Scientific justification for the selection of vegetable crops of the cruciferous family for the design of functional dairy products

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Abstract. This article is devoted to the study of the possibility of using domestic vegetable crops of the Cruciferous family (white cabbage, cauliflower, broccoli, kohlrabi, Brussels sprouts, red cabbage, Savoy cabbage, Chinese cabbage and turnip) as a source of essential food components based on the results of analysis of the nutrient composition. New data were obtained on the content of basic nutrients, water- and fat-soluble vitamins, micro- and macroelements and amino acids in samples of vegetable crops of the Cruciferous family. It was found that the highest content of protein and carbohydrates was observed in samples of Brussels sprouts (3.4 and 3.4%), broccoli (2.8 and 8.9%) and cauliflower (1.9 and 4.9%). It was found that the largest amount of vitamins is contained in Brussels sprouts and broccoli. According to the results of the amino acid composition of broccoli samples, it is distinguished by a variety of essential and non-essential amino acids with increased content in accordance with daily consumption standards: methionine 0.04 (2.1%), cystine 0.03 (1.6%), phenylalanine 0.12 (2.7%), aspartic 0.33 (2.7%), glutamine 0.4 (4.0%); glycine 0.09 (2.5%), serine 0.12 (1.5%). The research results obtained show the possibility of increasing the nutritional value of dairy products by adding cruciferous vegetables to expand the range of dairy products enriched with functional food ingredients. In particular, the choice of broccoli and Brussels sprouts for designing technology and modeling the composition of new dairy products with functional ingredients was scientifically justified. The data obtained allow us to consider vegetable products of the Russian agro-industrial complex as raw materials rich in essential food ingredients when creating new competitive dairy products.

1 Introduction

To ensure food safety in Russia in the domestic agro-industrial complex (AIC), it is necessary to develop and implement new approaches to improve the quality and safety of agricultural products and their processed products [8,10,21], expand the range of products [19] that meet the principles of healthy nutrition [1], find effective solutions to minimize technological risks in the production of products that do not meet established requirements [12], ensure

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production profitability through the use of effective methods of product quality management [14]. One of the solutions to this set of tasks facing agricultural enterprises is the application of the concept of targeted formation and forecasting of the quality of the final product at all stages from field to counter, from receiving raw materials to the final product [26]. Proper selection of the raw materials largely determines the quality of the finished product [11], consumer satisfaction [4], demand for products and the competitiveness of both individual products and enterprises [13], and domestic agriculture as a whole.

One of the key trends in the development of the food industry both in Russia and in the world is the expansion of the range of food products enriched with functional food ingredients [6,17,23]. The leaders in terms of growth rates in the healthy food products segment are bakery and dairy products. Dairy products are rich in easily digestible proteins and fats, a number of vitamins and minerals [16,22]. For most consumers, dairy products are associated with a healthy diet [5], and health-conscious consumers look for healthy products in the dairy department of a retail outlet [2]. Moreover, cottage cheese and products based on it are an essential element of a healthy diet and many specialized diets [16].

However, dairy products are not able to fully satisfy the human body's need for all the essential components of food, which are rich in vegetables and their processed products [15,18,20]. In addition, the requirements for healthy food include not only a high content of useful nutrients in an easily digestible and balanced form, but also the absence of undesirable ingredients, such as food additives with the E index (structure formers, preservatives, sweeteners, flavorings, regulators acidity, thickeners, dyes, etc.), added sugar, milk fat substitutes, salt, etc. [26] This is reflected in the current trend towards unsweetened dairy products with a minimal raw material composition, as well as containing plant materials rich in vitamins, dietary fiber, antioxidants and minerals [3,7]. Vegetable raw materials contain a large amount of fiber and other natural substances with the milk food matrix participate in the formation of the structure of the food system together, which eliminates the need for addition of structure formers and thickeners [24,25] and reduces the risks of defects in the consistency and appearance of products [12]. Natural substances that add flavor and color to vegetables can also shape the taste and color of the finished dairy product. At the same time, most vegetable crops of the Cruciferous family have a low cost, which leads to a high economic effect.

The first task in developing a new competitive product [9,26] that meets market trends and the principles of healthy nutrition is the selection of plant raw materials for the production of fortified dairy products.

The purpose of the research is to study the possibility of using vegetable crops of the Cruciferous family as a source of essential food components based on the results of the nutrient composition.

2 Material and methods

The study used standard laboratory analysis methods: mass fraction of water (GOST 33977-2016), mass fraction of fat (GOST 5867-90), mass fraction of protein (GOST 23327-98), mass fraction of carbohydrates (GOST 8756.13-87), vitamin content (GOST 25999-83, GOST 24556-89, GOST R 50479-93, GOST EN 14148-201, GOST 8756.22-80), fiber (GOST R 54014-2010). The content of microelements was determined on a Shimadzu AA-7000 Double-beam Atomic Absorption Spectrometer with WizAArd software. The results obtained in 3-5 fold repetitions were statistically processed on a personal computer in the Excel program.

3 Results and discussion

The study of the nutrient composition of vegetable raw materials is important for analyzing the physiological significance of the finished product. The current direction of development for the creation of healthy dairy-based food products is in the area of expanding the range of products through the development of recipes for new dairy products with functional ingredients using mathematical modeling methods. The uniqueness of dairy products is due to the ability not only to provide the human body with basic nutrients and irreplaceable essential food components, but also to meet the taste requirements of consumers. One of the criteria for choosing functional ingredients of plant origin is the chemical composition rich in essential components and antioxidants and taste compatibility with the milk base.

To justify the choice of vegetable crops as a source of functional food ingredients in the production of fortified dairy products, we conducted a set of studies on the nutritional and biological value of vegetable crops of the Cruciferous family: white cabbage, cauliflower, broccoli, kohlrabi, Brussels sprouts, red cabbage, Savoy cabbage, Chinese cabbage and turnips, presented by the Federal State Budgetary Scientific Institution "Federal Scientific Center" (FSBI "FSVC").

A comparative analysis of the results of studying the macronutrient composition of vegetable crop samples is presented in Table 1.

Table 1. Comparative analysis of the macronutrient composition of vegetable crops of the Cruciferous family

Indicator	White cabbage	Cauliflower	Broccoli	Kohlrabi	Brussels sprouts	Red cabbage	Savoy cabbage	Chinese cabbage	Turnip
Calorie content, (kJ)	115	124	170	134	215	151	138	81	125
Proteins (g)	1.7±0.1	1.9±0.1	**2.8**±0.1	1.7±0.1	**3.4**±0.1	1.4±0.1	2.0±0.1	1.2±0.1	0.9±0.1
Fat (g)	0.1±0.1	**0.3±0.1**	**0.4**±0.1	0.1±0.1	**0.3**±0.1	0.16±0.1	0.1±0.1	0.2±0.1	0.1±0.1
Carbohydrates (g)	5.0±0.1	4.9 ±0.1	**6.6**±0.2	6.3±0.1	**8.9**±0.2	**7.4**±0.2	6.1±0.1	3.3±0.1	6.4±0.2
Water (g)	**90.18** ±0.03	**92.07** ±0.04	89.31 ±0.03	91.13 ±0.02	86.46 ±0.02	90.39 ±0.03	91.22 ±0.02	**94.39** ±0.03	91.87 ±0.03
Ash (g)	0.61 ±0.02	0.76 ±0.02	**0.87** ±0.02	**1.04** ±0.04	**1.37** ±0.04	0.64 ±0.02	0.81 ±0.03	**0.98** ±0.02	0.73 ±0.03
Fiber (g)	2.1±0.1	2.0±0.1	2.6±0.1	**3.6**±0.1	**3.8**±0.1	2.1±0.1	3.1±0.1	1.2±0.1	1.8±0.1

According to the table, Brussels sprouts have the highest protein mass fraction, it is 3.4 g per 100 g of product, broccoli 2.8 g, cauliflower 1.9 g, turnips have the lowest protein content 0.9 g. Broccoli has a mass fraction of fat of 0.4 g, Brussels sprouts 0.3 g, cauliflower 0.3 g, the lowest mass fraction of fat of 0.1 g is noted in white cabbage, kohlrabi, Savoy cabbage and turnips. A high value of the mass fraction of carbohydrates was noted in Brussels sprouts, white cabbage and broccoli, it is 8.9 g, 7.4 g, and 6.6, respectively. Ash content in descending order: Brussels sprouts 1.37 g, kohlrabi 1.04 g, Chinese cabbage - 0.98 g, broccoli - 0.87 g, in the rest the ash content is less than 0.87 g. As for fiber, 3.8 g is found in Brussels sprouts, 3.6 g in kohlrabi, and less than 3.6 g in other cruciferous vegetables.

In order to organize a balanced diet, it is important to study the composition of macronutrients (proteins and amino acids, fats and fatty acids, carbohydrates) and micronutrients (vitamins, minerals and microelements, dietary fiber and biologically active substances) in basic raw materials, functional ingredients and in developed new products. A comparative analysis of the content of amino acid composition, vitamins and minerals in cruciferous vegetables was carried out in accordance with the standards established in MP

2.3.1.0253-21. 2.3.1. “Food hygiene. Balanced diet. Norms of physiological requirements in energy and nutrients for various groups of the population of the Russian Federation. Methodological recommendations" (Tables 2, 3).

Table 2. Comparative analysis of the content of vitamins and vitamin-like substances in vegetable crops of the Cruciferous family

Content of vitamins and vitamin-like substances											
Indicator		**Daily value**	**White cabbage**	**Cauli-flower**	**Broccoli**	**Kohl-rabi**	**Brussels sprouts**	**Red cabbage**	**Savoy cabbage**	**Chinese cabbage**	**Turnip**
Vita-min A	m, mcg	900 mcg ret.eq.	4.8±0.1	2.0±0.1	29.7±0.1	2.2±0.1	38.2±0.2	56.0±0.3	51.2±0.4	16.0±0.3	16.5±02.
	n, %		0.5	0.2	3.4	0.2	4.2	6.2	5.6	1.8	1.8
Beta caro-tene	m, mcg	5000 mcg	42.3±0.1	0.0	361.5±1.2	21.8±0.2	453.8±3.2	654.0±6.2	595.6±5.5	187.6±4.5	0.0
	n, %		0.8	0.0	7.2	0.4	9.1	13.1	11.9	3.8	0.0
Vita-min E	m, mg	15 mg toc. eq.	0.15±0.01	0.08±0.01	0.78±0.02	0.48±0.01	0.88±0.02	0.11±0.01	0.17±0.01	0.12±0.01	0.03±0.01
	n, %		1.0	0.5	5.2	3.2	5.9	0.7	1.1	0.8	0.2
Vita-min K	m, mcg	120 mcg	**76.0**±0.5	15.5±0.3	**101.9**±1.1	0.1±0.1	**177.4**±1.2	**38.2**±0.3	**68.9**±0.4	**43.1** ±0.3	0.1±0.1
	n, %		**63.3**	12.9	**84.9**	0.1	**147.8**	**31.8**	**57.4**	**35.9**	0.1
Vita-min C	m, mg	90 mg	**36.6**±0.2	**48.2**±0.3	**89.2**±0.4	**62.4**±0.3	**84.9**±0.4	**57.0**±0.4	**31.3**±0.2	**27.1** ±0.1	**21.0**±0.1
	n, %		**40.7**	**53.6**	**99.1**	**69.3**	**94.3**	**63.3**	**34.8**	**30.1**	**23.3**
Vita-min B1 (mg)	m, mg	1.5 mg	0.06±0.01	0.05±0.01	0.07±0.01	0.05±0.01	0.14±0.01	0.07±0.01	0.07±0.01	0.04±0.01	0.04±0.01
	n, %		4.0	3.3	4.7	3.3	9.3	4.7	4.7	2.7	2.7
Vita-min B2 (mg)	m, mg	1.8 mg	0.04±0.01	0.06±0.01	0.12±0.01	0.02±0.01	0.09±0.01	0.07±0.01	0.03±0.01	0.05±0.01	0.03±0.01
	n, %		2.2	3.3	6.7	1.1	5.0	3.9	1.7	2.8	1.7
Vita-min B3 (mg)	m, mg	20.0 mg niac. eq.	0.23±0.01	0.51±0.02	0.64±0.02	0.41±0.01	0.75±0.01	0.42±0.01	0.32±0.01	0.41±0.02	0.39±0.01
	n, %		1.2	2.6	3.2	2.1	3.8	2.1	1.6	2.1	2.0
Vita-min B5 (mg)	m, mg	5 mg	0.22±0.01	0.67±0.02	0.57±0.01	0.16±0.01	0.31±0.01	0.15±0.01	0.19±0.01	0.11±0.01	0.21±0.01
	n, %		4.4	13.4	11.4	3.2	6.2	3	3.8	2.2	4.2
Vita-min B6 (mg)	m, mg	2.0 mg	0.12±0.01	0.19±0.01	0.18±0.01	0.15±0.01	0.22±0.01	0.21±0.01	0.19±0.01	0.23±0.01	0.09±0.01
	n, %		6.0	9.5	9.0	7.5	11.0	10.5	9.5	11.5	4.5
Vita-min B1 (mcg)	m, mcg	400 mcg	43.2±0.2	57.6±0.2	**63.2**±0.3	15.9±0.1	**61.5**±0.2	18.0±0.1	**80.4**±0.3	**79.2**±0.3	15.3±0.1
	n, %		10.8	14.4	**15.8**	4.0	**15.4**	4.5	**20.1**	**19.8**	3.8

Symbols used in the table:
m – content of functional food ingredient per 100 g;
n – share of the recommended daily intake of a functional food ingredient, %.

Vitamins belong to the group of micronutrients, substances necessary for local action. The human body is not capable of synthesizing them, so vitamins are mainly supplied through food consumption. The biological value of vegetables is directly related to the mass fraction of vitamins, since they contribute to the formation of enzymes and are responsible for the regulation of metabolism. It has been determined that the highest content of the vitamin complex can be found in Brussels sprouts and broccoli. Brussels sprouts are distinguished by a high content of vitamin E, its mass fraction is 6.0% of the daily value, the content of vitamin K per 100 g of Brussels sprouts is 147%, vitamin C is 94.4%. Brussels sprouts are rich in B vitamins, e.g., B1 (11.6%), B2 (6.9%), B3 (4.7%), B6 (16.8%) per 100 g of the daily value.

The content of vitamins in broccoli is less high, but during a comparative analysis it stands out above the rest of the Cruciferous family. The content of vitamins in broccoli: vitamin E (5.3%), vitamin K (84.7%), vitamin C (99.1%), vitamin B2 (9.0%), vitamin B5 (11.5% of the daily value).

Table 3. Comparative analysis of the content of mineral substances in vegetable crops of the Cruciferous family

Content of mineral substances											
Indicator		**Daily value**	**White cabbage**	**Cauli-flower**	**Broccoli**	**Kohlrabi**	**Brussels sprouts**	**Red cabbage**	**Savoy cabbage**	**Chinese cabbage**	**Turnip**
Cal-cium	m, mg	1000	40.2±0.2	22.1±0.2	46.8±0.2	23.9±0.1	41.8±0.3	44.9±0.2	35.4±0.4	77.3±0.5	29.8±0.3
	n, %		4.0	2.2	4.7	2.4	4.2	4.5	3.5	7.7	3.0
Iron	m, mg	10	0.47±0.02	0.42±0.02	0.73±0.03	0.41±0.02	1.42±0.03	0.81±0.03	0.40±0.02	0.31±0.02	0.31±0.01
	n, %		4.7	4.2	7.3	4.0	14.2	8.0	4.0	3.1	3.0
Mag-nesium	m, mg	420	12.3±0.1	14.9±0.2	21.3±0.1	19.3±0.2	23.4±0.2	16.2±0.1	28.0	13.2±0.1	11.3±0.1
	n, %		2.9	3.5	5.1	4.6	5.6	3.9	6.7	3.1	2.7
Phos-phorus	m, mg	700	26.2±0.1	44.4±0.2	66.3±0.2	45.7±0.2	69.2±0.3	30.3±0.2	42.1±0.2	29.0±0.1	27.4±0.2
	n, %		3.7	6.3	9.5	6.5	9.9	4.3	6.0	4.1	3.9
Potas-sium	m, mg	3500	173±1	301±3	315±5	351±4	389±3	243±3	230±2	238±4	191±1
	n, %		4.9	8.6	9.0	10.0	11.1	6.9	6.6	6.8	5.5
So-dium	m, mg	1300	18.1±0.1	30.3±0.2	32.9±0.2	20.2±0.1	25.5±0.2	27.6±0.1	28.2±0.2	9.3±0.1	67.4±0.7
	n, %		1.4	2.3	2.5	1.6	2.0	2.1	2.2	0.7	5.2
Zinc	m, mg	12	0.18±0.01	0.27±0.01	0.41±0.02	0.03±0.01	0.42±0.01	0.22±0.01	0.27±0.01	0.23±0.01	0.27±0.01
	n, %		1.5	2.3	3.4	0.3	3.5	1.8	2.3	1.9	2.3
Copper	m, mg	1.0	0.019 ±0.002	0.039 ±0.002	0.049 ±0.004	0.129 ±0.001	0.073 ±0.004	0.017 ±0.001	0.062 ±0.003	0.036 ±0.002	0.085 ±0.005
	n, %		1.9	3.9	4.9	12.9	7.3	1.7	6.2	3.6	8.5
Man-ganese	m, mg	2.0	0.16±0.01	0.16±0.01	0.21±0.01	0.14±0.01	**0.34**±0.02	0.24±0.02	0.18±0.01	0.19±0.01	0.14±0.01
	n, %		8.0	8.0	10.5	7.0	**17.0**	12.0	9.0	9.5	7.0
Sele-nium	m, mcg	55	0.3±0.1	0.6±0.1	2.5±0.1	0.7±0.1	1.6±0.1	0.6±0.1	0.9±0.1	0.6±0.1	0.7±0.1
	n, %		0.5	1.1	4.5	1.3	2.9	1.1	1.6	1.1	1.3

Symbols used in the table:
m – content of functional food ingredient per 100 g;
n – share of the recommended daily intake of a functional food ingredient, %.

The excretion of metabolic products from the body is associated with osmotic pressure created in the cells of organs and tissues by mineral components supplied with food. The lack of minerals in the diet can lead to the development of so-called diseases of civilization: cardiovascular diseases, metabolic disorders, cancer, impaired cognitive functions of the body, etc. Broccoli and Brussels sprouts stand out in a comparative analysis of nine cruciferous vegetables. In terms of iron content, Brussels sprouts contain 14.0% of iron of the daily value; in broccoli, its content is 7.3%, which is more than in white cabbage (4.7%), cauliflower (4.2%), kohlrabi (4.0%), Savoy cabbage (4.0%), Chinese cabbage (3.1%) and turnips (3.0%). The mass fraction of phosphorus, the main element involved in the absorption of vitamins and vitamin-like substances, in broccoli and Brussels sprouts is 9.4% and 9.9% of the daily value, respectively. The potassium content in kohlrabi and Brussels sprouts differs positively from the content in other representatives of the vegetables of the Cruciferous family, it is 7.4% and 8.3%, respectively. The potassium content in white cabbage is 3.6%, in cauliflower is 6.4%, in broccoli is 6.7%, and 5.2%, 4.9%, 5.1% and 4.1% in white cabbage, Savoy cabbage, Chinese cabbage and turnips, respectively.

As studies have shown, in samples of a number of vegetables of the Cruciferous family, a relatively high amount of protein was found (Brussels sprouts 3.4%, in broccoli 2.8%, cauliflower 1.9%), which is comparable to the protein content in dairy products (drinking milk, cream , buttermilk, whey, fermented milk drinks). In this connection, we conducted studies of the amino acid composition of samples of vegetables of the Cruciferous family (Table 4) to select vegetable crops that have a more balanced amino acid composition.

Table 4. Comparative analysis of the content of amino acids in vegetable crops of the Cruciferous family

Content of mineral substances											
Indicator		Daily value (mg)	White cabbage	Cauliflower	Broccoli	Kohlrabi	Brussels sprouts	Red cabbage	Savoy cabbage	Chinese cabbage	Turnip
Trypto-phan	m, g	0.8	0.01±0.01	0.02±0.01	0.03±0.01	0.01±0.01	0.04±0.01	0.01±0.01	0.02±0.01	0.01±0.01	0.01±0.01
	n, %		1.4	2.5	4.1	1.3	4.6	1.5	2.5	1.5	1.1
Threo-nine	m, g	2.4	0.04±0.01	0.08±0.01	0.09±0.01	0.05±0.01	0.12±0.01	0.04±0.01	0.07±0.01	0.04±0.01	0.03±0.01
	n, %		1.5	3.2	3.7	2.0	5.0	1.6	2.9	1.6	1.0
Isoleu-cine	m, g	2	0.03±0.01	0.07	0.08±0.01	0.08±0.01	0.13±0.01	0.03±0.01	0.10±0.01	0.07	0.04±0.01
	n, %		1.5	3.6	4.0	3.9	6.6	1.7	5.1	3.4	1.8
Leu-cine	m, g	4.6	0.04±0.01	0.11±0.01	0.13±0.01	0.07±0.01	0.15±0.01	0.05±0.01	0.10±0.01	0.07±0.01	0.03±0.01
	n, %		0.9	2.3	2.8	1.5	3.3	1.0	2.2	1.5	0.7
Lysine	m, g	4.1	0.04±0.01	0.22±0.02	0.14±0.01	0.06±0.01	0.15±0.01	0.05±0.01	0.09±0.01	0.07±0.01	0.04±0.01
	n, %		1.1	5.3	3.3	1.4	3.8	1.2	2.3	1.7	0.9
Methi-onine	m, g	1.8	0.01±0.01	0.02±0.01	0.04±0.01	0.01±0.01	0.03±0.01	0.01±0.01	0.02±0.01	0.01±0.01	0.01±0.01
	n, %		0.7	1.1	2.1	0.7	1.8	0.8	1.1	0.4	0.6
Cystine	m, g	1.8	0.01±0.01	0.02±0.01	0.03±0.01	0.01±0.01	0.02±0.01	0.01±0.01	0.02±0.01	0.01±0.01	0.01±0.01
	n, %		0.6	1.1	1.6	0.4	1.2	0.7	0.9	0.7	0.3
Pheny-lala-nine	m, g	4.4	0.03±0.01	0.07±0.01	0.12±0.01	0.04±0.01	0.10±0.01	0.04±0.01	0.06±0.01	0.04±0.01	0.02±0.01
	n, %		0.7	1.5	2.7	0.9	2.2	0.8	1.5	0.8	0.4
Tyro-sine	m, g	4.4	0.02±0.01	0.05±0.01	0.05±0.01	-	-	0.02±0.01	0.03±0.01	0.02±0.01	0.01±0.01
	n, %		0.4	1.2	1.1	-	-	0.5	0.8	0.5	0.3
Valin	m, g	2.5	0.04±0.01	0.13±0.01	0.13±0.01	0.05±0.01	0.16±0.01	0.05±0.01	0.09±0.01	0.05±0.01	0.03±0.01
	n, %		1.7	5.0	5.0	2.0	6.2	1.9	3.4	2.1	1.2
Argi-nine	m, g	6.1	0.08±0.01	0.09±0.01	0.19±0.01	0.11±0.01	0.20±0.01	0.08±0.01	0.11±0.01	0.07±0.01	0.02±0.01
	n, %		1.2	1.4	3.1	1.7	3.3	1.4	1.9	1.1	0.4
Histi-dine	m, g	2.1	0.02±0.01	0.06±0.01	0.06±0.01	0.02±0.01	0.08±0.01	0.02±0.01	0.04±0.01	0.02±0.01	0.01±0.01
	n, %		1.0	2.7	2.8	0.9	3.6	1.1	2.0	1.0	0.7
Alanin	m, g	6.6	0.04±0.01	0.12±0.01	0.10±0.01	-	-	0.05±0.01	0.07±0.01	0.07±0.01	0.04±0.01
	n, %		0.6	1.8	1.6	-	-	0.7	1.1	1.0	0.5
Aspar-tic	m, g	12.2	0.12±0.01	0.18±0.01	0.33±0.01	-	-	0.14±0.01	0.20±0.01	0.09±0.01	0.06±0.01
	n, %		1.0	1.5	2.7	-	-	1.1	1.6	0.7	0.5
Gluta-mic	m, g	13.6	0.29±0.02	0.26±0.01	0.54±0.02	-	-	0.33±0.02	0.45±0.02	0.29±0.01	0.13±0.01
	n, %		2.2	1.9	4.0	-	-	2.4	3.3	2.1	1.0
Gly-cine	m, g	3.5	0.03±0.01	0.07±0.01	0.09±0.01	-	-	0.03±0.01	0.04±0.01	0.04±0.01	0.03±0.01
	n, %		0.9	2.0	2.5	-	-	1.0	1.3	1.0	0.7
Proline	m, g	4.5	0.05±0.01	0.07±0.01	0.11±0.01	-	-	0.05±0.01	0.39±0.02	0.03±0.01	0.03±0.01
	n, %		1.1	1.6	2.4	-	-	1.2	8.7	0.6	0.6
Serin	m, g	8.3	0.05±0.01	0.09±0.01	0.12±0.01	-	-	0.06±0.01	0.12±0.01	0.04±0.01	0.03±0.01
	n, %		0.6	1.0	1.5	-	-	0.7	1.4	0.5	0.3

Symbols used in the table:
m – content of functional food ingredient per 100 g;
n – share of the recommended daily intake of a functional food ingredient, %.

The data obtained allow us to judge the effectiveness of using broccoli. In comparison with the studied vegetables of the Cruciferous family, broccoli is distinguished by a variety of essential and non-essential amino acids with increased content in accordance with daily consumption standards: methionine - 0.04 (2.1%), cystine - 0.03 (1.6%), phenylalanine - 0.12 (2.7%), aspartic – 0.33 (2.7%), glutamine – 0.4 (4.0%); glycine – 0.09 (2.5%), serine – 0.12 (1.5%).

Analysis of data presented in the tables allows us to judge the effectiveness of using such vegetable crops as broccoli and Brussels sprouts. The mass fractions of macro- and

micronutrients per 100 g of these products provide the human body with 0.1% to 147.5% in essential nutrients. For example, the mass fraction of a group of fat-soluble and water-soluble vitamins, generally called vitamins K, involved in protein synthesis in the adult body in Brussels sprouts, is 147.5% of the daily value. Vitamin C is an integral component for the adequate course of physiological processes in the body of an adult, mass fraction of it per 100 g of broccoli is 99.1% of the daily value.

The data obtained allow us to consider vegetable products of the domestic agro-industrial complex as raw materials rich in essential food ingredients when creating new competitive dairy products.

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5 Conclusion

The use of non-traditional plant raw materials in dairy food technologies is a promising direction for the development of the Russian dairy industry. The content of basic food nutrients, water- and fat-soluble vitamins, micro- and macroelements and amino acids in samples of vegetable crops of the Cruciferous family has been established. The data obtained indicate the possibility of increasing the nutritional value of food products by adding the studied vegetables. The results of a study of the chemical composition of vegetable crops of the Cruciferous family allow us to scientifically justify the choice of broccoli and Brussels sprouts for designing technology and modeling the composition of new dairy products with functional ingredients.

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