RESEARCH ARTICLE

Functional products from black root preparation technology

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Abstract

The article discusses the physicochemical properties of black root, the juice obtained from it, as well as the technology for preparing various functional products from black root. The color of black radish is given by the anthocyanin and a small amount of α-carotene. The body converts this pigment into vitamin A. This vitamin is not only beneficial for skin and eye diseases, but also increases resistance to cardiovascular diseases and cancer.

It supports the healing process of stomach acid-related problems such as ulcers. It protects our body from free radicals due to its very strong antioxidant properties. This property also ensures that it creates a protective effect on our body from flu to various types of cancer.

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Introduction

Carrot (Daucus carota) is one of the vegetables cultivated and consumed in our country. When attention is paid to its production, it is known that the largest production is in European countries. While it is mainly consumed as a winter vegetable in our country, it is consumed in every season in countries around the world. In addition, although it is almost not canned in our country, it is canned and consumed in large quantities in European countries. Most of the consumption is carried out in the northern hemisphere.

Black radish is harvested in November-December. It can be consumed whole (in salads and pickles) or used in dishes.

The thick juice of black root can be used as a natural colorant in food products. These products include ice cream, cakes, biscuits, yogurt, drinks, and sweets.

Blackcurrant juice, one of the healthiest alternatives to synthetic food colors, is a product in demand in this field because it is heat and light resistant and can be stored for a long time due to its rich anthocyanins.

The taste quality of the root is determined by the amount of aromatic and phenolic compounds it contains (Fataliyev HK et al. 2017, p. 89).

100 grams of carrots contain an average of 42 calories, 8 g of carbohydrates, 1 g of protein, 0.3 g of fat, 35 mg of calcium, 0.9 mg of iron, 0.06 mg of B1, 0.04 mg of B2, 0.6 mg of niacin, and 5 mg of vitamin C.

Methodology

For the research, black root from the experimental area I set up on the territory of TETI was used.. A number of research works were carried out in the experimental field and in the laboratory to study the properties of the plant in more depth. The storage capacity of these plant products at different maturity periods was studied, the biochemical processes occurring during storage were monitored, and various products were prepared by processing. Biological preservation of these vegetables was carried out, various marinades, dry products and powder samples of these raw materials, as well as juices were prepared.

First, some of their physical properties were studied.A random sample of 2 kg (21 pieces) of black root crop was taken and the mass and length of each root were measured (Table 1). Diameter measurements were taken from two different locations, the middle and the top of the root.

Table 1

Some physical properties of black root

Examples No.	Mass, g	Length, mm	Diameter (mm)	
			Middle side	Top side
1	87.05	200	31.3	22.3
2	68.09	172	28.9	23.1
3	80.31	183	34.1	22.7
4	96.41	213	33.0	23.5
5	62.65	222	28.6	18.5
6	66.92	206	26.4	21.5
7	73.91	218	29.0	20.7
8	105.30	286	31.9	21.0
9	147.60	248	41.5	27.7
10	114.70	240	33.0	24.3
Average price	**90.29**	**21.83**	**31.7**	**22.53**

As can be seen, the average mass of a single black root was 90.29g, the

average length was 21.83mm, the average diameter was 31.7mm in the middle and 22.53mm at the top.

The supplied black root product was squeezed and juiced. This juice is completely 100% natural juice. Because natural juices are made from one type of raw material. It is not allowed to add other juices, sugar or preservatives to it. These juices are distinguished by their high quality, excellent variety, and exemplary quality. This natural juice is divided into 4 parts:

Part I is completely pure and natural, without any additives.

Squeeze lemon juice into the second part to change the taste.

Apple juice is added to part III as an auxiliary raw material.

Black carrot juice mixed with apple juice and lemon juice is now called blended juices. "Blended juices" are prepared by mixing other fruit and berry juices to enhance the taste, color, and nutritional properties of the main juice. In this case, the compositional parameters of the juice (acidity, sugar content, etc.) are also adjusted according to the conditions (Fataliyev HK et al. 2017, p. 158).

In part IV, both apple juice and cinnamon powder are added as auxiliary raw materials. Cinnamon lowers the amount of sugar in the blood by 10%. Cinnamon is obtained from the dried bark of young shoots of the evergreen cinnamon tree. It is released in the form of fiber extracted from the shoots or in powder form. It contains essential oils, antioxidants and resin, giving it a specific aroma (Fataliyev HK et al., 2017, p. 153). Thus, the sugar level of patients using this spice remains normal.

In the research work conducted, the mass of the root was first determined by weighing it on a scale. It was found that the root crop was 51.25 kg. The raw root juice obtained by squeezing it was 18.4 kg.

Let's calculate the juice yield:

Juice yield, %=$\frac{18,4}{51,25}$·100=35.9%.

This juice yield was within the established norms.

As a result of the analyses conducted on the squeezed and not yet filtered black root juice samples, the following indicators were determined (Table 2).

Table 2

Physicochemical indicators of black root juice

Indicators	Quantity	
	Barda	Dashkasan
Brix	10.82	9.05
Titratable acidity, g/100 cm3	0.101	0.315
pH	6.0	5.1
Reducing sugar, g/dm3	15.61	14.25
Total sugar, g/dm3	48.71	42.31
Sucrose, g/dm3	32.29	28.01
Ascorbic acid, mg/100 cm3	26.20	28.31

As can be seen, different compositional indicators were obtained in black root juice depending on the cultivation conditions. While ascorbic acid was 26.20 mg/100 cm3 in Barda root juice, it was more than 2.11 mg/100 cm2 in Dashkesan root juice. However, the brix index and the amount of sugars were higher in the black root juice grown in Barda compared to Dashkesan. However, the high content of acids and low pH value were noticeable in the latter sample. Both samples, in addition to being rich in ascorbic acid, also showed themselves as a source with a high content of anthocyanins (Nancy E. M., Brianna A., Shivi G., Nathan M., Noor A. H. (2024).

To clarify the root juice, it was previously depectinized. For this, pectolytic enzyme preparations that act on pectin were used. Depectinization was carried out at the natural pH (6.0) of the turbid root juice obtained by pressing and at a pH adjusted to 4.3 by adding citric acid.

Root juices were treated with different amounts of enzyme and kept at 500C for 2 hours. Then, the samples were subjected to coarse filtration and NTU values were determined on a turbidimeter. "NTU (Nephelometric Turbidity Unit)" is an indicator reflecting the level of turbidity (table 3).

Table 3

Results of depectinization of black carrot juice

pH	Pectolytic enzyme	Dosage (ml/100 ml)	NTU
6.0	-	-	>2000
4.3	-	-	>2000
6.0	+	0.3	1630
4.3	+	0.1	5.25-5.35
		0.2	2.60-2.62
		0.3	3.77-3.79

As can be seen from the table, the first and second samples differed from each other in terms of the pH of the medium (pH 6.0 and 4.3) and were taken as controls. Pectolytic enzyme preparations were not used in the control samples. As a result, the NTU indicator, i.e. turbidity, was up to 2000 in both samples. In the experimental variant, the enzyme dose in the sample with pH 6.0 was 0.3 ml per 100 ml, and since the NTU indicator was still high, its other variants were not considered. The pH 4.3 variant was taken as 0.1; 0.2 and 0.3 ml/100 ml depending on the dose of the enzyme used. It turned out that in the variant where the pH of the black root juice was reduced to 4.3, the best depectinization was possible at a dose of 0.2 ml/100 ml, while the NTU indicator was lower, i.e., varying between 2.60-2.62, and differed from the other samples in its clarity (Joe L. R., Joshua W. S., Catherine C. A., Miller R.J, Matthew A. W., Amandeep K., Jesus N. S., Salma M., Steven K. C., William D O'Brien, John W. E., (2020).

Then, experimental studies were conducted to determine the optimum dosage of the thickener that would provide better thickening in depectinized root juice. For this, tests were carried out with different dosages of thickeners - gelatin and kieselsol. The results of some of the gelatin and kieselsol tests are given below (table 4). Table 4

Applied to black root juice (50 ml)

some gelatin and kieselsol tests

Gelatin (0.5%)	Silica (15%)	NTU
0.5 ml	0.1 ml	0.940-0.960
	0.5 ml	0.840-0.870
	1.0 ml	1,120-1,135
	1.5 ml	2,240-2,280
1.0 ml	0.1 ml	1,620-1,670
	0.5 ml	0.730-0.750
	1.0 ml	0.740-0.770
	1.5 ml	1,030-1,105
1.5 ml	0.1 ml	0.720-0.770
	0.5 ml	0.660-0.680
	1.0 ml	0.830-0.880
	1.5 ml	1,420-1,470
2.0 ml	0.1 ml	0.720-0.750

	0.5 ml	1,010-1,040
	1.0 ml	1,060-1,110
	1.5 ml	1,103-1,120

The results show that the lowest NTU value, i.e. higher transparency, was achieved by applying 1.5 ml of gelatin (0.5%) and 0.5 ml of kieselsol (15%) to 50 ml of depectinized root juice. Therefore, the optimal dosage for juice clarification was 1.5 ml of 0.5% gelatin and 0.5 ml of 15% kieselsol.

Black carrots are also prepared in various semi-finished products (dried, powder). During the drying process, a large amount of water is removed from the raw material by evaporation, and as a result, the amount of dry matter increases, making the product resistant to long-term storage (Fataliyev HK et al. 2017, p. 184).

The raw materials used for drying must be fresh, normally ripe, free from mechanical damage, and have a color characteristic of the variety. It is not advisable to use products damaged by diseases or pests. This will reduce the yield of the finished product and the product itself will be of poor quality.

Before drying, the raw material is washed, inspected and sorted to remove non-standard shapes. Then it is chopped (in the form of rings) and placed in a thermostat for drying. Black carrots are dried at 700C for 13 hours. During drying, the water remaining on the fruit from washing evaporates first. Because it is not in contact with the raw material, it is removed very quickly. Then the water in the product itself begins to evaporate.

Some of the dried black carrots were ground and made into powder. Diabetics can drink the carrot powder by adding it to water. It is also possible to use these prepared powders in dishes (Fataliyev HK et al. 2014, p. 257).

At the same time, canned black carrots and Jerusalem artichokes were also prepared. Jerusalem artichoke tubers, which are rich in inulin, were also used in the preparation of this canned food.

Jerusalem artichoke (yeramudu) is mainly used as a fodder plant. This fodder plant has yellow, reddish or yellowish-white tubers weighing 50-60 g. It contains 74-79% water, 13-20% inulin, up to 6% sugar, 2-5% nitrogenous substances and 2-3% cellulose (Fataliyev HK et al. 2017, p. 89)It is used in the production of alcohol, inulin, fructose, and also as a food product in small quantities when cooked (Joe L. R., Joshua W. S., Catherine C. A., Miller R.J, Matthew A. W., Amandeep K., Jesus N. S., Salma M., Steven K. C., William D O'Brien, John W. E., (2020).

First, both vegetable varieties are washed. Then the Jerusalem artichokes are cleaned. Since we choose the especially small ones, they are not chopped. In carrots, the end of the root and the green part of the head are removed, then they are boiled in water at a temperature of 900C for 2-4 minutes. In order to reduce the residues formed during cooling, the carrots are peeled chemically. For this, the carrots are boiled for 1-2 minutes in 2-3% stored in a sodium soda solution. After chemical cleaning, the roots are thoroughly washed with cold water to completely remove the peel and alkaline residue. Before chopping, the quality of root cleaning is checked and incompletely cleaned parts are cleaned manually. Carrots are chopped into rings. The jar is filled with black carrots and carrots alternately, as much as possible, and a 2% boiling solution with a temperature of at least 900C is added to it. The filled jars are sealed in vacuum sealing machines and immediately sterilized. Sterilization is carried out at 1200C for 25-30 minutes (Fataliyev HK, 2010, p. 117). After sterilization, the jars are quickly cooled with water to 40-450C (Fataliyev HK et al., 2017, p. 155).

The amount of root in ready-made canned food is 55-60%, solution is 45-40%, and table salt is 0.8-1.5%.

The technology for making black carrot marmalade uses 1 kg of black carrots, 10 g of sugar, and 1 lemon. The roots are washed, cleaned, and cut into 1.5-2 cm thick slices. Mix the carrots with powdered sugar and leave for 8 hours. Then add lemon juice and boil for 10 minutes. Then cool and boil 3 times in the same way and cool. After cooling, the black carrot slices are placed on a baking sheet, placed in the oven for 4 hours at 1000C, and the marmalade is ready.

Conclusion and Discussion

1. A random sample of 2 kg (21 pieces) of black root crop was taken and the mass and length of each root were measured. Diameter measurements were taken from two different locations, the middle and top of the root. It was

found that the average mass of a single black root was 90.29 g, the average length was 218.3 mm, and the average diameter was 31.7 mm in the middle and 22.53 mm at the top.

2. The mass of the root crop was determined to be 51.25 kg by weighing it on a scale. The raw root juice extracted from it was 18.4 kg, and the juice yield was 35.9%. This juice yield was within the established norms.

3. Different compositional indicators were obtained in black root depending on the cultivation conditions. Ascorbic acid was 26.20 mg/100 cm3 in Barda root juice, while it was 2.11 mg/100 cm3 more in Dashkesan root juice. However, the brix indicator and the amount of sugars were superior in the black root juice grown in Barda compared to Dashkesan.

4. In order to clarify the root juice, its depectinization was carried out beforehand. For this, pectolytic enzyme preparations that affect pectin were used. It was found that in the variant where the pH of the black root juice was reduced to 4.3, the best depectinization was possible at an enzyme dose of 0.2 ml/100 ml, while the sample obtained with a lower NTU indicator, i.e. varying between 2.60-2.62, was distinguished by its superior clarity compared to the others.

5. Then, in order to determine the optimum dosage of the fining agent that provides better fining in depectinized root juice, tests were carried out with different doses of gelatin and kieselsol. The results obtained show that the lowest NTU value, i.e. higher transparency, was achieved by applying 1.5 ml of gelatin (0.5%) and 0.5 ml of kieselsol (15%) to 50 ml of depectinized root juice. Therefore, the optimum dosage for fining the juice was 1.5 ml of 0.5% gelatin and 0.5 ml of 15% kieselsol.

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