BIOLOGICAL VALUE OF PROTEINS FROM WHEAT BRAN IN BAKERY PRODUCTS

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Abstract: *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.*

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 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.*

The optimal technological regimes for protein isolation and the rational type of grain raw materials have been determined [1,2,4]. 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].

Scientific novelty. 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%. 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 [5,6,7,8].

Peculiarities.

-protein products from wheat bran have biological value;

-the addition of protein flour improves the quality of food raw materials.

Proteins are one of the main and essential components of healthy and nutritious food. 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 [9,10,11].

To provide 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 [12,13,14]. 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 [15,16,17].

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. The share of protein in bran accounts for 25.6-29.2% of its total amount in the raw material [18,19,20].

Protein products of high biological value and multifunctional purposes, obtained from wheat bran, the use of these products in the production of products for mass, preventive and dietary purposes [21,22,23].

As a result of comprehensive research[24,25,26], optimal technological regimes for protein isolation and a rational type of grain raw material were determined [27,28,29]. 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 [30,31,32].

Studies have shown that protein products from bran have a true digestibility value relative to casein equal to 94%, and an average biological value for “growth characteristics” of 55.5%. They contain more essential amino acids than the original raw material, and protein flour from the granulometric fraction - the bran product - is richer than protein flour from common bran in deficient lysine, threonine , as well as valine and leucine. 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 [33,34,35,36].

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

Amino acids	Are common bran	BMOO	Otrubnoy product	BMOP	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	Methionine

*** 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 (25-53%), is represented by dextrins (8.5-10.5%) and maltose (2.4-3.0%) [37,38]. The products also contain soluble (0.33%) and insoluble (2.9%) 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 $_{\mathrm{B\,b\,6}}$, $_{\mathrm{E}}$ 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, if the MAC values were not exceeded for the starting raw materials. No aflatoxin found in protein products In $_{p}$ zearalenone and pesticides [39].

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. From the table 3 shows that the new bran products have all types of functional properties with the exception of gelation.

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 emulsion type and stabilize the latter (stabilized emulsion - SE), as evidenced by the lack of coalescence and destruction of this emulsion when heated to 80°C. Along with the ability to change surface tension at the oil-water interface, protein products from bran had a similar property in relation to the gas-water phases. In terms of foaming ability (POC), protein flour, for example, was inferior to soybean 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 obtained from by-products of wheat grain processing [40,41].

The dependence of the functional properties of protein products on technological factors and recipe components was 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 [42].

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

Protein products obtained from wheat bran were characterized by high biological value and multifunctional properties. 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 [43].

LITERATURE

1. Аманов, Б. Н. (2013). Функциональное питание как основной фактор гармоничного развития личности. XXI аср-интеллектуал-инновацион ғоялар асри республика илмий-амалий семинар материаллари. *Материалы республиканского научно-практического семинара «XXI векинтеллектуально-инновационных идей». Ташкент*, 64-69.
2. Аманов, Б. Н., Исабаев, И. Б., Аманова, З. М., & Хайдар-Заде, Л. Н. (2021). Способы применения пробиотических бактериальных препаратов при производстве ржаного хлеба. *NVEO-Журнал О ПРИРОДНЫХ ЛЕТУЧИХ ВЕЩЕСТВАХ И ЭФИРНЫХ МАСЛАХ| NVEO*, 8152-8165.
3. Аманов, Б. Н. (2017). Новое хлебобулочное изделие с повышенными показателями качества. *Хлебопечение России*, (3), 20-22.
4. Аманов, Б. Н., & Бакоева, С. С. (2023). Оценка биологической ценности тыквенного порошка при использовании в производстве. *Жизненно важное приложение: Международный журнал новых исследований в области передовых наук*, *2*(1), 18-22.
5. Аманов, Б. Н., & Нодиров, А. А. (2022). Ржаной хлеб на сухой пароварке по дискретной технологии. *Пионер: Журнал передовых исследований и научного прогресса*, *1*(6), 45-49.
6. Аманов, Б. Н., Исабаев, И. Б., Атамуратова, Т. И., & Садыков, И. С. (2021). Влияние продуктов из томатного пресса на эффективность технологического процесса и качество ржаного хлеба. *Европейский журнал безопасности и стабильности жизнедеятельности (2660-9630)*, *6*, 12-20.
7. Аманов, Б. Н. ИССЛЕДОВАНИЕ ПОКАЗАТЕЛЕЙ НАЦИОНАЛЬНЫХ ХЛЕБЦЕВ. *ББК 36.81 я43 Т38 Редакционная коллегия: д. т. н., профессор Акулич АВ (отв. редактор) к. т. н., доцент Машкова ИА (отв. секретарь)*, *30*.
8. Аманов, Б. Н., & Нурматов, Д. Д. (2023). Пищевая ценность хлебобулочных изделий увеличивает ее. *Жизненно важное приложение: Международный журнал новейших исследований в области передовых наук*, *2*(1), 165-169.
9. Аманов, Б. Н., & Амонова, З. М. (2023). ДИСКРЕТНАЯ ТЕХНОЛОГИЯ ПРОИЗВОДСТВА РЖАНОГО ХЛЕБА НА ОСНОВЕ СЫРЬЯ. *Procedia of Теоретические и прикладные науки*, *3*.
10. Мухамедова, М. Е., & Аманов, Б. Н. (2023). ПРИМЕНЕНИЕ НОВЫХ ВИДОВ СЫРЬЯ В ПРОДУКТАХ ИЗ МУКИ ГРУБОГО ПОМОЛА. *Procedia of Теоретические и прикладные науки*, *3*.
11. АМАНОВ, Б. Н. (2016). РАСШИРЕНИЕ АССОРТИМЕНТА НАЦИОНАЛЬНЫХ ХЛЕБОБУЛОЧНЫХ ИЗДЕЛИЙ. In *Наука молодых-будущее России* (pp. 331-334).

12. Аманов, Б. Н. (2013). Методологический подход к проектированию рецептур хлебобулочных изделий с использованием композитных смесей. Ўзбекистон Республикаси фанлар академияси. *Ёш олимлар ахборотномаси илмий журнал*, (1-2), 39-44.
13. Аманов, Б. Н., & АЛЬБУМИНОВ, И. ИЗ ПШЕНИЧНЫХ ОТРУБЕЙ. *КОМПЛЕКСНЫЕ СОЕДИНЕНИЯ НИКОТИНАТА КАЛЬЦИЯ С АМИДАМИ*, *83*.
14. Аманов, Б. Н. МОДЕЛИРОВАНИЕ ХИМИЧЕСКОГО СОСТАВА КОМПОЗИТНЫХ СМЕСЕЙ ДЛЯ ХЛЕБОБУЛОЧНЫХ ИЗДЕЛИЙ. *ББК 36 Т38 Редакционная коллегия: д. т. н., профессор Акулич АВ (отв. редактор) к. э. н., доцент Козлова ЕА (отв. секретарь)*, *194*.
15. Аманов, Б. Н. ДИЕТИЧЕСКИЕ ХЛЕБОБУЛОЧНЫЕ ИЗДЕЛИЯ ДЛЯ ПИТАНИЯ НАСЕЛЕНИЯ. *ТЕХНИКА И ТЕХНОЛОГИЯ ПИЩЕВЫХ ПРОИЗВОДСТВ*, *76*.
16. Аманов, Б. Н., Амонова, З. М., Хайдар-Заде, Л. Н., & Файзуллаев, А. Р. (2021). Перспективы использования продуктов переработки томатов в производстве ржаного хлеба. *Анналы Румынского общества клеточной биологии*, 1009-1022.
17. Бакоева, С. С., & Аманов, Б. Н. (2023). Использование тыквенной муки при производстве полуфабриката для печенья. *ЕВРОПЕЙСКИЙ ЖУРНАЛ ИННОВАЦИЙ В НЕФОРМАЛЬНОМ ОБРАЗОВАНИИ*, *3*(2), 101-105.
18. Мухамедова, М. Е., & Аманов, Б. Н. (2023). Использование пищевых добавок при производстве сухариков. *ЕВРОПЕЙСКИЙ ЖУРНАЛ ИННОВАЦИЙ В НЕФОРМАЛЬНОМ ОБРАЗОВАНИИ*, *3*(2), 96-100.
19. Аманов, Б. Н., & Адизова, Н. Б. (2023). Пищевая ценность хлеба из муки сорта Веда. *ЕВРОПЕЙСКИЙ ЖУРНАЛ ИННОВАЦИЙ В НЕФОРМАЛЬНОМ ОБРАЗОВАНИИ*, *3*(3), 45-50.
20. Amanov, B. N., Amonova, Z. M., Khaidar-Zade, L. N., & Fayzullaev, A. R. (2021). Prospects for Using Tomato Processing Products in the Production of Rye Bread. *Annals of the Romanian Society for Cell Biology*, 1009-1022.
21. Бакоева, С. С., Аманов, Б. Н., & Амонова, З. М. (2023). Биологическая ценность тыквенного порошка при использовании в производстве. *ЕВРОПЕЙСКИЙ ЖУРНАЛ ИННОВАЦИЙ В НЕФОРМАЛЬНОМ ОБРАЗОВАНИИ*, *3*(4), 133-137.
22. Аманов, Б. Н., & Амонова, З. М. Хайдар-Заде ЛН и Файзуллаев АР (2021). Перспективы использования продуктов переработки томатов в производстве ржаного хлеба. *Анналы Румынского общества клеточной биологии*, 1009-1022.
23. Amanov, B. N., Isabaev, I. B., Amanova, Z. M., & Khaidar-Zade, L. N. (2021). Methods Of Application Of Probiotic Bacterial Preparations In The Production Of Rye Bread. *Nveo-natural volatiles & essential oils Journal| NVEO*, 8152-8165.

24. A.A. Nodirov, B.N. Amanov, & Z.M.Amonova. (2023). RYE BREAD USING DISCRETE TECHNOLOGY. *Multidisciplinary Journal of Science and Technology*, *3*(3), 350–355. Retrieved from http://mjstjournal.com/index.php/mjst/article/view/247
25. Muxamedova, M. E. ., & Amanov, B. N. . (2023). Treatment of Pullorosis in Chickens of Biological Control of an Incubation Egg. *EUROPEAN JOURNAL OF INNOVATION IN NONFORMAL EDUCATION*, *3*(6), 169–176. Retrieved from http://inovatus.es/index.php/ejine/article/view/1823
26. Baqoyeva, S. S., Amanov, B. N., & Amonova, Z. M. (2023). Biological Value of Pumpkin Powder when Used in Production. *EUROPEAN JOURNAL OF INNOVATION IN NONFORMAL EDUCATION*, *3*(4), 133–137. Retrieved from http://inovatus.es/index.php/ejine/article/view/1629
27. Amanov, B. N. ., & Adizova, N. B. . (2023). Nutritional Value of Bread from Veda Flour. *EUROPEAN JOURNAL OF INNOVATION IN NONFORMAL EDUCATION*, *3*(3), 45–50. Retrieved from http://inovatus.es/index.php/ejine/article/view/1528
28. Baqoyeva, S. S. ., & Amanov, B. N. . (2023). Use of Pumpkin Flour in the Production of Semi-Finished Biscuit. *EUROPEAN JOURNAL OF INNOVATION IN NONFORMAL EDUCATION*, *3*(2), 101–105. Retrieved from http://inovatus.es/index.php/ejine/article/view/1485
29. Muxamedova, M. E. ., & Amanov, B. N. . (2023). Use of Food Additives in the Production of Rusk Products. *EUROPEAN JOURNAL OF INNOVATION IN NONFORMAL EDUCATION*, *3*(2), 96–100. Retrieved from http://www.inovatus.es/index.php/ejine/article/view/1484
30. Amanov, B. N., & Nurmatov, J. J. (2023). Nutritional Value of Bakery Products Increasing It. *Vital Annex: International Journal of Novel Research in Advanced Sciences*, *2*(1), 165-169.
31. Amanov, B. N., & Baqoyeva, S. S. (2023). Evaluation of the Biological Value of Pumpkin Powder When Used in Production. *Vital Annex: International Journal of Novel Research in Advanced Sciences*, *2*(1), 18-22.
32. Amanov, B. N., & Nodirov, A. A. (2022). Rye Bread on Dry Steader by Discrete Technology. *Pioneer: Journal of Advanced Research and Scientific Progress*, *1*(6), 45-49.
33. Аманов, Б. Н., Исабаев, И. Б., Атамуратова, Т. И., Очилов, Ш. Б., Жаббарова, С. К., & Кусова, И. У. (2022). СОВЕРШЕНСТВОВАНИЕ ТЕХНОЛОГИИ ПРИГОТОВЛЕНИЯ РЖАНЫХ СОРТОВ ХЛЕБА. In *Совершенствование рациона питания населения, обеспечение качества и безопасности кулинарной продукции* (pp. 8-16).
34. Amanov, B. N., & Majidov, K. H. FUNCTIONAL PROPERTIES OF ALBUMINS FROM WHEATEN BRAN. *КОМПЛЕКСНЫЕ СОЕДИНЕНИЯ НИКОТИНАТА КАЛЬЦИЯ С АМИДАМИ*, 83.
35. Амонова, З. М., & Бухарский технологический институт пищевой и легкой промышленности. (2001). Технологические особенности выпечки мучных

изделий с применением ИК-излучения. Хранение и переработка сельхозсырья, (2), 16-17.

36. Sh.Sh.Baqoyeva, B.N.Amanov, & Z.M.Amonova. (2023). USING PUMPKIN FLOUR IN COOKIE PRODUCTION. Multidisciplinary Journal of Science and Technology, 3(4), 119–125. Retrieved from https://mjstjournal.com/index.php/mjst/article/view/314
37. B.N Amanov, Z.M.Amonova, B.S.Abdullayev, & Q.G.Majidov. (2023). STUDY OF THE FUNCTIONAL PROPERTIES OF PROTEINS FROM WHEAT BRAN IN BAKERY PRODUCTS. Multidisciplinary Journal of Science and Technology, 3(4), 102–108. Retrieved from https://mjstjournal.com/index.php/mjst/article/view/311
38. Sh.Sh.Baqoyeva, B.N.Amanov, & Z.M.Amonova. (2023). USING PUMPKIN FLOUR IN COOKIE PRODUCTION. Multidisciplinary Journal of Science and Technology, 3(4), 119–125. Retrieved from http://mjstjournal.com/index.php/mjst/article/view/314
39. Qodiraliyeva, H. G., Amanov, B. N., Iskandarova, S. M., Rahimova, M. Z., & Nurmatov, J. J. (2023). STUDY OF THE FUNCTIONAL PROPERTIES OF PROTEINS FROM WHEAT BRAN IN BAKERY PRODUCTS. Innovative Development in Educational Activities, 2(24), 13–22. https://doi.org/10.5281/zenodo.10431266
40. Qodiraliyeva, H. G., Amanov, B. N., Iskandarova, S. M., Rahimova, M. Z., & Nurmatov, J. J. (2023). FUNCTIONAL PROPERTIES OF PROTEINS FROM WHEAT BRAN IN BAKERY PRODUCTS. Innovative Development in Educational Activities, 2(24), 23–32. https://doi.org/10.5281/zenodo.10431302
41. Qodiraliyeva, H. G., Amanov, B. N., Iskandarova, S. M., Rahimova, M. Z., & Nurmatov, J. J. (2023). INFLUENCE OF FUNCTIONAL PROPERTIES OF PROTEINS FROM WHEAT BRAN IN BAKERY PRODUCTS. Innovative Development in Educational Activities, 2(24), 33–41. https://doi.org/10.5281/zenodo.10431318
42. Эргашева, Х. Б. (2002). Исследование технологических свойств пшеницы местных сортов (Doctoral dissertation, -Ташкент: ТХТИ).
43. Эргашева, Х. Б. (2000). Исследование влияния исходной характеристики зерна пшеницы на его мукомольные свойства./2-я международная научная конференция «Управление свойствами зерна в технологии муки, крупы и комбикормов». Тезисы докладов. М, 86.