS

The research was conducted on the basis of the scientific research laboratory of the Department of Food Technology of the Tashkent Institute of Chemical Technology.

The objects of the study were wheat germ (PP) and oilseed flax seeds (SL). Since the recipe for gluten-free bakery and flour confectionery products plans to completely replace flour with wheat sorghum flour (MS), in this case, this particular type of flour served as the object of comparison (control).

The chemical composition of the research objects was investigated [1, 2, 3].

The results of the quality analysis of the studied samples of PO and SL are shown in Tables 1-3.

The reason for choosing wheat grain (Triticum vulgare, Triticum durum) is the high content of high-value protein, essential fatty acids, tocopherols (their most active forms are α – tocopherol, and the total amount of β-, γ-, σ- tocopherols is 93 mg%, tocopherol acetate is 83 mg%), provitamin A, minerals. The oil of this product is a strong antioxidant and helps to improve the lipid composition of the blood [4].

PO obtained industrially at grain processing plants must comply with TU 9295-010-00932732-08 "Wheat germ flakes". In the research, the PO obtained in JSC "Dune" (Kashkadarya region, Uzbekistan) was used.

In Uzbekistan, currently, in accordance with the Decree of the President of the Republic of Uzbekistan dated 01/16/2019 No.PP- 4118 "On additional measures for the further development of the fat and oil industry" [5], a significant increase in the acreage of oilseeds, in particular flax, is envisaged to expand the range of vegetable oils. A strong argument for increasing the crops of this crop is its increased drought resistance, which is not unimportant for regions with dry and hot climates, water scarcity, which includes Uzbekistan. In addition, oilseed flax has a simple cultivation technology that does not require the use of insecticides, as a result, its food safety increases and profitability increases.

The work used flax seeds of the oilseed variety "Bakhmalsky -2" (Latin Línum usitatíssimum L.) obtained at Zamona Rano LLC (Tashkent region, Uzbekistan). SL supplied to enterprises of the processing industry must comply with the requirements of GOST 10582 - 76 "Oilseed flax seeds. Industrial raw materials. Technical conditions". This variety was bred in the Uzbek Grain Research Institute by selection from the Bakhmalsky- 1056 variety. The variety is early–maturing with a growing season from 74 to 77 c/ha, yield – 5.9...7.8 c/ ha, weight of 1000 seeds – 5.7...6.4 g, mass fraction of fat - 40.9% (6).

The basis for choosing oilseed flax seeds is their content of full-fledged amino acid composition of proteins, polyunsaturated fatty acids of the families ω-3, ω-6 and ω-9, dietary fibers and vitamins. The therapeutic effect of using flax seeds is also due to the presence of lignans - "natural hormones", mucus and linamarin glycoside. Flax seeds are recommended for use in inflammatory diseases of the bronchi, gastritis, peptic ulcer of the stomach and duodenum, chronic colitis. They contain water-soluble pentosans (mucus), which prevent the absorption of toxic substances formed in infectious diseases from the intestine, and linamarin glycoside, which regulates secretory and motor functions of the intestine [7,8,9,10,11,12,13].

The chemical composition of the studied raw materials was determined according to generally accepted methods. The organoleptic and physico-chemical quality indicators of the PO and SL are presented in Table 1. It was found that according to these indicators, the samples of the studied raw materials met the requirements of TU 9295-010-00932732-08 and GOST 10582 - 76. The SL was dry in terms of humidity (up to 8.0% inclusive), and "clean" in terms of purity (up to 90.0% inclusive).

Table 1

Organoleptic and physico-chemical quality indicators of wheat germ and flax seed

Indicators	The value of the indicators	
	ZP	*SL*
Appearance	Heterogeneous, rather loose	The seeds are whole, developed, dense in the fracture
Colour	powdery mass	Brown
Smell	Heterogeneous, from light to dark brown	Mild, characteristic cloying, odorless
Taste	Slightly pronounced, characteristic of the smell of wheat grain, without musty, malty and	Characteristic of flax seeds, without extraneous taste and bitterness
Mineral impurities	moldy odor	Not detected
Purity, %	-	94,0
Length/width/	-	3,8 / 1,8 / 1,0

thickness of seeds, mm		
Humidity, %	10,20±0,30	7,20±0,50
Acid number, mg KOH/g	5,7±0,30	1,80±0,10
Peroxide number, mM/kg	1,10±0,30	6,35±0,50

The chemical composition and energy value of the studied PO and SL samples are presented in Table 3.10.

Table 2

Chemical composition and energy value of the PO and SL

Name of the substance	The amount of the substance, in g/ 100 g of the product / g / 100 g of SV				
	product		CNF	RSP, as a % of the SNFP	
	ЗП	*СЛ*		*ЗП*	*СЛ*
Proteins (B)	25,80/28,70	19,53/21,04	76,00	33,95	25,70
Fats (G)	10,10/11,32	40,47/43,61	56,00	18,03	72,27
Carbohydrates (Y)	43,20/48,10	1,50/1,62	219,00	19,73	0,68
Fiber	5,80/6,44	27,70/29,85	20,00	29,00	138,50
Ash	4,90/5,44	3,60/3,88	-	-	-
B:F:Y	1,0:0,4: 1,7	1,0:2,1: 0,1	1,0:1,0:4,0	-	-
Calorie content, kcal	356	534	1684	21,14	31,71

From the data presented in Table 3.10, it can be seen that carbohydrates (on average 43.2%) and proteins (25.8%) dominate in the PO, while fats (40.47%) and dietary fiber (27.7%) dominate in the SL. The calculation of the degree of satisfaction of the average norm of physiological need (SNFP) of the nutrient showed that 100 g of PP satisfies the need for protein by 33.95%, and SL – by 25.7%. The calculated average values (RSP) for fats and fiber in SL exceed similar values in PP by 54.25% (abs.) and 109.50%, respectively. In addition, the PO is a less high-calorie product compared to the SL.

There is also an imbalance in the composition of proteins, fats and carbohydrates in these products.

In terms of composition and nutritional value, ZP proteins are close to physiologically active proteins of animal origin (proteins of powdered milk, chicken eggs, casein). A wide range of amino acids has been found in the protein component of the PO, a significant part of which are essential. The embryo proteins include albumin, globulin and protease [14], are limited in methionine and cystine, while the AX for lysine (the world's most deficient amino acid) is on average 111%, the biological value is 73.0±1.5%.

SL proteins are mainly represented by globulins (linin, conlinin) and glutelin; albumins and glutein are absent, limited in lysine, but characterized by high levels of arginine and glutamic acid, as well as high digestibility coefficient (89.6%) and biological value [15].

The fatty acid composition of the studied raw materials for the main essential fatty acids is presented in Table 3.11.

Table 3
The content of essential fatty acids in ZP and SL oil

Name of the fatty acid	The amount of fatty acid, in g/ 100 g of the product	
	ЗП	*СЛ*
	1,665	3,663
Saturated Fatty Acids (EFAs)		
Polyunsaturated fatty acids (PUFA) :	0,723	5,910
- linolenic acid (ω - 3)	5,287	22,813
- linoleic acid (ω - 6)	1,332	7,361
- oleic acid (ω - 9)	1,0 : 7,3	1,0 : 3,9

The main component (up to 60.0...70.0%) of ZP oil is polyunsaturated linoleic acid. In addition, the product contains glycerides of linolenic, oleic, palmitic and stearic fatty acids, lecithin, carotene, vitamin E in significant amounts and vitamins B and F, micro- and macronutrients in an easily digestible organic form. It was found that the ratio of PUFA such as ω-3:ω-6 is 1.0 : 7.3 (Table.3.11) in oil, the PO refers to the upper permissible limit, namely 1 : 8.

SL contain a significant amount of fat (35.0...45.0%), mainly represented by triglycerides, which is characterized by a high level of polyunsaturated fatty acids (PUFA), especially α-linolenic acid of the family ω-3, low content of saturated fatty acids (9-10% of the total) and a relatively high level (about 20%) of monounsaturated fatty acids, mainly oleic [16]. It was found that the ratio of ω-3:ω-6 is 1.0:7.3 (Table.3.11) in SL, it is almost ideal, which once again confirms the expediency of using this raw material as a functional ingredient for flour products for a specific purpose.

These acids are involved in the synthesis of hormones that regulate metabolic processes in cells, have an effect on cardiovascular activity, are necessary for proper growth and functioning of the human body, they are part of all cell membranes and membranes, and their deficiency leads to extensive pathological changes in various organs [17].

Comparative analysis of the chemical composition of the studied products (Table.3.10) with MS (Table 3.4) showed that the mass fraction of the protein fraction in PP and SL is 17.87 and 10.21, fat – 9.91 and 42.20, fiber – 4.44 and 27.85 g/ 100 g of CB is higher than in the comparison sample. At the same time, ZP and SL have 37.13 and 83.61 g/100 g of SV less carbohydrates than in MS.

The results of the study of the mineral and vitamin composition of the gluten–free raw materials under study are shown in Table 3.12.

Table 4

Mineral and vitamin composition of the studied gluten

–free raw materials

№	Name of the substance	The content in 100 g of the product, mg	
		ЗП	*СЛ*
Mineral substances			

1	Potassium	890,4	832,5
2	Calcium	38,7	150,5
3	Magnesium	237,8	698,0
4	Phosphorus	840,7	780,3
5	Iron	6,5	9,8
6	Manganese	13,0	124,1
7	Selenium, mcg	78,8	46,2
8	Zinc, mcg	12,2	36,2
Vitamins			
1	Carotenoids	-	-
2	Thiamine (B1)	1,87	1,96
4	Riboflavin (B2)	0,51	0,17
5	Pyridoxine (B6)	1,34	0,52
6	Niacin (PP)	6,87	3,54
7	Vitamin E, Alpha tocopherol, TE	9,8	9,5

In terms of the content of B vitamins and a number of minerals, SL are close to cereals and are practically not inferior to ZP. An important component of the PO is the presence of essential polycosanol (from 1.5 to 8.0 mg/100 g), which prevents the development of atherosclerotic disorders, affects the proliferation of muscle cells, stimulates active oxygen consumption by tissues during physical exertion, improves neuromuscular functions, etc.. It is effective for muscle pain after intense physical exercise or with reduced endurance, as well as for muscular dystrophy and other neuromuscular diseases [18]. SL are a source of a unique essential element – selenium, which is necessary for the antioxidant protection of the human body, which has an immunomodulatory effect and participates in the regulation of the action of thyroid hormones. Deficiency of this element leads to osteoarthritis, endemic myocardiopathy, hereditary thrombasthenia, and other diseases [19]. A specific feature of flax seeds is the presence of a significant amount of mucus in them (5-12% of the weight of dry seeds). It is believed that flax mucus has moderate immunoprotective and radioprotective properties [20, 22, 23]. Flax seed lignans have a powerful antioxidant and anti-allergic effect. Their use in the treatment of atherosclerosis and coronary heart failure is based on this property [21].

CONCLUSION. The analysis of the content of physiologically active ingredients of flax seeds having a balanced chemical composition, having high nutritional and biological value, showed the possibility of using them as raw materials for the production of functional food products (food concentrates).

As a result of the conducted research on the analysis of the chemical composition, energy value (calorie content) and food safety of the studied additives, namely flour from sorghum, rice and chickpeas, wheat germ and flax seeds of the oilseed variety "Bakhmalsky -2", it was found that this raw material is advisable to use as prescription components in bread and flour confectionery. The introduction of vegetable raw materials processing products into the technological process of flour products production will eliminate the prescription amount of wheat baking flour and enrich the products with proteins, dietary fibers, biologically active oils, vitamins, minerals and other essential and minor substances.

The studied raw materials according to organoleptic and physico-chemical parameters meet the requirements for raw materials for use in the production of bread and flour confectionery products.

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