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Original scientific paper

DEVELOPMENT OF FUNCTIONAL BEVERAGES FROM PLANTRAW MATERIALS — REPLACEMENTS FOR DAIRY PRODUCTS

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ABSTRACT

Nowadays, there is a growing consumer interest in food products, made from vegeta-ble raw materials. The article is devoted to an actual topic related to the choice of plant mate-rials, based on its nutritional and biological value, in order to create functional beverages. The analysis of the world market of vegetable analogues of milk was implemented. Based on the literature, the following raw materials were analyzed: cashew nuts, cannabis fruits, sesame and poppy seeds, almond kernels, buckwheat seeds and oats, soybeans. The data on nutritional value, vitamin-mineral and amino acid composition, as well as the composition of fatty acids of the specified raw materials was presented. The conclusion is made about the perspective of its use for the manufacture of drinks, alternative cow's milk. The article reflects the results of research work on the creation of a functional drink based on sesame seeds, provides information about the nutritional value and biochemical composition of the drink, made on the basis of this raw material. Sesame milk when used regularly can help prevent diseases of the car-diovascular system, the gastrointestinal tract, the musculoskeletal system.

1. Introduction

One of the main priorities of the Russia Federation State Policy is strengthening public health. The government was defined a goal in the field of healthy nutrition, consisting in «…preservation and strengthening public health, prevention of diseases caused by inadequate and unbalanced nutrition» [1]. To achieve this goal, the following documents were adopted: «the Doctrine of food security of the Russian Federation» and «Fundamentals of the state poli-cy of the Russian Federation in the field of healthy nutrition for the period up to 2020», which among the priorities set the task of «increasing the production of new enriched, dietary and functional foods» for different groups of the population» [1,2]. Given the special importance of the problem, the President of the Russian Federation signed a decree in 2019 on national projects, including the demography project, which includes five Federal projects. The main task one of the Federal projects, namely «Strengthening public health», is «formation of the system of citizens' motivation to a healthy lifestyle, including a healthy diet…» [3].

Health is a state of the human body, which allows him to lead an active career, realiz-ing their abilities, with the maximum preservation of life expectancy and quality of life. One of the important factors affecting the quality of life is nutrition.

Modern science of nutrition considers food not only as a source of energy and plastic material, but also as a complex of biologically active substances that regulate individual functions of the human body, providing a health-improving effect on the human body. Aspects of proper nutrition are important for different groups of people who are interested in maintaining their health. In recent years, the scientific community has increasingly held discussions about personalized nutrition, based on the individual characteristics of the human body, its genotype, allowing to improve health.

Thanks to the active promotion of healthy lifestyles by the media and specialists in this field, there is an increased interest in the organization of their food in society. The consumer defines a healthy food product as both tasty and healthy, as well as a product for the preven-tion of diseases or as a functional product. The demand of the population for products made on a natural basis, in particular from vegetable raw materials, is increasing. Thus, the care of the modern consumer about his health stimulates technologists to develop a new range of food products that can positively affect the physiological processes in the human body.

Among the population of our country, there is an increase in the number of allergic diseases. They affect both adults and children equally. In each case, there are prerequisites for this. In particular, Allergy to lactose and cow's milk protein (casein) is considered one of the most common and is associated with poor absorption of their human body due to a violation of the enzymatic system. It is observed in almost 25 % of the adult population [4] and 15–20 % of school-age children [4,5] .

As an alternative to cow's milk, which contains up to 80 % of casein in its protein composition, beverages made of vegetable grain raw materials and nuts, which do not contain lactose and casein, can be used [6,7].

The market of plant analogues of milk is growing all over the world. According to Eu-romonitor, since 2014 sales of dairy alternatives have grown and amounted to: Europe — 24 %, USA — 31 %, Asia-Pacific — 14 %, Latin America — 17 % [5,8].

In Russia, «milk» on a vegetable basis is of specific interest to the modern consumer. Basically, these people, who want to try a new product that adheres to religious traditions, as well as representatives of the growing vegetarian and vegan types of food. The market for these products, though slowly, but expanding. In the first quarter of 2018, sales of dairy alter-natives increased 2.5 times compared to the same period in 2017 and amounted to 1.7 million liters of vegetable «milk» for the entire 2017 year, which in turn amounted to only 1.0 % of the sale of cow's milk [8].

Based on the above, the development of an assortment of plant analogues of cow's milk is relevant.

2. Materials and methods

The objects of research are sesame seeds and experimental samples of vegetable «milk» obtained because of their processing.

Evaluation of the quality of the drink was carried out based on organoleptic character-istics obtained as a result of the tasting, in accordance with GOST 8756.1–2017 «Products of processing

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of fruits, vegetables and mushrooms. Methods for determination of organoleptic characteristics, the mass fraction of component parts, weight or volume».

3. Results and discussion

We have analyzed the biochemical composition of the following plants: cashew nuts, hemp fruits, sesame seeds and poppy seeds, almond kernels, buckwheat and oats, soybeans, which allows us to conclude about their high nutritional value.

Data on the nutritional value and biochemical composition of plant materials are pre-sented in Table 1, Table 2, Table 3 and Table 4 [9,10].

From Table 1, Table 2, Table 3 and Table 4 it follows that the analyzed vegetable raw material has a wide range of mineral-vitamin, amino acid and fatty acid compounds. The presence of significant amounts of vitamins A, group B and mineral elements: potassium, calcium, magnesium, phosphorus, etc. makes them promising for use in the production of functional beverages.

At this stage of research, sesame seeds were used as a plant raw material for the pro-duction of a functional drink alternative to cow's milk, because they have a high biological value. Sesame contains more than 20 % protein, 50 % fat, a significant amount of dietary fiber (13.3 %) in its composition (Table 1), as well as a sufficiently high content of minerals such as calcium, phosphorus, iron and zinc and vitamins: A, E and group B (especially folic acid) (Table. 2) [11]. Table 3 illustrates that seed protein has a high biological value, as it includes a complete set of essential amino acids, especially methionine and tryptophan. The composition of fats in sesame seeds indicates their great benefits for the human body, as it contains unsatu-rated fatty acids 7 times more than saturated.

Table 1

Data on the nutritional value of vegetable raw materials (per 100g of edible part)

Nutrional value, g	Name of raw materials							
	Oat grains	Soybeans	Cashew	The fruits of cannabis	Sesame seeds	Poppy seeds	Almond kernel	Buckwheat grains
Proteins	16.9	36.5	17.9	30.0	23.3	1.6	21.4	11.7
Fats	6.9	19.9	42.9	50.0	50.0	3.7	50.0	2.7
Carbohydrates	66.3	30.2	32.1	10.0	16.7	2.5	21.4	75.0
Dietary fiber	10.6	9.3	3.6	3.3	13.3	19.5	10.7	10.3

Table 2

Data on mineral and vitamin composition of plant raw materials (per 100g of edible part)

Name components'	Name of raw materials							
	Oat grains	Soybeans	Cashew	The fruits of cannabis	Sesame seeds	Poppy seeds	Almond kernel	Buckwheat grains
Mineral substance, mg								
Potassium	429.0	1797.0	607.0	1200.0	468.0	719.0	733.0	320.0
Calcium	54.0	277.0	71.0	70.0	975.0	1438.0	269.0	17.0
Magnesium	177.0	280.0	214.0	700.0	351.0	347.0	270.0	221.0
Phosphorus	523.0	704.0	536.0	1650.0	629.0	870.0	481.0	319.0
Iron	4.7	15.7	5.14	7.95	14.55	9.76	3.71	2.5
Sodium	2.0	2.0	750.0	5.0	11.0	26.0	1.0	11.0
Zinc	4.0	4.9	4.29	9.9	7.75	7.9	3.12	2.4
Vitamins								
Vitamin A, mkg	—	1.0	—	1.0	3.0	—	1.0	—
Vitamin C, mg	—	6.0	0.5	0.5	—	1.0	—	—
Vitamin E, mg	—	0.9	0.9	0.80	0.25	1.77	25.63	—
Thiamine (B1), mg	0.8	0.9	0.4	1.275	0.791	0.854	0.205	0,2
Riboflavin (B2), mg	0.1	0.9	0.1	0.285	0.247	0.1	1.138	0,3
Niacin (PP), мг	1.0	1.6	—	9.2	4.515	0.896	3.618	—
Vitamin B6, mg	0.1	0.4	0.4	0.6	0.790	0.247	0.137	0,4
Choline (B4), mg	—	115.9	—	—	25.6	8.8	52.1	54.2
Folic acid (B9), mg	56.0	375.0	25.0	110.0	97.0	82.0	44.0	42.0
Pantothenic acid (B5), mkg	1.3	0.8	0.9	—	0.050	0.324	0.5	1.2

Table 3

Comparative data on the proportion of amino acids in vegetable raw materi-als from the daily value (per 100 g of the edible part)

Amino-acid	The proportion of amino acid content of the daily value, %							
	Oat grains	Soy-beans	Cashew	The fruits of cannabins	Sesam seeds	Poppy seeds	Almond kernel	Buckwheat grains
Leucine	27.9	71.9	32.0	47.0	32.6	28.7	32.0	16.0
Isoleucine	34.7	98.6	39.5	64.3	37.5	41.0	37.6	22.1
Valine	37.5	81.2	43.8	71.1	39.2	43.8	34.2	2.,0
Threonine	24.0	73.6	28.7	52.9	30.4	28.6	25.0	18.7
Lysine	17.1	66.0	22.6	31.1	15.9	23.2	13.9	14.5
Methionine	17.3	30.4	20.1	51.8	48.9	27.9	8.7	8.5
Phenylalanine	20.3	48.2	21.6	32.9	21.4	17.2	25.7	10.5
Tryptophan	29.3	73.9	35.9	46.1	41.3	23.0	26.4	21.3
Tyrosine	13.0	35.0	11.5	28.7	18.0	16.5	10.2	4.8

Table 4

Comparative data on fatty acids of vegetable raw materials (per 100g of edible part)

Fatty acids, g	Name of raw materials							
	Oat grains	Soy-beans	Cashew	The fruits of cannabins	Sesame seeds	Poppy seeds	Almond kernel	Buckwheat grains
Deep	1.22	2.88	7.14	4.6	6.957	4.517	3.802	0.59
Monoenes-shield	2.18	4.4	25.0	5.4	18.759	5.982	31.551	0.83
Palingenesy-shield	2.54	11.26	8.93	38.1	21.773	28.569	12.329	0.83
Cholesterol, mg	—	—	—	—	—	—	—	—
TRANS-isomers	—	—	—	—	—	—	—	—

All of the above is of particular interest to this vegetable raw material and makes it at-tractive for the production of functional drink.

The technology of beverage production includes the following stages: preparation and hydration of seeds, grinding in water (hydro module 1:9), filtering, mixing with flavorings to give a more complete taste and thermal treatment.

The resulting drink is a suspension of white with a light creamy tint, sesame flavor and sweet taste.

At the meeting of the working tasting Commission, samples of the drink received a positive assessment.

From the data of Table 5 it is clear that «milk» made on the basis of sesame seeds is not inferior to cow's milk in nutritional value and biochemical composition and surpasses it in some positions. For example, sesame milk does not contain in its composition such undesirable for the human body substances as hole-Sterin and TRANS-isomers of fatty acids. It is noted that the fatty acid composition of sesame milk differs markedly from the similar composition in cow's milk for the better. Thus, the content of saturated fatty acids is much lower, and unsaturated (MUFAS and Pufas) was significantly higher than in cow's milk.

Table 5

Comparative data on food and biological value of sesame and cow's milk (calculated)

Nutrient material	Name of produce (milk)	
	sesame	Cow'
Proteins, g	2.3	3.3
Fats, g	5.0	3.7
Carbohydrates, g	1.7	4.7
Saturated fatty acids (EFAS), g	0.7	2.3
Monounsaturated fatty acid (MUFAS), g	1.9	1.1
Polyunsaturated fatty acid (PUFA), g	2.2	0.14
Cholesterol, mg	—	14.0
TRANS-isomers of fatty acids, g	—	0.09
Vitamins, mg:		
Vitamin a, mcg	0.3	33.0
B1 (Thiamine)	0.1	—
B2 (Riboflavin)	0.02	0.2
B3 (Niacin, RR)	0.5	0.1
B6 (Pyridoxine)	0.1	—
B9 (folic acid, mg	9.7	5.0
Mineral substances, mg:		
Calcium	97.5	119.0
Potassium	46.8	151.0
Phosphorus	97.5	93.0
Magnesium	35.1	13.0
Iron	1.5	0.1
Zinc	0.8	0.4

4. Conclusion

Thus, a functional drink from sesame seeds has been developed, which, with systematic use, can contribute to the improvement of the cardiovascular system, gastrointestinal tract, musculoskeletal system. In addition, one of the main advantages of this product is that it does not contain milk sugar — lactose and can be recommended for use by people suffering from intolerance.

In the future, we plan to continue working towards the creation of alternative milk drinks based on other types of vegetable raw materials. Work in this direction is a step towards the organization of personalized food for the population of Russia.

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