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Общее содержание полифенолов и флавоноидов в сортах черешни казахстанской селекции

РЕЗЮМЕ

Актуальность. Фенольные соединения представляют собой ароматические соединения, в которых бензольное кольцо связано с одной или несколькими гидроксильными группами. Флавоноиды, входящие в состав черешни, обладают лечебными свойствами и применяются в том числе как биологически активные добавки к пище. Исследования, затронутые в статье, являются актуальными, как с точки зрения научной новизны, так и для обоснования пользы потребления черешни новых сортов казахстанской селекции.

Цель — провести анализ содержания полифенолов и флавоноидов в черешне казахстанской селекции. Задачи исследования: собрать теоретические данные, применить методы исследования для получения результатов содержания полифенолов и флавоноидов в лабораторных условиях, сделать релевантные выводы.

Методы. Объект исследований — плоды черешни сортов казахстанской селекции: Айгерим, Лязат и Мерей. Методы оценки физико-химических показателей стандартные: определение содержания сухих веществ, общих сахаров и титруемой кислотности, изучение флавоноидов.

Результаты. Установлено, что среди рассмотренных сортов черешни самые высокие значения, по химическим показателям: сахарокислотному индексу, содержанию аскорбиновой кислоты (витамина С), содержанию общих полифенолов и общих флавоноидов — у сорта Лязат. По общим содержаниям полифенолов и флавоноидов сорта Айгерим (866 мкг/мл и 275 мкг/мл), Лязат (885 мкг/мл и 290 мкг/мл) и Мерей (865 мкг/мл и 255 мкг/мл) близки друг к другу. По общему содержанию полифенолов самые низкие данные имеют Айгерим и Мерей — на 0,05% и 0,13% меньше, чем в сорте Лязат, соответственно. Также определены относительные значения общего содержания флавоноидов для Айгерим и Мерей — 0,05% и 0,22% соответственно.

Ключевые слова: антиоксиданты, антоцианы, биологически активные соединения, флавоноиды, полифенолы, черешня.

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The total content of polyphenols and flavonoids in cherry varieties of Kazakhstan selection

ABSTRACT

Relevance. In general, phenolic compounds are aromatic compositions, where a benzene ring is associated with one or more hydroxide groups. All phenolic compounds are divided into groups by structure and fragment's type. There are more 10 000 types of different phenolic compounds structures that are found in plants raw materials and food products.

The studies covered in the article are relevant, both from the point of view of scientific novelty, and to substantiate the benefits of consuming cherries of new varieties of Kazakhstan breeding.

The purpose of the study is to analyze the content of polyphenols and flavonoids in the cherries of Kazakhstan selection. Research objectives: to collect theoretical data, apply research methods to determinethe content of polyphenols and flavonoids in the laboratory, to draw relevant conclusions.

Methods. For the study of physico-chemical and chemical indicators of the total polyphenols and total flavonoids contents, following sweet cherry varieties of the Kazakhstan selection were considered: Aigerim, Lyazat and Merei. Following physico-chemical indicators were studied: solids content, total sugars and titratable acidity. It was found that among the considered sweet cherry sorts, the highest values had variety Lyazat, specifically in the chemical indicators: sugar-acid index, ascorbic acid (vitamin C) content, total polyphenols and total flavonoids contents.

Results. By the total polyphenols and flavonoids contents varieties Aigerim (866 μg/mL and 275 μg/mL), Lyazat(885 μg/mL and 290 μg/mL) and Merei (865 μg/mL and 255 μg/mL) are close to each other. In the considering relatively Lyazat, the Total polyphenols content, Aigerim and Merei have lowest data by 0.05% and 0.13%, respectively. Total flavonoids content of varieties values for Aigerim and Merei 0.05% and 0.22% — were also identified. In general, a review of all obtained data with the known values shows that indicators of the total polyphenols and flavonoids contents are with in the acceptable variations.

Key words: antioxidants, anthocyanins, biologically active compounds, flavonoids, polyphenols, cherries

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Введение / Introduction

By recommending using of a particular product, it is necessary to take into account its antioxidant activity. This is an extremely important indicator that shows the presence of substances neutralize the excess of free radicals and interrupts the chain of oxidative reactions that damage the cells and tissues of human body. An excess of free radicals is formed as a result of malnutrition, poor ecology, stress, smoking et al. Reducing the antioxidant status of the body can reduce immunity, lead to the emergence and development of many pathological processes, in particular diseases of the gastrointestinal tract and its related organs [1].

It is well-recognized that the regular consumption of fruits, vegetables and herbal infusions is an excellent strategy for the reduction of the risk of *diabetes mellitus* (DM). According to global estimates of the World Health Organization (WHO), the number of diabetic individuals worldwide will be about 366 million in 2030 [2].

In this regard it is a serious matter for the public health to prevent a higher morbidity and mortality, by advising and using in the nutrition natural phytochemicals, mainly phenolic acids, flavonoids, anthocyanins and others [3].

Specifically, phenolic compounds are aromatic compositions, where a benzene ring is associated with one or more hydroxide groups. All phenolic compounds are divided into groups by structure and fragment's type. There are more 10 000 types of different phenolic compounds structures that are found in plants raw materials and food products [4].

Phenolic acids, flavonoids, condensed tannins, and coumarins are examples. Phenolics range from a simple, low molecular-weight, single aromatic ringed compounds to large and complex tannins and derived polyphenols. They can be classified based on the number and arrangement of their carbon atoms in flavonoids and nonflavonoids [5].

Sweet cherries contain various phenolic compounds such as anthocyanins, flavonoids and procyanidins. According to some studies, the most abundant anthocyanin type found in the sweet cherry was determined to be cyanidin 3-O-rutinoside [6].

Sweet cherries are also rich in hydroxycinnamic acid derivatives such as 3-O-caffeoylquinic acid (chlorogenic acid), 5-O-caffeoylquinic acid (neochlorogenic acid) and p-coumaroylquinic acid [7]. Epicatechin is the main flavan-3-ol, and it also contains a high rate of quercetin-3-O-rutinoside (rutin) as the main flavonol in its structure [8].

In terms of sugar content, there are five types of sugars found in sweet cherries (glucose, fructose, sorbitol, sucrose and maltose) and among them, glucose and fructose make up approximately 90% of the sugar content [9].

Sweet cherry (*Prunus avium L.*) have phenolic compounds that contribute to total antioxidant activity. Its fruits are a significant source of various polyphenols, flavonoids or anthocyanins that contribute for total antioxidant activity [10].

Sweet cherry was recognized as having beneficial medicinal properties such as anticancer, dietary, antioxidant and anti-inflammatory, which is related with content of antioxidant compounds [11].

In recent years, the scientists of Kazakhstan Research Institute of Fruit Growing and Viticulture have cultivated the following new sweet cherry varieties Aigerim, Lyazat and Merei, that have various sizes, cultivation time and organoleptic indicators. The studies covered in the article are relevant, both from the point of view of scientific novelty, and to substantiate the benefits of consuming cherries of new varieties of Kazakhstan breeding.

The purpose of the study is to analyze the content of polyphenols and flavonoids in the cherries of Kazakhstan selection. Research objectives: to collect theoretical data, apply research methods to determine the content of polyphenols and flavonoids in the laboratory, to draw relevant conclusions.

Материал и методы исследования / Materials and method

The physicochemical properties and chemical indicators in the various sweet cherry varieties of the Kazakhstan selection were considered: Aigerim, Lyazat and Merei. Mostly, the recognized and available research methods were used.

Solids content

The approach is based in the identification a sum of soluble solids by using a refractometer. The found value is expressed in units of the mass fraction of sucrose in an aqueous solution of sucrose, which under given conditions has the same refractive index as the analyzed solution, in % (Brix) (GOST 51433: 1999).

Titratable acidity

Determination of the mass concentration of titratable acids in terms of malic, tartaric or citric acids (g/dm^3) was carried out using potentiometric titration with sodium hydroxide solution to pH = 8.1. Measure the volume of solution used for titration (GOST 34127: 2017).

Total sugars content

The permanganate analysis is based on the possibility of sugar carbonyl groups to reduce copper (II) oxide to copper (I) oxide in an alkaline medium. When dissolved with iron ammonium alum, the resulting copper (I) oxide, oxidized to copper (II) oxide, reduces iron (III) to iron (II), the amount of which is analyzed by a solution of potassium permanganate titration (GOST 8756.13: 1987).

Sugar-acid index

Fruits and berries contain mainly three types of saccharides: glucose and fructose (monosaccharides) and sucrose (disaccharides). Glucose-dextrose, or grape sugar, is a component of sucrose, polysaccharides — starch, cellulose, hemicellulose, and many glucosides. Fructose-levulose, or fruit sugar, is part of sucrose and inulin polysaccharide. The sugar-acid index is used to assess the palatability of the tested product, i.e. the ratio of the percentage of the sum of sugars (fructose, glucose and sucrose) and acid. Fruits and berries are especially rich in sugars, in average they made up to 8–12% of total mass (Machulkina et al., 2020).

Ascorbic acid (vitamin C) content

The method is based on the vitamin C extraction by an acid solution (hydrochloric, metaphosphoric or a mixture of acetic and metaphosphoric) followed in assistance with visual or potentiometric titration and a solution of sodium 2,6-dichlorophenolindophenolate until forming of a light pink colour (GOST 24556: 1989).

Total polyphenols content

The total polyphenols in the extract is observed by the colorimetric method by using the Folin — Ciocalteu reagent. The Folin — Ciocalteu reagent contains phosphotungstic acids that are reduced upon interaction with easily oxidized OH groups of phenol. In this case, tungsten blue is formed, which has a characteristic absorption band with a maximum at a wavelength 765 nm and imparts a blue color to the test solution (GOST 14502-1– 2010).

Total flavonoids content

The total flavonoids in water-ethanol extracts are measured by using an extract or a standard solution of catechin, with the

addition of solutions of sodium nitrite and aluminum chloride. The absorbance ability is measured at 510 nm. Flavonoid content is expressed as µg catechin equivalent per 1mL of dry weight (Eremeeva and Makarova, 2017).

Sweet cherry extracts were preliminarily prepared for research. The extracts were obtained by maceration method and by steeping raw sweet cherry in a ratio of 1:10 with 70% ethanol.

Результаты и обсуждение / Results and discussion

In the presented work, the following physico-chemical parameters were studied: solids content, total sugars and titratable acidity. The obtained results are shown in table 1.

Consequently, it was discovered that among the considered sweet cherry varieties, the highest values had variety Lyazat (0,114 mg of sugars).

The sugar-acid index, content of ascorbic acid (vitamin C), total polyphenols and total flavonoids compounds contents in the extracts of sweet cherry were determined by the spectrophotometer. The obtained data are shown in table 2.

The analysis of table 2 demonstrates that all sweet cherry varieties have hig indicators in average 875±10 µg/mL.

Table 1. **Physico-chemical indicators of the sweet cherry variety**

Indicators	Name of the sweet cherry variety		
	Aigerim	Lyazat	Merei
Solids content, mg	0,137	0,142	0,130
Sugars, mg	0,108	0,114	0,105
Titratable acidity, mg/mL	1,9	2,4	1,5

Table 2. **Chemical indicators of the sweet cherry variety**

Indicators	Name of the sweet cherry variety		
	Aigerim	Lyazat	Merei
Sugar-acid index	19,4	19,7	19,0
Vitamin C, µg/mL	18,0	19,5	17,8
Polyphenols content, µg/mL	866	885	865
Flavonoids content, µg/mL	275	290	255

Particularly, the total polyphenols and flavonoids values of Aigerim (866 µg/mL and 275 µg/mL), Lyazat (885 µg/mL and 290 µg/mL) and Merei (865 µg/mL and 255 µg/mL) are close to each other. However, among them, Lyazat has the highest values and was determined as one of the promising sweet cherry variety. Total polyphenols content of varieties, Aigerim and Merei is lower than that of Lyazat by 0.05% and 0.13%, respectively. Total flavonoids content values for Aigerim and Merei — 0.05% and 0.22% — were also identified.

In the study [6], we see an analysis of the content of photosynthetic pigments in cherries of domestic selection. Their study of leaves of cherry varieties showed that the highest content of chlorophylls is characteristic of the varieties Revna and Veda, respectively (1.69–1.64 mcg/g), the minimum content — for the variety Fatezh. Chlorophyll B prevails in the pigment sector in all studied samples. Only the Veda variety (1.02 mcg/g) has an equal pigment content. The content of carotenoids in all studied samples varies in the same range (0.33–0.23 mcg/g). The study of the content of phenolic compounds in the leaves of cherry varieties showed that the highest content is observed in the leaves of the Gift Ryazan variety (15.68 mcg/g). The lowest content of phenolic compounds was recorded in the leaves of the Rechitsa variety (9.35 mcg/g). This content of phenolic compounds in the plant suggests that it is able to prevent oxidative stress [6]. In comparison the cherry of Kazakhstan breeding (Lyazat variety) is more useful.

Выводы / Conclusion

It was found that among the considered sweet cherry varieties the highest values of chemical indicators: sugar-acid index, ascorbic acid (vitamin C) content, total polyphenols and total flavonoids contents — had Lyazat variety.

By the total polyphenols and flavonoids contents varieties Aigerim (866 µg/mL and 275 µg/mL), Lyazat (885 µg/mL and 290 µg/mL) and Merei (865 µg/mL and 255 µg/mL) are close to each other. Total polyphenols content of Aigerim and Merei is lower than that of Lyazat variety by 0.05% and 0.13%, respectively. Total flavonoids content values for Aigerim and Merei — 0.05% and 0.22% — were also identified.

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All authors bear responsibility for the work and presented data.

All authors have made an equal contribution to this scientific work.
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