INFLUENCE OF FUNCTIONAL PROPERTIES OF PROTEINS FROM WHEAT BRAN IN BAKERY PRODUCTS

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Abstract: *To create a wide range of food products with controlled composition and nutritional properties for the production of protein products, it is advisable to use raw materials that actually exist in the country - wheat bran.*

In terms of water-binding capacity, bran protein flour is close to full-fat soy flour and surpasses all other protein products in this indicator (1.3-5.3 times). Protein products from bran have a high fat-binding ability to form an "oil in water" emulsion. Along with the ability to change the surface tension at the oil-water interface, bran protein products had a similar property in relation to the gas-water phases.

Keywords*: proteins, wheat bran, protein enrichment, functional properties, quality, nutritional value.*

Assessment of the quality of protein products of high biological value and multifunctional purposes obtained from wheat bran.

The optimal technological regimes for protein isolation and the rational type of grain raw materials have been determined[1,4]. They were total flow bran obtained from various technological process systems and providing a protein yield of 47-49%, as well as a granulometric fraction of total bran with a particle size of 196-670 microns, providing a protein yield of about 6% of the total protein content in the raw material[1,2,3,4].

Protein products from bran have a true digestibility value relative to casein equal to 9%, and an average value of biological value based on "growth characteristics" is 55.5%[5,6]. They contain more essential amino acids than the original raw material, and protein flour from the granulometric fraction (bran product) is richer than protein flour from total bran due to the presence of deficient lysine, threonine , as well as valine and leucine[7,8,9].

However, an analysis of the structure of protein nutrition in recent years shows that there is a shortage of dietary protein in the country and its deficiency is likely to persist in the coming decades [10,11,12].

To solve the problem of providing the population with cheap and high-quality protein, the rational use of raw materials of plant origin and the creation of food protein products based on them will become increasingly important. All over the world, wheat, along with soybeans, is widely used for these purposes due to its large resources, the historically established tradition of eating this crop and the absence of anti- nutrients [13,14,15].

In order to create a wide range of food products with controlled composition and nutritional properties for the production of protein products, it is advisable to use raw materials that actually exist in the country - wheat bran [16,17]. The share of protein in bran accounts for 25.6-29.2% of its total amount in the raw material [18,19].

As a result of comprehensive research[20,21], optimal technological regimes for protein isolation and a rational type of grain raw material were determined. They were total flow bran obtained from various technological process systems and providing a protein yield of 47-49%, as well as a granulometric fraction of total bran with a particle size of 196-670 microns, providing a protein yield of about 60% of the total protein content in the raw material[22,23].

They contain more essential amino acids than the original raw material, and protein flour from the granulometric fraction - bran product (BMOP) - is richer than protein flour from common bran in deficient lysine, threonine , as well as valine and leucine[24,25]. The limiting amino acid of both bran protein products is isoleucine, while, for example, in dry gluten it is lysine, and in soybean isolate - sulfur-containing amino acids (Table 1). It is important to note that protein products made from bran have higher levels of all amino acids without exception than dry wheat gluten, and protein flour from bran is higher than concentrate from the same bran.

Table 1. Amino acid score of protein products, %*

Amino acids	Are common bran	BMOO	Otrubnoy product	BM OP	Common bran concentrate	Dry gluten [1]	Soy isolate [2]
Valin	89	96	93	100	97	86	100
Leucine	93	120	101	127	111	98	117
Isoleucine	79	93	79	89	97	105	122
Threonine	90	104	98	115	100	60	95
Lysine	88	113	94	128	103	29	114
Sulfur-containing	137	154	140	142	128	97	77
Aromatic	121	156	128	152	153	128	142
Limiting			Isoleucine			Lysine	Methionin

*** The calculation is based on the 1973 FAO/WHO recommendations and - calculated data: - chemical composition of food products. Book 2. Ed. I.M. Skurikhin and M.M. Volgarev , 1987. [2] - advertising brochure of the company "Protein Technologies International"**

Protein products contain unsaturated fatty acids (85.9%), of which linoleic acid accounts for 72.9%, linolenic acid 6.7% and oleic acid 20.4%.

The carbohydrate part, along with starch, is represented by dextrins and maltose. The products also contain soluble and insoluble fiber. In terms of the content of vitamins B_2 and PP, as well as the amount of potassium, calcium, iron, sodium, protein flour from wheat bran is superior to the original bran, and in terms of the content of vitamins B_b 6, E and folic acid it differs little from them (Table 2) .

Table 2. Content of vitamins and minerals in bran protein products

Indicators	Flour	Concentrate	Bran
Vitamins, mg/100 g:			
IN:	0.82	1.08	1.14
AT 2	0.47	0.53	0.24
AT 6	0.58	-	0.88
B_s (folacin)	0.12	0.11	0.12
PP (niacin)	22.7	17.73	11.7
E (tocopherol)	32.3	33.1	34.5
Minerals, mg/100 g:			
sodium	152	90.5	53
potassium	1477	322	1312
calcium	323	85	94
magnesium	184	87	421
phosphorus	420	380	900
iron	28	8	12

An assessment of protein products, including sanitary and hygienic studies, showed that the samples met the established requirements for the content of heavy metals (nickel, chromium, lead, cadmium, arsenic, mercury, zinc and copper), if the starting raw materials did not exceed the MPC values. No aflatoxin found in protein products In_p zearalenone and pesticides. The amount of deoxynivalenol was within normal limits[26,27,28].

The theoretical justification for the use of protein products from bran in food production included the study of functional properties and their dependence on various technological factors and recipe components[29]. From the table 3 shows that the new bran products have all types of functional properties with the exception of gelation[30,31].

Protein flour from common bran has a lower solubility than animal proteins, but higher than wheat gluten or, for example, safflower meal isolate.

Table 3. Functional properties of protein products

Product	Solubility, %	VSS, y /y	ZhSS, y /y	ZhES, %	Emulsion stability, %	NOSE, %	SP, %
Bran protein meal (BPF)	16.0	3.9	4.2	8.9	97	99	83
Protein flour from the rub fraction (BMOP)	52.7	4.3	2.7	72	74	100	52
Bran protein concentrate	12.0	2.1	1.0	55	60	69	15
Non-defatted soy flour	72.1	4.7	2.1	46	52	27	38
Soy isolate *	38.0	-	-	74	65	113	77
Wheat gluten	3.1	1.2	1.7	57	61	65	43
isolate *	11.2	0.8	3.6	12	-	15	50
Egg powder	86.2	2.4	0.4	12	48	15	50
Powdered milk	78.4	1.8	1.9	32	22	10	0

* Literature data

In terms of water-binding capacity, bran protein flour is close to full-fat soy flour and surpasses all other protein products in this indicator. Protein products from bran have a high fat-binding ability, the ability to form an “oil in water” emulsion and stabilize the latter, as evidenced by the lack of coalescence and destruction of this emulsion when heated to 80°C. Along with the ability to change the surface tension at the oil-water interface, bran protein products had a similar property in relation to the gas-water phases[32,33]. In terms of foaming ability, protein flour, for example, was inferior to soy flour isolate , and in terms of foam stability it was superior to all other protein products. It is important to note that traditional animal protein products had lower functional property values than new products derived from wheat grain by-products[34,35,36].

The functional properties of protein products from technological factors and recipe components were also considered as a way to regulate these properties in order to maximize the potential for the production of high-quality food products with a strictly defined chemical composition. At the same time , both separate and combined effects of the above factors on the behavior of proteins in food systems and the quality of finished products using them were allowed[37,38,39].

The data obtained made it possible to expediently use protein products from wheat bran (Table 4).

Table 4. Functional properties and uses of wheat bran protein products

Functional properties	Method of action	Products that use the property
Solubility	Protein solubility depending on pH	Bakery products, flour confectionery products, extrudates , food concentrates
Fat emulsifying ability	Emulsion formation and stabilization	Sausage, flour confectionery, bakery products; mayonnaise, breakfast spreads, protein -fat semi-finished products and candy masses
Water-binding ability	Water retention	Bakery, sausage, confectionery products, cakes, biscuits, food concentrates
Fat-binding ability	Binding of free fats	Sausage and food concentrate products
Foaming ability	Formation of films to retain gas	Biscuits, creams, desserts, pastille marmalade masses

They are good emulsifiers, stabilizers, foaming agents, and also products that firmly retain fat and water.

Protein products obtained from wheat bran were characterized by high biological value and multifunctional properties[40]. The high nutritional and biological value of protein flour and concentrate made it possible to use them in the form of promising improvers of the composition and quality of food raw materials. Taking into account their amino acid composition, they are recommended as fortifiers or substitutes for protein products[41,42].

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