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PROSPECTS FOR THE USE OF WHEAT GERM PRODUCT IN THE PRODUCTION OF GRAIN BREAD FOR SPECIAL PURPOSES

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Abstract

The article considers the feasibility of using the germ product as an alternative substitute for wheat grain in the production of grain bread for special purposes. A comparative analysis of the fractional and chemical composition, biological value of the studied raw materials was carried out. The main quality indicators and therapeutic-prophylactic properties of wheat germ product are described. The expediency of using this product in the production of grain types of bread is substantiated.

Keywords: *wheat, grain, germ product, quality, medicinal properties, nutritional value, biological value*

In recent years, the problem of providing the population with high-quality and nutritious food products has become particularly acute, in the range of which grain types of wheat bread are of no small importance. However, as is well known, neither wheat grain, nor wheat flour of the highest and first grades, in terms of the content and balance of the most important macro- and micronutrients and structural components, is able to provide the necessary, according to the requirements of modern dietetics and nutritionology, a complete composition of the finished product.

One of the most promising ways to solve this problem is to include multifunctional natural raw materials in the formulation, in particular wheat germ product as an alternative to grain in the production of grain bread with a predicted health-improving effect, especially for dietary nutrition in senile asthenia and its main geriatric syndromes (malnourishment, sarcopenia).

The wheat germ product is obtained both in the grain cleaning and grinding department. The principle of embryo selection in the grain cleaning department is based on the separation of some part of the embryo during dry peeling of grain on paper or brush machines, followed by pneumatic separation of feed products (Juraeva N. R. 2017. P. 81–84; Babaev S. D., 2012. p. 16; Alekseeva T. V., P. 30–33).

The research used samples of wheat germ product (hereinafter referred to as WGP) obtained at JSC Dunyo-M (Uzbekistan). The comparison sample was wheat grain (hereinafter referred to as WG), which, according to GOST 9353–2016, belonged to type III wheat – soft spring white grain, subtype 4, class 3 (Fig. 1).

Figure 1. *Appearance of grain (a) and wheat germ product (b)*

a) b)

In terms of organoleptic (sensory) and physico–chemical quality parameters, the studied WGP met the requirements of TU 9295–010–00932732–08 "Wheat germ flakes, edible" for this raw material (Table.1), which determines the possibility of using this product as an alternative to wheat grain (wheat grits) in the production of grain bread, which will also improve the taste and aromatic properties of this product, which are particularly important for consumers (Table 1).

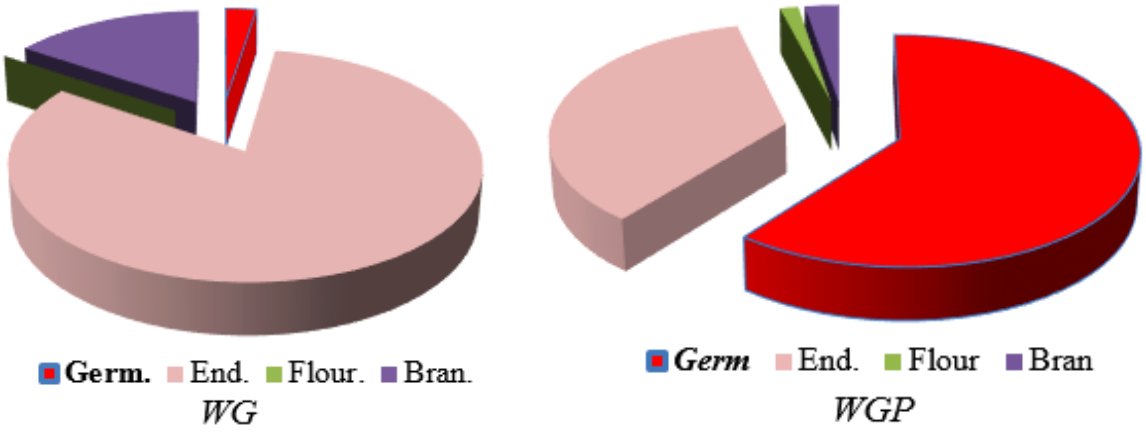
Next, the fractional composition of WP and WGP was studied (Fig. 2).

Table 1. *Organoleptic and physico– chemical quality indicators of wheat germ product*

Indicator	Characteristic
Appearance	Heterogeneous, loose mass
Colour	Heterogeneous, from light brown to brown
Smell	Characteristic, slightly pronounced, without musty, malty and moldy odors
Taste	Characteristic, with a nutty taste, without extraneous flavors
The presence of mineral impurities	Not detected
Humidity, %	12.50 ± 0.20
Volume weight, g/dm ^{3}	645 ±15
Weight of 1000 pieces, g	0.45 ± 0.50
Peroxide number, mM/kg	0. 90 ± 0.10
Acid number, mg KOH/g	5. 30 ± 0.20

The fractional composition of WG and WGP was studied (fig. 2)

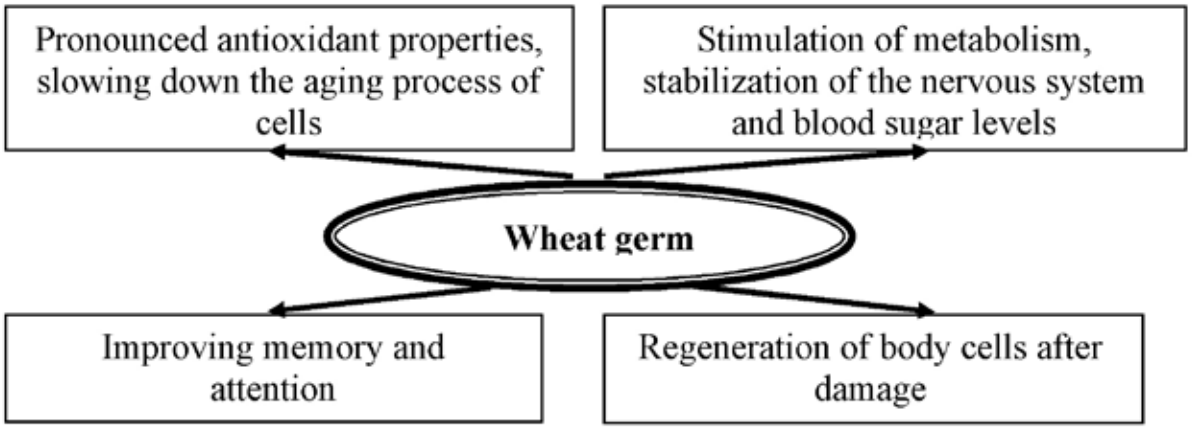
Figure 2. *The average fractional composition of wheat grain (WG) and germ product (WGP):* Ger. – germ, End. – endosperm, Flour. – flour-like feed, bran. –bran, shells, aleurone layer



As follows from the data obtained (Fig. 2), WGP contains on average 24...30 times more germ (~ 60.0...65.0% of the total weight of the product) and almost 2.4 times less than other parts of the grain (endosperm, flour, bran, amounting to about 35.0...40.0% of the total weight of the product), than the WG.

Particularly valuable components of this potential grain substitute are the high content of germs, which are the most nutritious part of it, which determines the prospects of its use for fortification of the functional properties of bread intended for the prevention and treatment of alimentary-dependent diseases (Fig. 3).

Figure 3. *Characteristics of the therapeutic and prophylactic properties of the wheat germ product as a raw material for the production of grain bread for special purposes*



WGP is characterized by an increased content of proteins, minerals, vitamins, and one of the most deficient and significant fatty acids, omega – 3, is found in its oil (Sergeev V. N., P. 143–152).

The uniqueness of this raw material also lies in the presence of polycosanol (germ oil, saturated with vitamin E), which has a beneficial effect on physical fitness, energy, and the cardiovascular system. Especially important for solving the main goal of the work, namely the development of a grain bread recipe for the prevention and treatment of the main symptoms of senile asthenia, is the proven effectiveness of germ oil in pain caused by muscular dystrophy and other neuromuscular diseases (Alekseeva T. V., P. 30–33; Sergeev V. N., P. 143–152).

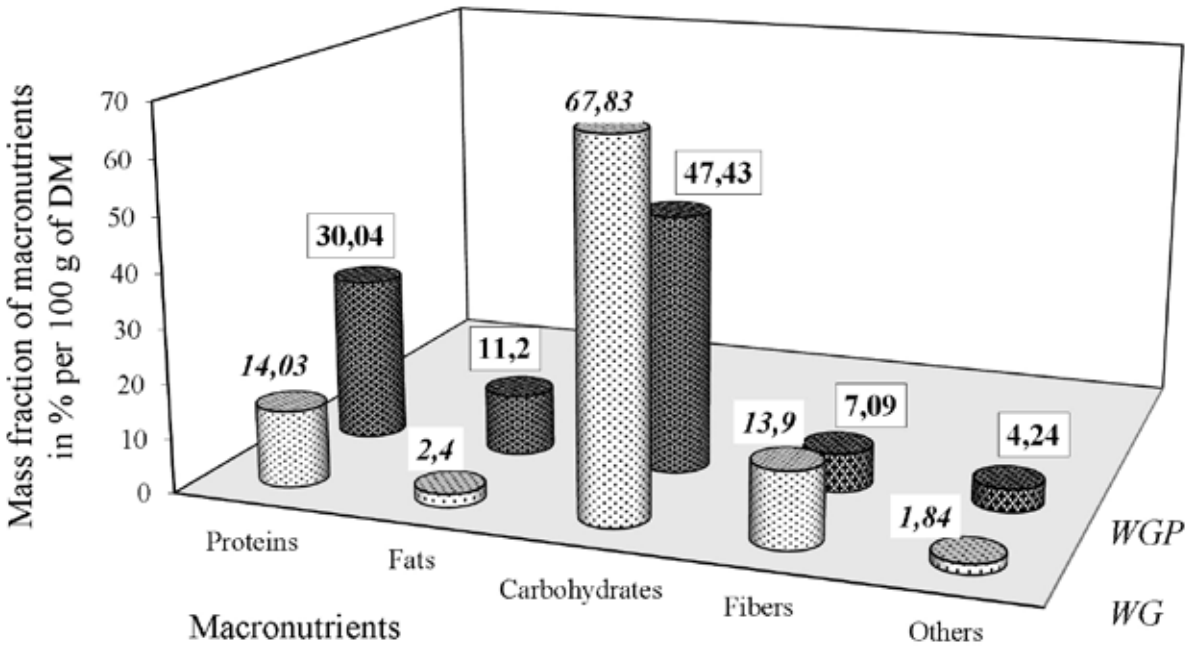
However, there are certain risks and limitations when using this product, as, in other respects, for almost all cereals. Thus, wheat germ contains gluten, which makes

it unsuitable for people with celiac disease or gluten intolerance. This product is subject to rapid oxidation due to its high fat content, which leads to its rapid rancidity and loss of useful properties, and phytic acid is found in it. The latter circumstance is not significant, since this problem is successfully solved by soaking or heat treatment of the product. In the case of bread production, in particular grain, these two stages of the technological process are envisaged (soaking and heat treatment – baking), therefore, the negative impact of phytic acid is practically canceled, that is, minimized. For food purposes, it is recommended to use a large and medium undisturbed germ, and a small destroyed one for forage purposes.

The results of a comparative analysis of the chemical composition that determines the nutritional value of raw materials, WGP, positioned as an alternative (substitute) for WG in the formulation of grain bread for special purposes, are shown in Figure 4 and in Table 2. For greater clarity and an objective assessment of the comparison of the studied raw materials with different humidity, the mass fraction of the main macronutrients was recalculated for dry substances (Fig. 4).

It was found that the content of proteins and fats in the WGP is quantitatively higher than similar indicators in the WG by an average of 2.1 and 4.7 times, respectively. At the same time, carbohydrates and dietary fiber in the study object are 1.6 and 2.0 times less than in the comparison sample, respectively.

Figure 4. *Composition of the main macronutrients in wheat grain and germ product, in % of dry matter (DM)*



It should be noted that the ratio of proteins and fats in the WGP has been slightly improved – 1.0:0.4, with this ratio in the WG – 1.0:0.2; the ratio of proteins: carbohydrates – 1.0:3.3 with optimal – 1.0;4.0.

It has been established that in terms of the content of certain, in this case important, minerals, namely calcium, magnesium, phosphorus and iron, WGP is inferior, and in terms of vitamins it surpasses WG, especially in terms of the mass fraction of tocopherols (vitamin E) (Table 2). At the same time, the mineral composition of these nutrients as in the control, and the experimental samples are not balanced in accordance with the requirements of modern nutritionology.

Table 2. *Mineral and vitamin composition of the studied raw materials*

Nutrients	The amount of nutrients in mg per 100 g of product/ grade	
	WG	WGP
Calcium (Ca)	51.00 / 1	26.80 / 2
Magnesium (Mg)	107.10 / 1	32.05 / 2
Phosphorus (P)	347.16 / 1	132.00 / 2
Iron (Fe)	5.28 / 1	9.12 / 1
Thiamine (B1)	0.39 / 2	2.20 / 1
Riboflavin (B2)	0.16 / 2	1.48 / 1
Niacin (PP)	6.82 / 2	7.32 / 1
Tocopherols (E)	2.20 / 2	34.05 / 1
Total points (rank)	12 / 2	11 / 1

The biological value of wheat germ is estimated very highly, especially in comparison with ordinary wheat flour. This makes them a useful addition to the diet, especially for those who seek to improve the quality of their protein intake and increase the intake of micronutrients. The biological value of WGP proteins was investigated (Amanov, B. N., & Nurmatov, J. J., 2023; Amanov, B. N., & Baqoyeva, S. S., 2023). The comparison sample was the WG and the reference protein according to FAO/WHO. The results of the study are shown in Figure 5 and in Table 3. It has been established that the protein in the PSA is almost 2.0 times more than in the WG. Accordingly, the content of essential amino acids (EAA) in the study object increased by an average of 3.0 times, since the mass fraction of the main sources of protein in the germ is almost 5.0 times higher than in the grain, in which up to 82.0% of the grain weight is accounted for by the endosperm (Fig. 5).

Figure 5. *Mass fraction of essential amino acids (EAA) in 100 g of grain and wheat germ product (in mg)*

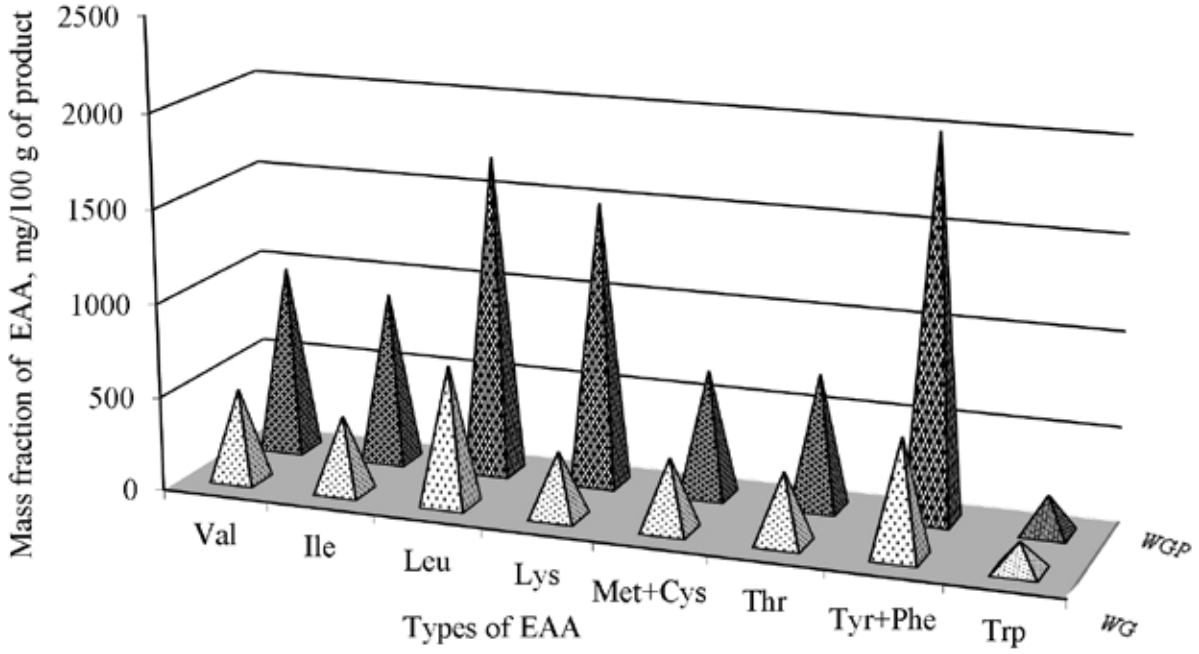


Table 3. *The matrix of ranking of the studied raw materials according to indicators of biological value*

Indicators of biological value	The value of indicators / Rank, score	
	WG	WGP
Mass fraction of protein, %	12.53/2	26.20/1
The total amount of EAA in the product, g/100 g of the product	3.330/2	9.814/1
EAA content in protein, g/100 g of protein	28.06/2	37.97/1
BCAA content, g/100 g of product	1.64/2	3.71/1
The minimum score for the 1st limiting amino acid (amino acid)	50 (Lysine)	73 (met. + cys.)
Total AKS (at NSR' = 0.93), %	67/2	95/1
Coefficient of imbalance of amino acid composition (CIA), %	32.5	29.0
Biological value of protein, %	67.5/2	71.0/1
Total rank, score / place	12 / 2	6 / 1

Of particular importance in this context, namely for the production of bread intended for preventive and curative nutrition in sarcopenia, is the increased content of lysine and BCAA amino acids (English branched-chain amino acids, BCAA), these include valine (maintains nitrogen balance, participates in regenerative processes), leucine (stimulates synthesis protein, regulates blood sugar levels) and isoleucine (participates in energy metabolism, provides muscle recovery), recommended for a number of diseases associated with depletion of muscle mass and their corresponding weakness (sarcopenia) (BCAA/ The material is from Wikipedia 2024; BCAA – its role in the body and effectiveness in sports. 2024).

It was found that the biological value of the WGP is almost 3.5% (abs.) higher than that of the WG (Table.3), and the value of the total Amino acods score (at SSD = 0.93) is approaching the "ideal" value (100%) and is 95% with a control value in the comparison sample of 67%.

Thus, the technological effectiveness of the use of WGP in the composition of grain bread for special purposes as a full-fledged substitute (substitute) for wheat grain (wheat grits) is substantiated. This replacement is also advisable in the sense that no pretreatment is required to use the WGP, the raw materials from the mill come ready for use, while the whole grain must be ground to medium size.

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