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FOOD COLORS OF VEGETABLE RAW MATERIALS, THEIR PHYSICAL AND CHEMICAL PROPERTIES

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ABSTRACT

The use of fruits and vegetables is important due to their rich chemical composition and high nutritional value. Nature colored fruits and vegetables in a wide range. Leaves, stems, roots and ripened fruits of plants are a source of colors. These sources are widely used in the color formation of food products and beverages. In industry, food colors are extracted from plant materials and their secondary products.

As an example, we analyze several varieties of plants belonging to the Amarantus family. Amaranth seeds are used in traditional medicine, national cuisine in cooking, and in industry. A mixture of amaranth grains with corn is used in the preparation of cereals, it is widely used in the manufacture of confectionery. Amaranth has been used in medicine since ancient times for the treatment of wounds, skin diseases (measles, rubella), weight loss, obesity, cardiovascular diseases, with impaired liver and kidney function, and the elimination of bad breath.

Amaranth is a one-year plant, grown in various directions of use, for example, as vegetables (Amaranthus gangeticus, Amaranthus mangostanus), cereal (Amaranthus caudatus, Amaranthus paniculatus), ornamental (Amaranthus blitum), and food purpose [1,3–9]. The most valuable m healing part of amaranth is its seeds. 100 g of amaranth seeds contain energy of 370 calories, 7 g of lipids, 4 mg of sodium, 508 mg of potassium, 65 mg of carbohydrates, 1.7 mg of sugars, 14 mg of protein, 159 mg of calcium, 4.2 mg of vitamin C, 7.6 mg of iron, 248 mg of magnesium, 0.6 mg of vitamin B6, B2-riboflavin, B1-thiamine, rare forms of vitamin E tocopherol and tocotriene, vitamin D, pantogenic acid, squalene. Naturally, amaranth oil does not contain cholesterol, it is secreted by the content of serotonin, which is important for the human organizm, and red pigments, for example xanthine, as well as bile acid, choline, and steroids.

The extraction of colors from flowers is not well understood. Therefore, the aim of our research is to extract coloring substances that are harmless to the human organizm and use them in the food industry. Therefore, 4 species of plants from the Amaranthus family were selected as the object of research. These are the following types:

1.Amaranthus hypochondriacus L. - "ugryumaya shiritsa".

2. Amaranthus tricolor L. - "three-colored shiritsa".

3. Amaranthus cruentus L. (A. Hybridus L. subsp. Cruentus (L) Thell., A. panikulatus L.) - "blood shytich".

4. Amaranthaceae-Celosia cristata L- "ribbed celosia" [2, 4-9].

The experiments were carried out in the following sequence:

drying and grinding plants; extraction of components in an alcohol solution; filtration and centrifugation of the extract; concentrating the extract by evaporation; precipitation of by-products; solution filtration; concentration of the solution by evaporation; extraction of natural dye from the concentrate.

Conducting experiments. Amaranth flowers are dried at room temperature for 3-5 days. 10 g are taken from each type of dried material, 1% citric acid is poured into 200 ml of a 30% solution of ethyl alcohol and extracted for 12-18 hours at 20°C, then the solution is filtered. The physicochemical parameters of the extract are determined. In a rotary evaporator, the concentration of the solution is adjusted to a 10/1 ratio. The physicochemical parameters of the concentrate are investigated and the results are entered in table 1.

Table 1
Physical and chemical characteristics of the extract concentrate

№	Amaranth species	Density, g/l	The amount of solids, %	pH
1.	Amaranthus hypochondriacus L.	0,997	2	4,33
2.	Amaranthus tricolor L.	1000	2	4,40
3.	Amaranthus cruentus L.	0,997	2,3	4,48
4.	Amaranthaceae-Celosia cristata L.	1000	2,2	4,30

The amount of solids in the flowers of varieties Amaranthus cruentus L and Amaranthaceae-Celosia cristata L. amaranth is greater compared to others. The concentrate medium is neutral

The photocalorimetric method was used to determine the amount of coloring substances in the extract concentrate. The measurement results are given in table 2.

Table 2
The amount of coloring matter in the concentrate

№	Plant species	540 (нм) g/l coloring matter
1	Amaranthus hypochondriacus L. - «Shiritsa ugryumaya»	1,2
2	Amaranthus tricolor L.- «threecolor shiritsa»	2,2
3	Amaranthus cruentus L.- «blood shiritsa»	2,4
4	Amaranthaceae-Celosia cristata L- «ribbed celosia»	2,7

According to these data, it is seen that the amount of colors in the species Amaranthus cruentus L and Amaranthaceae-Celosia cristata L. is greater in comparison with others. These colors are used in the manufacture of the following products:

1) egg protein and sugar (bizet);
2) soft drinks;
3) confectionery cream;
4) marmalade products.

The essence of the experiments. In a sample of a food product weighing 100 g, 2 g of a natural dye from amaranth is added. A comparative analysis of the color index of the sample with a standard analogue is carried out and the following changes are found [3-7].

1.When adding a natural color obtained from Amaranthus hypochondriacus L. - "Urgyumaya syrup" to confectionery products (a mixture of egg protein and sugar) forms light red, in soft drinks it is also light red, reddish and red in marmalade in confectionery color.

2. When adding a natural coloring matter obtained from the amaranthus amaranthus tricolor L. variety - "three-colored shiritsa" in food products (a mixture of egg protein and sugar) and soft drinks, a light pink color forms, in the confectionery cream it is red-raspberry-colored, in marmalade reddish color.

3. When adding a natural coloring matter obtained from the amaranthus variety amaranthus cruentus L. (A. Hybridus L. subsp. Cruentus (L) Thell., A. panikulatus L.) - "blood syrup" in a food product (a mixture of egg protein and sugar) forms red, when added to soft drinks it is dark red, in the confectionery cream it is reddish raspberry and marmalade is red.

4. When adding a natural coloring matter obtained from the amaranthus amaranthus Celosia cristata L. variety - "comb celosia" in a food product (a mixture of egg protein and sugar) is dark yellow; in soft drinks it forms dark red; when added to a pastry cream, brown and the marmalade is dark red in color.

Based on the research, we can conclude:

1. The natural colors in the species Amaranthus cruentus L. are "blood shytich", Amaranthaceae-Celosia cristata L. - "combed celosia" amaranth is 10-18% more than in other species.

2. Natural coloring substances do not change the indicators of taste and quality of food products.

3. In amaranthus cruentus L. "blood shiritsa" there is plenty amount solids, and the acid index is neutral.

Another source containing many anthocyanins that turn into colors is basil - maximum basilicum L. Lamiaceae - a representative of the family of Lamiaceae.

Basil is sown in the countries of Central Asia in the form of a one-year plant. In all types of basil there are essential oils, which makes the plant smell pleasant. The terrestrial part of the plant contains camphor oil, cineole, linalin, octimene, pinene, etc. It also contains up to 6% tannins, glycosides, saponins, 150 mg% vitamin P, 3.2-3.5% vitamin C and 3.0 -8.7% of vitamin A. In traditional medicine, the anti-inflammatory properties of leaves, juice, young shoots, and water extracts of basil stems are used in the treatment of wounds, against coughs, the diuretic system, to ward off insects, to eliminate unpleasant odors and when disinfecting rooms. Stem water extract is used for inflammation of the upper respiratory organs, chronic gastritis, energy colitis and food poisoning. In cooking, leaves are used as spices.

Basil anthocyanins are investigated experimentally.

The leaves of the basil are dried until 11-12% residual moisture is achieved, crushed, sieved with a sieve with a hole diameter of 0.3 mm, and 50 mg is taken, extract is made in 10-70% alcohol in a proportion of 1:10.

Extraction is carried out twice, at room temperature for 5 and 18 hours, respectively, anthoyas are secreted. The resulting solutions are combined, filtered, centrifuged and solid particles are isolated from them. The resulting solutions are concentrated to a proportion of 1/7.

The amount of solids, the acidity of the medium and the bulk density of the purified solution and concentrate containing colors were determined. The results are summarized in table 3.

Table 3

Indicators of coloring substances in the extract and concentrate of basil leaves

№	Alcohol solution,(%)	Bulk density, (g/l)		Solids, (%)		Medium acidity, pH	
		extract	concentrate	extract	concentrate	extract	concentrate
1	10%	1,003	1,056	5,4	11,4	4,0	3,5
2	20%	0,985	1,063	6,2	18,5	4,0	3,3
3	30%	0,975	1,081	9,2	21,0	4,0	3,2
4	40%	0,960	1,052	14,6	15,2	4,0	4,5
5	50%	0,961	1,078	17,0	21,6	4,0	4,5
6	60%	0,875	1,085	21,0	15,8	4,2	4,5
7	70%	0,871	1,091	21,2	16,0	4,2	4,4

The amount of solids in a 30% alcohol extract is 9.2, in a concentrate 21.0%, in a 50% solution of 17.0%, in a concentrate, 21.6%, which are determined using electro-fotocolorimeter.

Changes in the amount of colors available in the extract and basil concentrate at different wavelengths are shown in Figures 1 and 2.

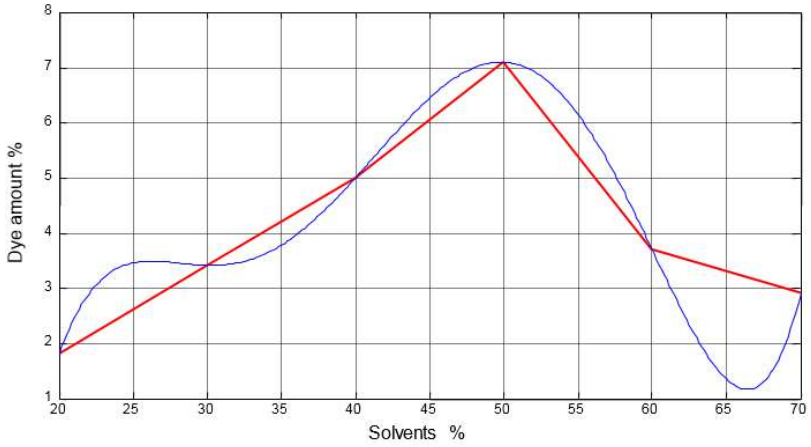

Fig.1. The amount of colors in the concentrate, depending on the density of absorption of rays by concentrates at a wavelength 540 нм.

The regression equation obtained using information on the increase in the concentration of alcohol in the composition of the solution designed to extract natural coloring matter from the leaves of the plant (Fig.1) has the following form:

$$У=1.7e\text{-}00.6^{x}\, x^{5}\text{-}0.00037^{x}x^{4}+0.03^{*}x\text{-}1.2^{*}x^{2}\text{-}22^{*}x\text{-}1.6e+002 \quad (1)$$

As can be seen from Figure 1, when the alcohol concentration in the composition of the extract was 50%, the amount of coloring matter reached 7%. Now you can calculate the amount of colors obtained using the regression equation.

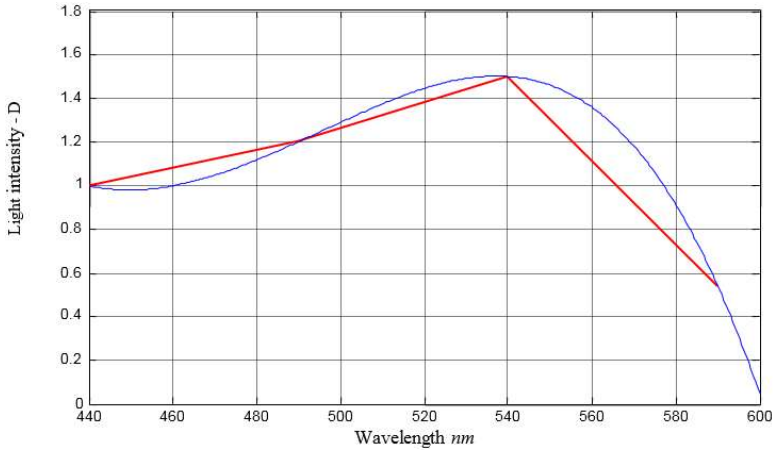

Fig.2. The density of absorption of rays by the extract obtained with a 50% solution of alcohol at wavelengths 440, 490, 540 и 590 нм.

Fig. 2 shows graphs expressing the number of natural plant colors obtained by measuring in the 440-600 nm range of the electro-fotocolorimeter device. The maximum amount of coloring matter contained in the extract, corresponding o a wavelength of 540 nm electro-fotocolorimeter is 1.47 g/l. To carry out the calculation of this process, a regression equation is obtained by processing experimental data:

$$У= -3.1e\text{-}009^{*}x^{4}+4.6\ e\text{-}006^{*}x^{3}\text{-}0.0023^{*}x+0.37^{*}x \quad (2)$$

The content of sugars and vitamins in the concentrate obtained from basel leaves was determined, the results are shown in table 4.

Table 4
The amount of carbohydrates and vitamins in the concentrate obtained from basil leaves

Concen-trate	Carbohydrates, мg/l			Vitamins, мg/l				
	Fructose	Glucose	Sucrose	B_1	B_2	B_6	B_{12}	B_c
20%	5.94	-	-	27.52	341.67	-	-	-
30%	8.46	6.94	2.73	22.20	376.36	-	-	-
40%	9.12	4.76	4.59	274.40	375.40	-	524.17	651.40
50%	7.14	5.6	6.82	265.70	265.70	-	526.32	617.20

The proportion of fructose among sugars extracted from basil leaves is 1.3-2.1 times higher compared to other sugars. Therefore, these products can be used in diet products intended for people with diabetes, atherosclerosis, stroke, heart attack.

The amount of carbohydrates, namely fructose and glucose, which are part of the chemical composition of the concentrate of natural food colors, in 30-40% alcohol solutions is more than in a 50% solution. This means that at low carbohydrate concentrations, the amount of monosaccharides is higher. Logically, it should be so, monosaccharides dissolve faster and in full. The polymer chains consisting of their sugars precipitate at high alcohol concentrations.

There are more vitamins in the concentrate when using a 40% alcohol solution, which means that vitamins dissolve better in water than in alcohol.

Natural colorants are more excreted when using a 50% alcohol solution, but with an increase in the concentration of the solution, the amount of anthocyanin decreases. This proves that the optimal solvent is a 50% alcohol solution of 1% citric acid.

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