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Chemical-Technological Assessment of Wild Berries for Healthy Food Production.

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ABSTRACT

Human health depends largely on the quality of food consumed. Recently, there is a shortage in the supply of adequate food products. Wild berries are a natural source of biologically active substances so necessary for normal functioning of our body. Therefore, developing wild berries-based food products is a topical area of research. Objects of research are wild berries - briar, barberry, buckthorn, hawthorn, and viburnum, which are widespread in the territory of Dagestan. These berries are highly popular and widely used in traditional medicine. However, these berries are not involved in the industrial processing of the republic. Based on the studies of the chemical-technological characteristics, we can conclude that wild berries are generally recognized as leaders in the content of the most important nutritional bioactive, naturally-generated components, and therefore represent an exceptional value for a healthy diet and, of course, are a valuable source of raw materials for high-quality food products.

Keywords: wild berries, briar, hawthorn, buckthorn, cranberry, bilberry, nutritional value, biologically active dietary supplements, drying, commercial quality.

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INTRODUCTION

Analysis of modern trends in the diet structure shows unbalance in the main food nutrients such as proteins, carbohydrates, lipids, vitamins, macro- and microelements, etc.

The experts observe today and predict in the future the deficiency in these important biologically active components in the diet. This anxious situation is further exacerbated by the deteriorating environmental situation in our country. Therefore, the problem of creating and implementing the preventive products containing a wide range of biologically active compounds, which are able to compensate for the effect of aggressive environmental factors and thereby contribute to the maintenance and preservation of health, becomes highly important [1].

Wild berries are generally recognized as leaders in the content of the most nutritionally and biologically important naturally-generated components, and therefore represent an exceptional value for a healthy diet and, of course, are a valuable source of raw materials for high-quality food products [2].

On the background of growing demand of the customers for the dried wild berries and food products from berries, many forest areas of the Republic of Dagestan are used inefficiently and non-uniformly [6].

The Republic of Dagestan has neither enterprises nor organizations for gathering and integrated processing of wild berries. Integrated processing of wild berries allows using own raw material base of our country, improving the range of food products, producing food of increased biological value, introducing non-waste technology of wild berries-based food production, as well as providing high involvement of the Republic of Dagestan in the wild berries gathering process [7].

Based on the foregoing, the relevant scientific problem is the chemical-technological evaluation of wild berries growing in the territory of the Republic of Dagestan.

RESEARCH OBJECTS, CONDITIONS AND METHODS

Objects of research are wild berries - briar, barberry, buckthorn, hawthorn, and viburnum, which are widespread in the territory of Dagestan. These berries are highly popular and widely used in traditional medicine. However, these berries are not involved in the industrial processing of the republic.

The studies were conducted at the Department of commodity research, food technology and catering, at the testing center of FSBEU HPE "DagSAU", Makhachkala, and in the testing laboratory of the North Caucasian Zonal Research Institute of Horticulture and Viticulture, Krasnodar, in accordance with GOST 15101-98 "Scientific research procedure"; "Guidelines for chemical-technological variety testing of vegetable, fruit, and berry crops" (M.: 1993).

In our research the following normative-technical documents were used: GOST - 3852-93. Hawthorn berries; GOST - 1994-93. Briar berries; RS RSFSR-22-75. Fresh viburnum; RS RSFSR-29-75. Fresh wild sea buckthorn; GOST- 51074-2003. Consumer information; GOST-6077 - 80. Herbal medicinal material. Packing, labeling, transportation, and storage; GOST-24027.0-80. Herbal medicinal material. Acceptance procedure and methods of sampling; GOST-24027.1-80. Methods of identification, storage pest infestation, grinding grade and impurities; GOST-24027.2-80. Moisture, ash, extractives, tannins, and essential oil determination methods.

MERCHANDISING ANALYSIS

Any raw materials used for the production of food products must meet the requirements specified in the GOSTs and SanPiN.

We conducted the merchandising analysis of all objects of the study. Wild berries were accepted under GOST-24027.0-80. First of all, we studied the homogeneity of raw materials by their preparation (whole, grinded, pressed), then the color, smell and content of impurities, the presence of mold, rot, stable foreign odor remaining after ventilation; infestation with poisonous plants and foreign impurities (stones, glass, droppings of rodents and birds).

The presence of storage pests was determined simultaneously with the naked eye and with a 5-10^x magnifying glass.

The merchandising analysis of prototype berries of briar, hawthorn, sea buckthorn, and viburnum showed that they meet the requirements set by the regulatory documents.

BIOCHEMICAL COMPOSITION OF WILD BERRIES

In recent years, the knowledge about the nutritional value of wild berries has increased. Biochemical composition affects significantly the nutritional value [3]. Biochemical indicators of quality are given in Tables 1, 2, and 3. According to the content of soluble solids and total sugar, the wild berries differ markedly from each other (Table 1).

For example, the highest content of soluble solids is found in briar and blood-red hawthorn (32.6 and 26.6%, respectively). This figure is 2.5 - 3 times greater than that of sea buckthorn and barberry. While, the share of sugar ranges from 23.7% in hawthorn to 86.2% to in viburnum. The content of sugar in briar and buckthorn ranges 50% of total content of soluble solids. According to the literature, the wild berry sugars consist principally of grape sugar (glucose) and fruit sugar (fructose). This is also confirmed by our studies (Fig.1 and Fig.2). Berries such as viburnum and rosehips contain more fructose than glucose. Sea buckthorn and blueberries contain less than 1% of fructose, and barberry - less than 1% of fructose.

Table 1 - Biochemical indicators of quality of wild berries growing in the territory of the Republic of Dagestan

Wild berries	Soluble solids, %	total sugar, % <i>actual content / % of total soluble solids</i>	glucose, % <i>actual content / % of total soluble solids</i>	fructose, % <i>actual content / % of total soluble solids</i>	sucrose, % <i>actual content / % of total soluble solids</i>
Sea buckthorn	9.4	5.33 / 56.7	2.5 / 46.9	2.3 / 43.2	0.5 / 9.9
Raspberry	10.2	8.8 / 86.2	2.02 / 22.9	4.31 / 48.9	2.35 / 28.2
Briar	32.6	15.8 / 48.5	5.84 / 34.7	7.7 / 48.7	2.14 / 13.6
Barberry	18.9	4.83 / 25.6	4.26 / 88.2	0.06 / 1.2	0.48 / 10.6
Blood-red hawthorn	26.6	6.3 / 23.7	0.78 / 12.3	2.76 / 43.9	2.62 / 43.8
Bilberry	8.9	6.1 / 68.5	3.52 / 57.7	2.08 / 34.1	0.5 / 8.2

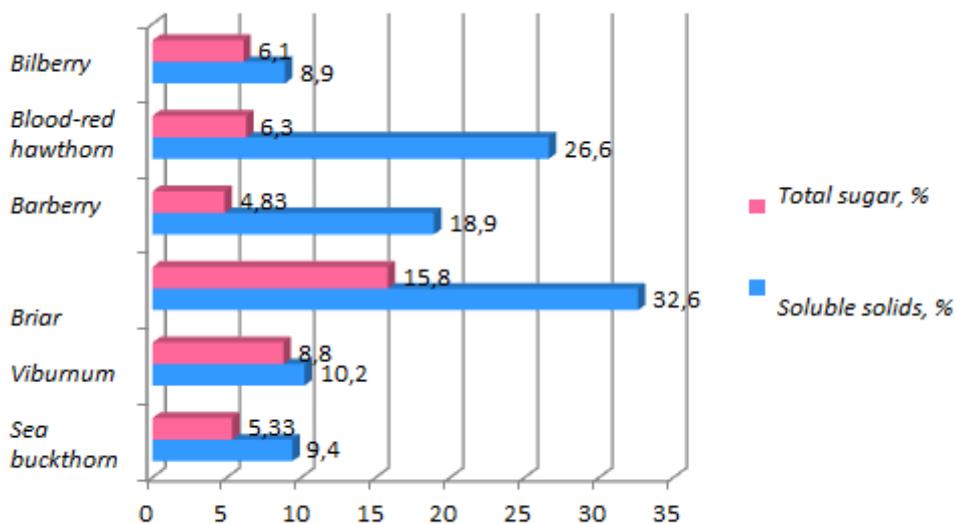


Fig (1) – Wild berries sugar structure, %

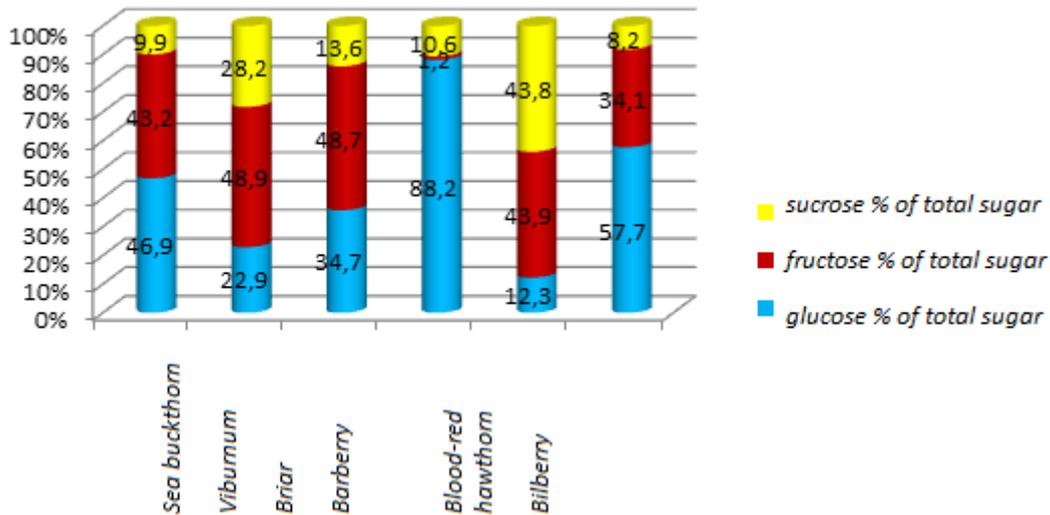


Fig (2) - Glucose, fructose, and sucrose percentage of the total content of sugar

The acids in combination with sugars, pectins and tannins make the taste of wild berries. They stimulate the appetite, increase the secretion of pancreatic and gastric acids, and stimulate intestinal peristalsis. Organic acids promote dissolution of uric acid salts and their removal from the human body [5]. The content of acids in the studied wild berries is shown in Table 2.

As can be seen from this table, the organic acids of the studied wild berries are represented by malic, valeric, citric, tartaric, and succinic acids. The highest content of organic acids is found in sea buckthorn and barberry. The following are viburnum berries, and the lowest content of organic acids is found in hawthorn.

The predominant acid in the sea buckthorn berries is malic acid; in barberry - malic, citric, tartaric; in viburnum - malic, valeric; in hawthorn - malic, citric, succinic, tartaric; and in briar - citric acid.

Table 2 - Wild berries total acidity

Wild berries	Total acidity (g per 100g of fresh berries)	Major acids
Sea buckthorn	2.1	Malic
Viburnum	1.1	Malic, valeric
Blood-red hawthorn	0.8	Malic, citric, succinic, tartaric
Briar	1.7	Citric
Barberry	1.7	Malic, citric, tartaric

Sugar-acid index provides information about the taste harmony. SAI data are shown in Table 3 and Fig. 3.

Table 3 - Wild berries sugar-acid index

Wild berries	total sugar, %	total acidity, %	Sugar-acid index
Sea buckthorn	5.33	2.1	2.54
Viburnum	8.8	1.1	7.36
Briar	15.8	1.7	9.29
Barberry	4.83	1.7	2.84
Blood-red hawthorn	6.3	0.8	7.88
Bilberry	6.1	1.15	5.3

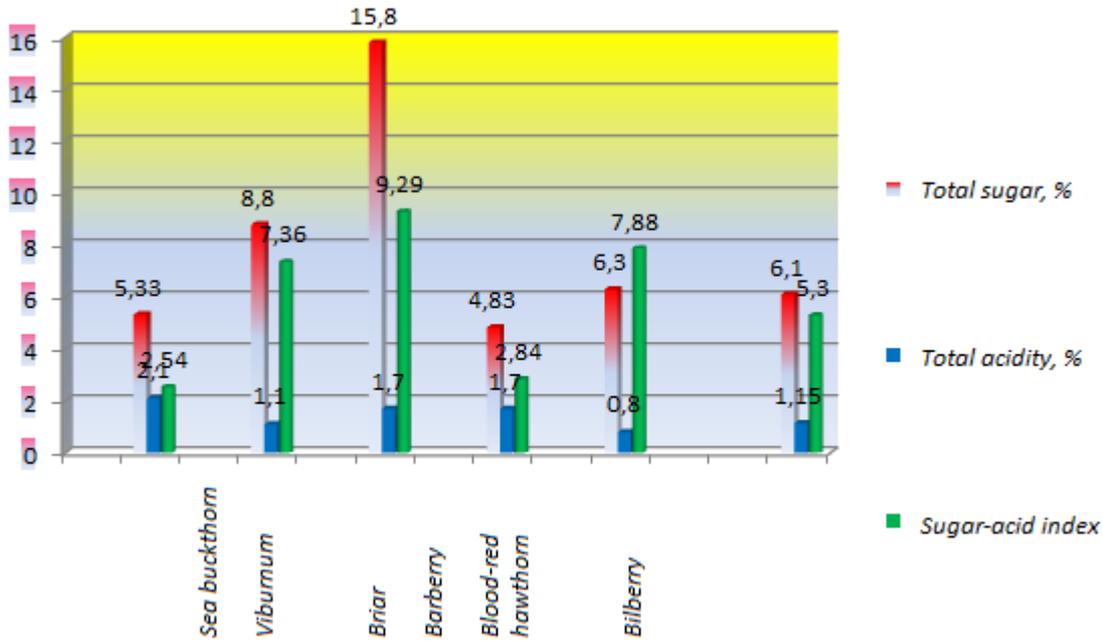


Fig (3) - Content of sugars and acids in wild berries

Pectins hold a special place among the carbohydrates. By interacting with acids and sugar contained in berries, they can form jelly. Without pectin it would have been difficult to produce jams, jellies, pastes, etc.

Pectins have the ability to bind (or otherwise neutralize) some toxic substances, such as lead, cesium, and cobalt compounds getting into a human body.

There is also variation in the content of pectins in the wild berries (Table 4). For example, the highest content of pectin is found in briar, which is 2 to 6 times higher than in other berries. Sea buckthorn and viburnum have the lowest content of pectins.

Table 4 - Content of pectin substances in wild berries

Wild berries	Total content of pectin substances (g per 100g of fresh berries)
Sea buckthorn	0.46-0.50
Viburnum	0.38-0.58
Blood-red hawthorn	1.29-1.61
Briar	1.80-3.74
Bilberry	0.66

For example, the bilberry pectin substances include pectin (56.1% and 43.9% of protopectin) (Table 5 and Fig. 4).

Table 5 - Bilberry pectin content

Variety	pectin	protopectin	Total pectin
Bilberry	+37	0.29	0.66

Bilberry

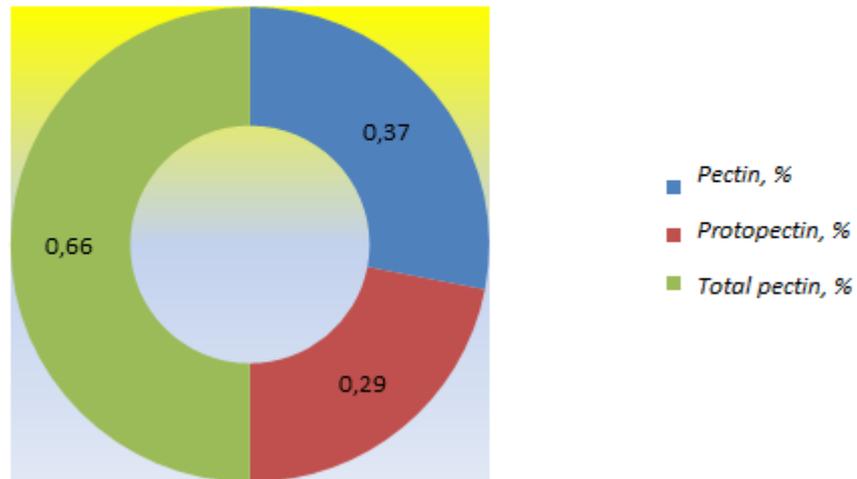


Fig. (4) - Content of pectin substances in wild bilberry

The vitamin composition of wild berries is very diverse (Table 5).

Wild berries contain mainly water-soluble vitamins C, P, and group B vitamins. Fat-soluble vitamins found in wild plant material are only carotene and vitamins K and E (Table 5).

Table 5. Vitamin composition of wild berries

Wild berries	Vitamin C mg/100g	Vitamin P mg/100g	anthocyanins, mg/100g	flavonoids, mg/100g	vitamin E, mg/100g	B-carotene, mg/100g
Sea buckthorn	70.0	36.2	-	10.1	9.8	3.73
Viburnum	18.5	138.2	94.9	-	-	-
Briar	160.2	274.0	-	12.0	4.45	5.4
Barberry	11.2	18.0	29.3	-	1.76	0.94
Blood-red hawthorn	30.8	252.0	114.6	-	2.6	1.71
Bilberry	11.0	41.8	804.3			

We should emphasize that the wild berries can only be of practical value as a source of vitamin C, P and carotene. The rest of the vitamins are contained in very small amounts, and therefore the wild berries can only serve as additional resources of these substances in the diet. Berries of sea buckthorn, viburnum, briar and other plants contain a fat-soluble orange pigment carotene, which dissimilates in the human body (in the liver and small intestine) and forms vitamin A.

Table 6 - Mineral composition of wild berries

Variety	K, mg/100g	Ca, mg/100g	Na, mg/100g	Mg, mg/100g
Sea buckthorn	258.5	21.4	19.1	17.0
Viburnum	335.0	44.7	11.7	31.4
Briar	464.1	193.6	11.0	69.2
Barberry	430 000	49.6	12.6	38.6
Blood-red hawthorn,	598.9	135.9	15.8	61.2
Bilberry	64.7	6.4	9.0	6.7

We have also studied the mineral composition of wild berries. It was found that wild berries contain significant amounts of potassium salts. Thus, the highest content of potassium found in hawthorn was 598.9 mg, in briar - 464.1 mg, and barberry - 430 mg per 100 g of product. Viburnum and sea buckthorn contain smaller amount - 335 and 258.5 mg per 100 g, respectively, and the lowest content of potassium is found in bilberries - 64.7 mg per 100g (Fig.5, Fig.6) and Table 6.

The highest Ca content is found in briar and hawthorn 193.6 and 135.9 mg per 100 g, respectively. sea buckthorn has the most of Na - 19 mg per 100 g, and briar leads in Mg - 69.2 mg per 100g.

Investigation of micronutrient composition of the wild berries growing in the Republic of Dagestan continues.

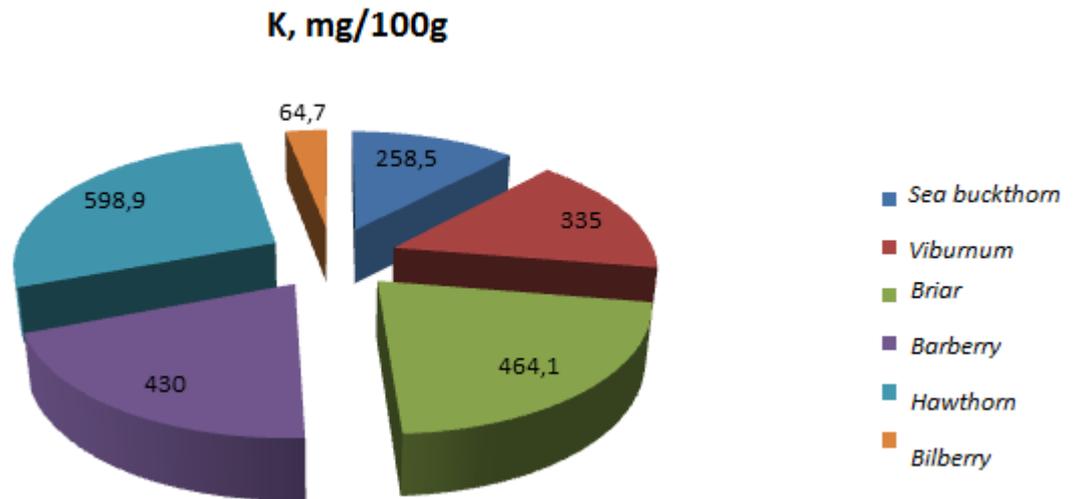


Fig (5) – The potassium content in wild berries

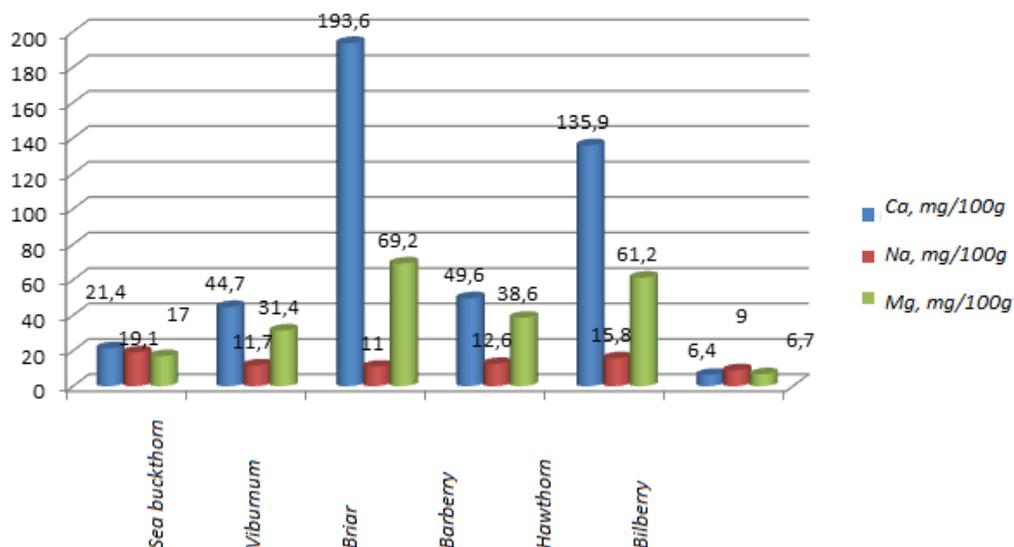


Fig (6) – Ca, Na, Mg content in wild berries

SUMMARY

Based on the conducted studies we can conclude that the wild berries contain a quite high amount of biologically active substances and may be a source of vitamins, micro- and macro-elements, organic acids, pectin, tanning, coloring and other substances necessary for normal growth and development of the human body.

CONCLUSION

The Republic of Dagestan is a favorable climatic zone for the growth of wild berries, variable in their species and chemical composition, which are of interest for both fresh consumption and industrial processing for further production of currently best-selling healthy food products.

CONFLICT OF INTERESTS

The author declares that the provided information has no conflicts of interest.

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