

## CHARACTERISTICS OF FISH ZRAZY WITH BRASSICA OLERACEA (*BRASSICA OLERACEA* L. VAR. *BOTRYTIS* L.) IN QUALITY OF FUNCTIONAL INGREDIENT

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**Key words:**

*Functional product*  
*Pike perch*  
*Romanesco cabbage*  
*Fish zrazes*  
*Sulforaphane*  
*Complex quality*  
*Assessment*  
*Amino-acid scorpion*

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**Article history:**

Received 16.01.2019  
Received in revised form  
31.01.2019  
Accepted 08.02.2019

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**ABSTRACT**

The article describes the nutritional state of Ukraine population, conclusions are made on the possible improvement of it by developing of the product's technology from fish raw materials with the introduction of vegetable fillers, which will have improved organoleptic index, improved chemical composition, and recommended as a functional product for certain categories of population.

To develop a technology for preparing a new species of fish zrazes, it is advisable to use the meat of pike perch as an ingredient that has dietary properties.

As a natural functional product is chosen kind of cabbage the Romanesco. The comparative characteristics of the contents of essential amino-acids in the Romanesco protein and the commonly used foods are given. The Romanian's protein of cabbage is valuable, because it contains all the essential amino-acids in its composition. The feature of Romanesco cabbage is the contents of its compounds of campherol and sulforaphane. It's proved that they prevent the formation of cancer cells, make anti-inflammatory, antimicrobial, and antioxidant properties in humans.

The recipe has been developed and the technology of cooking fish fillets of pike perch and Romanesco functional cabbage with improved organoleptic properties and high biological value has been improved. The optimal ratio of ingredients in the formulation of a new type of fish species with Romanesco (fillet of pike perch and Romanesque cabbage) is established. A five-point scale of organoleptic quality assessment was developed based on indicators of appearance, color, consistency, smell and taste; on the basis of it a profilogram was constructed.

Harrington method provides a comprehensive assessment of the quality of the new species of fish zrazes "Fish zrazes with Romanesco cabbage" and proved the expediency of introducing the vegetable ingredient into the recipe of fish zrazes.

The calculation of the amino acid has shown that the protein of the fish zrazes with Romanesco cabbage is digested by 93.4%.

## **ХАРАКТЕРИСТИКА РИБНИХ ЗРАЗ ІЗ КАПУСТОЮ РОМАНЕСКО (*BRASSICA OLERACEA* L. VAR. *BOTRYTIS* L.) ЯК ФУНКЦІОНАЛЬНОГО ІНГРЕДІЄНТА**

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*У статті охарактеризовано стан харчування населення України, зроблено висновки щодо можливого його покращення за рахунок розробки технології продуктів з рибної сировини із внесенням овочевих наповнювачів, які будуть мати поліпшені органолептичні показники, покращений хімічний склад, а також рекомендовані як функціональний продукт для певних категорій населення.*

*Для розробки технології приготування нового виду рибних зраз доведено доцільність використання м'яса судака як інгредієнта, що має дієтичні властивості.*

*Як природний функціональний продукт обрано капусту сорту Романеско (*Brassica oleracea* var. *botrytis* L.). Надано порівняльну характеристику вмісту незамінних амінокислот у білку капусти Романеско та загальноживаних продуктів харчування. Білок капусти Романеско — повноцінний, адже у своєму складі містить всі незамінні амінокислоти. Особливістю капусти Романеско є вміст у її складі сполук кемпферолу та сульфорафану. Доведено, що вони запобігають утворенню ракових клітин, чинять в організмі людини проти-запальні, антимікробні, антиоксидантні властивості.*

*Розроблено рецептуру й удосконалено технологію приготування рибних зраз з філе судака та капусти Романеско функціонального призначення з поліпшеними органолептичними властивостями та підвищеною біологічною цінністю. Встановлено оптимальне співвідношення інгредієнтів у рецептурі нового виду рибних зраз з капустою Романеско (філе судака та капуста Романеско). На основі розробленої п'ятибальної шкали органолептичної оцінки якості за показниками зовнішнього вигляду, кольору, консистенції, запаху і смаку визначено, що найкращі показники має зразок рибних зраз із вмістом капусти 50%.*

*За методом Харрінгтона проведено комплексну оцінку якості нового виду рибних зраз «Рибні зрази з капустою Романеско» та доведено доцільність введення овочевого інгредієнта у рецептуру рибних зраз.*

*Розрахунок амінокислотного скору показав, що білок рибних зраз з капустою Романеско засвоюється на 93,4%.*

**Ключові слова:** судак, капуста Романеско, рибні зрази, сульфорафан, комплексна оцінка якості, амінокислотний скор, функціональний продукт.

**Formulation of the problem.** Nutrition plays a significant role in human life and has a significant impact on health, because it ensures the development of the

organism, efficiency, protects against harmful environmental conditions, is a way of prevention and treatment of diseases. For the Ukrainian population, there is a deficiency of essential amino-acids, polyunsaturated fatty acids, vitamins C, B, E,  $\beta$ -carotene, macro-and trace elements: Ca, Fe, Zn, F, I, and other, food fibers. The deficiency of protein in the body of an average Ukrainian is 20%, micronutrients and vitamins — 50%, fiber — 30%. As a result, diseases developing, which include heart disease, cancer, high blood pressure, obesity, etc. [1].

Organizing healthy food can't only extend the life expectancy, but also improve its quality. Providing the human body with essential amino-acids, essential fatty acids, minerals and vitamins is the main task of functional nutrition. The use of functional foods is one of the best ways to adapt to the physiological changes occurring in the body and to ensure resistance to the adverse effects of surrounding factors [2].

Fish products are in demand among consumers, but in the Ukrainian market the range of fish products of functional orientation is limited. Extension of the line of assortment positions of such products could be accomplished by developing recipes and improving the technology of products from freshwater fish with the introduction of functional components of vegetable origin [3].

**The analysis of recent research and publications.** the problem of the development of new technologies and approaches to the comprehensive processing of fish raw materials, expansion of the directions of their use in the food industry is devoted to the work L.S. Abramova, T.G. Rodina, V.M. Poznyakovsky, M.I. Peresichny, O.V. Sidorenko, T.K. Lebskaya, NV Pritulskaya. That they occupy the leading position in the development of this problem. For example, Sidorenko O.V. studies the chemical composition and nutritional value of raw materials that can be used in the technology of production of fish-plant products of functional purpose, substantiates the scientific basis of regulation of the composition and structure of new fish products. Peresichny M. I. develops and improves the technology of functional fish food products for people of intellectual work. Abramova L.S. Investigates the technologies of manufacturing polycomponent products and new types of child's food on the basis of fish raw material, emulsion products based on fish roe [1; 4; 5; 6; 7].

**The aim of the study** is to develop the recipe and improve the technology of new fish semi-finished products ("Fish zrazes with Romanesco cabbage") by improving the chemical composition, improving the organoleptic parameters by adding to the traditional formulation of fish species a functional food ingredient of vegetable origin and carrying out a comprehensive assessment of their quality.

**Presenting main material.** The object of research is fish semi-finished products — fish snails on the basis of pike perch with the addition of Romanesco kind cabbage.

The main ingredient of fish species could be various types of sea and freshwater fish, for example, bream, pike perch, silver carp, carp, sazan [8]. Table 1 shows the content of vitamins, micro-and macro elements in pike perch [9].

Due to the fact that the pike perch contains a significant amount of potassium, phosphorus, sulfur, iron, zinc, it is recommended in the diet of a wide range of

consumers. The disadvantage of semi-finished products made from meat of pike perch according to the traditional recipe [8] is low nutritional properties and low organoleptic parameters.

*Table 1. The content of vitamins, micro-and macro elements in pike perch [9]*

Water, г		Fats, г		Proteins, г		Carbohydrates, г	
79,2		0,8		19		—	
Macroelements (mg)							
K	Ca	Mg	Na	S	P	Cl	
280	35	25	35	188	230	50	
Microelements (mcg)							
Fe	I	Mn	Cu	Ni	Cr	Zn	F
500	5	50	110	6	55	700	30
Vitamins (mg)							
A	E	C	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>6</sub>	
0.01	1.8	3.0	0.08	0.11	1.0	0.19	

In order to enrich the fish zrazes, made according to the traditional formula, a variety of cabbage - Romanesco (*Brassica oleracea* var. *Botrytis* L.) was chosen as a physiologically functional natural ingredient. This cabbage vegetable is grown in Ukraine, but is not well-known among consumers and isn't included in their diet. The main peculiarity (*Brassica oleracea* var. *Botrytis* L.) is the absence of a specific cabbage smell and taste. It is characterized by a rich chemical composition, in 100 g of cabbage contains: proteins — 2.4 g, carbohydrates (including food fibers) — 5,2 g (2,9 g), vitamins B<sub>1</sub> — 0.1 mg, B<sub>2</sub> — 0.1 mg, B<sub>4</sub> — 45.2 mg, B<sub>6</sub> — 0.2 mg, C — 73 mg, E — 0.2 mg, β-carotene — 0.02 mg, sodium — 10 mg, magnesium — 17 mg, copper — 42 mcg, potassium — 324 mg, calcium — 26 mg, iron — 1400 mcg, phosphorus — 51 mg, manganese — 0.15 mg, fluorine — 1 mcg, zinc — 280 mcg [10]. By the content of vitamins and minerals, the Romanesco cabbage is not inferior to the traditional types of cabbage vegetables, it has a significant content of vitamin C, iron, magnesium, β-carotene, edible fibers [11].

The protein of Romanian cabbage is full, because it contains all the essential amino acids in its composition. By the content of essential amino acids, the Romanesco protein is approaching the protein of commonly used products — wheat bread, milk, pork, buckwheat [9; 10].

*Table 2. Comparative characteristics of the amino acid composition of Romanesco cabbage and common foods (mg/1g protein) [9; 10]*

Amino acid	Cabbage Romanesco	Wheat bread	buckwheat	Milk	Pork
Valine	59.60	42.55	47.6	59.6	55.6
Isoleucine	50.30	36.4	43.7	59.0	47.5
Leucine	59.60	68.4	78.6	88.4	75.4
Lycine	64.32	30.4	24.7	81.2	79.9
Methionine + cystine	18.2 + 23.9	15.3 + 21.6	15.3 + 21.4	25.9 + 8.1	23.4 + 13.6
Tryptophan	13.65	12.7	10.7	15.6	13.4
Phenylalanine + tyrosine	46.2 + 24.1	48.8 + 33.3	52.4 + 26.2	54.6 + 36.1	39.9 + 34.0
Treon	41.3	32.1	30.6	45.8	47.1

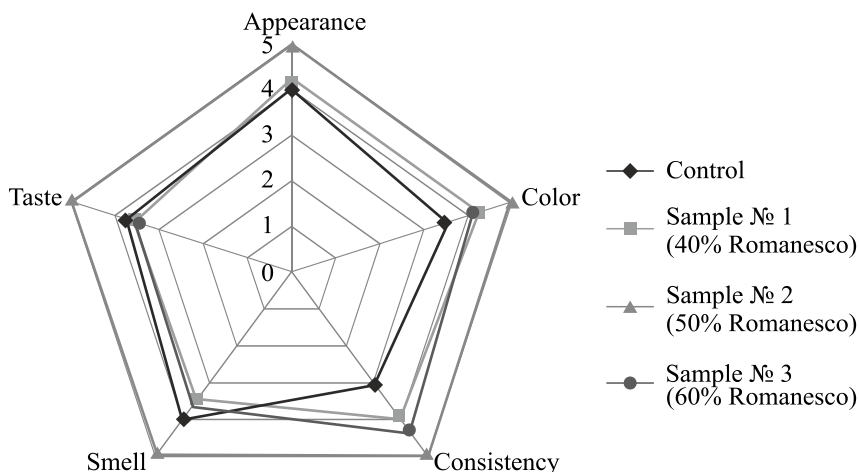
Romanesco’s cabbage has anti-inflammatory, antimicrobial, anti-oxidant properties, prevents the formation of cancer cells due to the content of camphers and sulforaphane [12].

In the development of technology of a new type of specimen, “Fish zrazes with Romanesco cabbage”, a sample prepared according to a traditional recipe consisting of chilled poultry fillet, bread, crackers, milk, onion, oil, mushrooms, salt [8].

In order to determine the optimal content of Romanesco cabbage in a new species of fish zrazes, its with 40%, 50%, and 60% content of fish are examined. According to the developed 5-point scale, an organoleptic assessment of the quality of the finished dish has been carried out; on the basis of it, a professor has been constructed (Table 3, Fig. 1). It has been established that the best organoleptic parameters have a sample of fish species with cauliflower content of 50% (fig. 1).

*Table 3. Organoleptic assessment of the fish zrazes “Romanesco cabbage”*

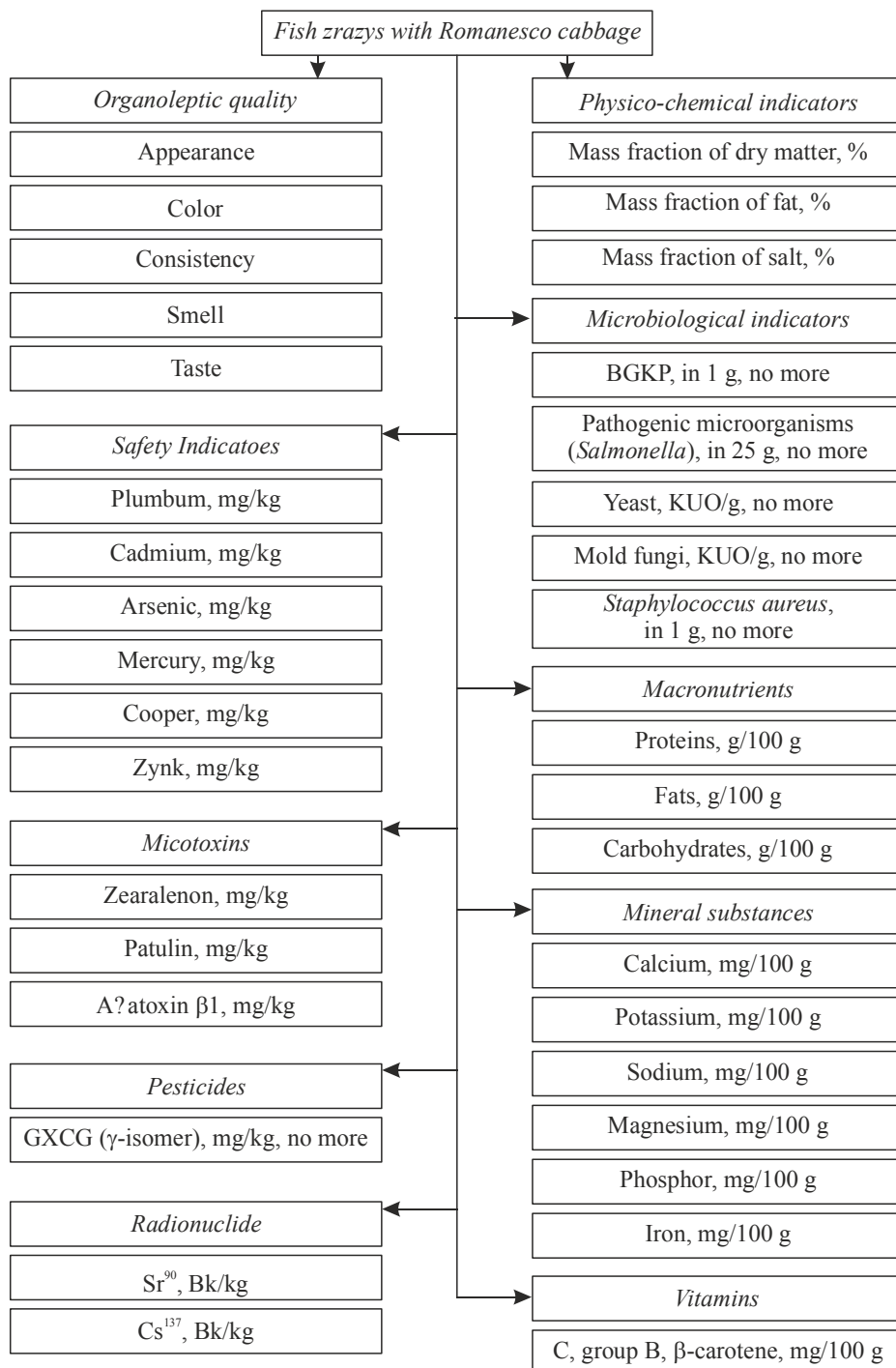
Characteristic	Samples			
	Control	Sample № 1 (40% Romanesco)	Sample № 2 (50% Romanesco)	Sample № 3 (60% Romanesco)
Appearance	4.1	4.2	4.9	3.9
Color	3.5	4.2	4.9	4.1
Consistency	3.1	4.0	5.0	4.4
Smell	4.0	3.5	4.9	3.6
Taste	3.8	3.6	5.0	3.5



**Fig. 1. Profilogram of the organoleptic properties of the fish species “Fish zrazes with Romanesco cabbage”**

The semi-finished products were cooked to steam, because with this method of heat treatment, the largest amount of vitamins is saved. It has been proved that steam preparation significantly minimizes the loss of sulforaphane [12].

Finished fish zrazes with Romanesco cabbage are correct oval, the color corresponds to the components, the consistency is juicy, tender, the smell and taste are pleasant, harmonious, without specific cabbage taste and smell.



**Fig. 2. Hierarchical structure of indicators of quality of the specimen "Fish zrazys with Romanesco cabbage"**

The mass fraction of dry matters (58.6%), fat (4.5%), salt (0.7%) in the control sample prepared according to the traditional formula and the developed sample of fish zrazes (dry matter content 44.6%, fat — 3.9%, kitchen salt — 0.5%) with cabbage Romanesco determined by standard methods [13].

It is established that the addition of Romanesco cabbage to the fish zrazes formulation is expedient, but requires detailed study. Harrington method has carried out a comprehensive vivacity of the quality of the specimen “Fish zrazes with cabbage Romanesco”. This method involves 5 intervals, in the general interval of the scale from 1 to 0: 1.00...0.80 — very good (excellent); 0.80...0.63 — good; 0.63...0.37 — fair; 0.37...0.20 — bad; 0,20...0,00 — very bad [14]. For the calculation of the quantitative assessment of the quality of the fish species “Fish zrazes with Romanesco cabbage” the standard and original indicators are defined. Standard indicators of quality — organoleptic (appearance, color, consistency, smell and taste), physical and chemical parameters (mass fraction of dry substances, fat, salt), safety indicators (lead, arsenic, mercury, cadmium, copper, zinc, mycotoxins aflatoxin β1, zearalenone, patulin, HCHC pesticides (γ-isomers), heptachlor GPH (heptachlor epoxies), cesium and strontium radionuclides) and microbiological (number of bacteria in the colon sticks, pathogenic microorganisms, in particular Salmonella, Staphylococcus aureus, yeast, mold fungi. To the original index to include protein, carbohydrates, fats, minerals and vitamins.

Nodal values of the quality indices of fish species with Romanesco cabbage are given in table 4.

*Table 4. Scale of nodal values of quality indicators of fish species with Romanesco cabbage*

Metric name. unit of measurement	Valuation $K_i$					
	1.00	0.80	0.65	<b>0.37</b>	0.20	0.00
	Coded value $V$					
	3.00	1.50	0.85	<b>0.00</b>	-0.50	-3.00
1	2	3	4	5	6	7
<b>Organoleptic quality</b>						
Appearance	5.0	4.0	3.0	<b>2.0</b>	1.5	1.0
Color	5.0	4.0	3.0	<b>2.0</b>	1.5	1.0
Consistency	5.0	4.0	3.0	<b>2.0</b>	1.5	1.0
Smell	5.0	4.0	3.0	<b>2.0</b>	1.5	1.0
Taste	5.0	4.0	3.0	<b>2.0</b>	1.5	1.0
<b>Physico-chemical indicators</b>						
mass fraction of dry matter. %	43.0	43.5	44.0	<b>44.6</b>	46.5	48.1
mass fraction of fat. %	3.75	3.8	3.85	<b>3.9</b>	4.2	4.5
mass fraction sodium chloride (salt).%	0.35	0.4	0.45	<b>0.5</b>	<b>0.7</b>	0.8
<b>Safety Indicators</b>						
Lead. mg/kg . no more	0.03	0.05	0.07	<b>0.1</b>	0.2	0.5
Cadmium. mg/kg. no more	0.005	0.01	0.02	<b>0.03</b>	0.2	0.4
Arsenic. mg/kg. no more	0.001	0.005	0.01	<b>0.05</b>	0.2	0.6
Mercury mg/kg. no more	0.001	0.002	0.003	<b>0.005</b>	0.1	0.3
Zinc. mg/kg. no more	2.0	3.0	4.0	<b>5.0</b>	7.0	9.0
Copper. mg/kg. no more	0.05	0.1	0.3	<b>0.5</b>	1.0	1.4
Micotoxins						

1	2	3	4	5	6	7	
Zarenol. mg/kg. no more	0.0	0.3	0.6	1.0	1.5	2.0	
Patulin. mg/kg. no more	0.0	0.01	0.03	0.05	0.1	0.2	
Aflatoxin $\beta$ 1. mg/kg. no more	0.0	0.001	0.003	0.005	0.01	0.02	
Pesticides							
GXCG ( $\gamma$ -isomer). mg/kg. no more	0.0	0.01	0.5	1.0	1.5	2.0	
Radionuclide							
Cs <sup>137</sup> . Bk/kg	10	200	400	600	800	1000	
Sr <sup>90</sup> . Bk/kg	10	100	150	200	400	600	
Microbiological indicators							
Bacteria of the <i>E. coli</i> group are 0.1 cm <sup>3</sup> . no more	0.0	0.0	0.0	0.0	0.1	0.3	
<i>Staphylococcus aureus</i> in 1.0 cm <sup>3</sup> of the product. no more	0.0	0.0	0.0	0.0	0.1	0.3	
Pathogenic microorganisms. in particular bacteria of the kind <i>Salmonella</i> . in 25 g the product. no more	0.0	0.0	0.0	0.0	0.1	0.3	
Yeast. no more in 1 g of the product. no more	0.0	0.0	0.0	0.0	0.5	1.0	
Mold fungi. in 1 g of the product. no more	2	20	50	100	200	300	
Macronutrients. g							
Proteins in 100 g of the product	New product	8.1	7.8	7.5	7.18	6.5	6.0
	Traditional recipes	11.4	11.2	11.0	10.74	9.0	8.0
Fats in 100 g of the product	New product	3.7	3.8	3.9	<b>4.0</b>	5.0	5.8
	Traditional recipes	3.9	4.0	4.1	<b>4.2</b>	4.6	5.2
Carbohydrates in 100 g of the product	New product	10.7	10.5	10.3	<b>10.07</b>	9.3	8.5
	Traditional recipes	5.9	5.6	5.3	<b>4.87</b>	4.3	4.0
Mineral substances . mg							
Calcium in 100 g of the product	New product	48.0	47.8	47.6	<b>47.4</b>	46.3	45.2
	Traditional recipes	47.0	45.8	45.6	<b>45.39</b>	44.3	42.1
Potassium in 100 g of the product	New product	258.5	258.2	257.9	<b>257.6</b>	255.1	252.1
	Traditional recipes	249.2	248.2	247.9	<b>247.5</b>	245.0	242.0
Sodium in 100 g of the product	New product	110.5	110.0	109.5	<b>109.0</b>	107.5	105.0
	Traditional recipes	116.5	115.8	115.0	<b>114.53</b>	113.0	112.1
Magnesium in 100 g of the product	New product	26.1	25.6	24.9	<b>24.5</b>	23.0	22.2
	Traditional recipes	28.2	27.6	27.1	<b>26.28</b>	25.0	23.5
Phosphor in 100 g of the product	New product	127.9	127.4	127.0	<b>126.47</b>	125.1	124.5
	Traditional recipes	166.2	165.7	165.1	<b>164.29</b>	163.0	162.1
Iron in 100 g of the product	New product	2.55	2.5	2.45	<b>2.34</b>	2.10	2.0
	Traditional recipes	2.3	2.25	2.2	<b>2.14</b>	2.0	1.9



1		2	3	4	5	6	7
<b>Vitamins. mg</b>							
Vitamin B <sub>1</sub> in 100 g of the product	New product	0.09	0.08	0.07	<b>0.06</b>	0.05	0.04
	Traditional recipes	0.09	0.08	0.06	<b>0.05</b>	0.04	0.03
Vitamin B <sub>2</sub> in 100 g of the product	New product	0.16	0.15	0.13	<b>0.11</b>	0.09	0.07
	Traditional recipes	0.14	0.13	0.12	<b>0.11</b>	0.08	0.06
Vitamin B <sub>4</sub> in 100 g of the product	New product	18.5	18.0	17.5	<b>17.17</b>	16.0	15.0
	Traditional recipes	8.5	8.0	7.5	<b>7.0</b>	6.0	6.5
Vitamin B <sub>6</sub> in 100 g of the product	New product	0.23	0.22	0.21	<b>0.19</b>	0.16	0.13
	Traditional recipes	0.27	0.25	0.22	<b>0.19</b>	0.15	0.13
Vitamin C in 100 g of the product	New product	19.6	19.3	18.9	<b>18.6</b>	18.1	17.5
	Traditional recipes	4.9	4.4	3.9	<b>3.2</b>	2.8	2.5
β- carotin in 100 g of the product	New product	0.75	0.7	0.65	<b>0.6</b>	0.4	0.3
	Traditional recipes	0.3	0.2	0.1	<b>0.01</b>	0.005	0

Based on the data of the table. 4, the new product “Fish zrazes with Romanesco cabbage” increased the content of potassium, calcium, iron, vitamin B<sub>1</sub>, B<sub>4</sub>, C, β-carotene and food fibers.

An estimation method for assessing the assimilation of new fish species, “Fish snakes with Romanesco cabbage”, is amino acid abbr of protein [9;10].

*Table 5. Amino acid abbr of the fish zrazes “Fish zrazes with Romanesco cabbage” [9; 10]*

Amino acid	The content of AK in the ideal protein. mg/g	The contents of the AK in zrazes		AC. %
		mg/100g	mg/1g proteins	
Valine	50	358.3	49.1	98.2
Isoleucine	40	332.3	46.2	115.5
Leucine	70	517.8	72.11	103
Lycine	55	496.9	69.2	125.8
Methionine + cystine	35	148.6 + 104.6	20.8 + 11.9	93.4
Tryptophan	10	97.5	12.5	125
Fenilalanine + tyrosine	60	278.4 + 201.9	38 + 28.1	110.1
Treon	40	292	40.6	101.5

The first limiting amino acids are methionine and cystine (AS = 93.4%), hence, the protein of fish species with Romanosko cabbage is digested by 93.4%.

**Conclusion**

A recipe for fish features of the functional purpose “Fish snails with Romanesque cabbage” has been developed, which have improved organoleptic properties and increased biological value.

Thanks to the Harrington Method was provided a comprehensive assessment of the quality of these products has been carried out, which has proven the feasibility of introducing Romanesco cabbage to the traditional formulation as a functional ingredient.

The new species of fish zrazes are enriched with potassium, calcium, iron, vitamins B<sub>1</sub>, B<sub>4</sub>, C, β-carotene, and food fibers.

It is determined that the protein of this product is assimilated by 93.4%.

Due to the content of sulforaphane, fish snails may be recommended in the diet for the prevention of cancer.

According to the results of the research, Ukraine's patent was obtained for a useful model [15].

In further researching, it is planned to determine the safety indexes of the sample "Fish zrazes with Romanesco cabbage".

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