УДК 615.322

Научная статья

Открытый доступ

DOI: 10.32634/0869-8155-2022-363-10-124-127

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Поступила в редакцию:
15.08.2022

Одобрена после рецензирования:
20.09.2022

Принята к публикации:
10.10.2022

Содержание флавоноидов в различных сортах груш казахстанской селекции

РЕЗЮМЕ

Актуальность. Фрукты и овощи являются отличным источником веществ, обладающих антиоксидантными и полезными для здоровья свойствами. К таким веществам относятся полифенолы, каротиноиды и тритерпеноиды. Фенольные соединения обладают сильными антиоксидантными, противовоспалительными, противовирусными и антиканцерогенными свойствами. Груша является основной плодовой культурой регионов с умеренным климатом с растущими масштабами культивирования. Флавоноиды груши способствуют окраске плодов, защите от патогенов и являются полезными для здоровья ингредиентами плодов. Цель исследований — провести анализ содержания флавоноидов в грушах казахстанской селекции.

Методы. Казахстанскими учеными выведены новые сорта груш: Бостандык, Нагима, Сыйлык и Жаздык, отличающиеся размерами, сроками выращивания и органолептическими показателями. Методы, используемые в исследовании, следующие: исследование содержания сухих веществ, определение титруемой кислотности, общего количества сахаров, сахаро-кислотного индекса, содержания аскорбиновой кислоты (витамина С), общего содержания фенольных соединений, общего содержания флавоноидов.

Результаты. Наилучшие показатели плоды груш демонстрируют по сахарокислотному индексу, содержанию аскорбиновой кислоты (витамина С), общему содержанию фенолов и общему содержанию флавоноидов. Экстракты груш сортов Сыйлык и Жаздык имеют наибольшую ценность по биологически активным веществам и могут быть рекомендованы для разработки технологии получения концентратов и обогащения составов пищевых продуктов.

Ключевые слова: груша, антиоксиданты, биологически активные вещества, свободные радикалы, фенолы, флавоноиды

Для цитирования: Майлыбаева Э.У., Еркебаева С.У., Тастемирова У.У., Алибеков Р.С., Шингисов А.У., Содержание флавоноидов в различных сортах груш казахстанской селекции. Аграрная наука. 2022; 363 (10): 124-127. https://doi.org/10.32634/0869-8155-2022-363-10-124-127 (In English).

Research article

Open access

DOI: 10.32634/0869-8155-2022-363-10-124-127

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Received by the editorial office:
15.08.2022

Accepted in revised:
20.09.2022

10.10.2022

The content of flavonoids in various varieties of pears of Kazakhstan selection

ABSTRACT

Relevance. Fruits and vegetables are an excellent source of substances with antioxidant and healthy properties. Such substances include polyphenols, carotenoids and triterpenoids. Phenolic compounds have strong antioxidant, anti-inflammatory, antiviral and anti-carcinogenic properties. Pear is the main fruit crop of regions with mild climate and have growing cultivation scales. Pear flavonoids contribute to the coloring of fruits, protect them against pathogens and are healthy ingredients of fruits.

The purpose of the research is to analyze the content of flavonoids in pears of Kazakhstan selection.

Methods. The methods used in the study are as follows: determining solids content (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 %) titratable acidity (determination of the mass concentration of titratable acids in terms of malic, tartaric or citric acids (μg/mL) was carried out using potentiometric titration with sodium hydroxide solution to pH = 8.1), total sugars (the permanganate method is based on the ability of sugar carbonyl groups to reduce copper (II) oxide to copper (I) oxide in an alkaline medium), sugar-acid index, ascorbic acid (vitamin C) content, total phenolic compounds content, total flavonoids content.

Results. The comparison analyses shows Syilyk and Zhazdyk varieties have the highest values of studied traits,. Specifically, physico-chemical indicators: solids content, total sugars and titratable acidity. Also the best indicators are shown in biological active compounds: sugar-acid index, ascorbic acid (vitamin C) content, total phenolic content and total flavonoids content. The polyphenols content in all pear varieties have high values in the range 107–124 μg/mL. Extracts of Syilyk and Zhazdyk pears have highest values of biologically active substances, and might be recommended for the development of technology in order to obtain concentrates and to enrich the compositions of the food products.

Key words: dry substances; phenolic compounds; flavonoids; biologically active substances; fruit crops; pears; apples

For citation: Mailybayeva E.U., Yerkebayeva S.U., Tastemirova U.U., Alibekov R.S., Shingisov A.U. The content of flavonoids in various varieties of pears of Kazakhstan selection. Agrarian science. 2022; 363 (10): 124-127. https://doi.org/10.32634/0869-8155-2022-363-10-124-127

Введение / Introduction

Fruits and vegetables are an excellent source of substances with antioxidant and pro-health properties. Such substances include polyphenols, carotenoids, and triterpenoids. Phenolic compounds possess strong antioxidant, anti-inflammatory, antiviral, and anticarcinogenic properties [1].

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 about 10 000 types of different phenolic compounds structures that are found in plants raw materials and food products [2].

For instance, anthocyanins are a group of plant pigments belonging to the flavonoids or bioflavonoids groups. In general, anthocyanins are powerful antioxidants and neutralize free radicals; assist in the prevention of violations of cardiac and vascular activity; inhibit inflammatory processes; activate the body's resistance to carcinogens, viruses; protect blood vessels, reduce capillary fragility; detoxify chemicals and pollutants; and also increase a human life span [3].

Pear (*Pyrus sp*.) is a major fruit crop of regions with mild climate and have increasing extent of cultivation. Pear flavonoids contribute to its fruit color, pathogen defense, and are health beneficial ingredients of the fruits. Pears (*Pyrus communis, European pear, P. bretschneideri, P. ussuriensis, Chinese pears*, and *P. pyrifolia*, Asian pear or Nashi) are important pome fruits, since they are favorable foodstuff due to their delicious flavor and their manifold cultivars. World production of pear fruits is about 17 million tons per year. Currently, pear cultivation is continuously rising worldwide and drastically expanding in Asia [4].

Pears contain a broad spectrum of phenolic compounds comprising different flavonoid classes; anthocyanins, flavonols, monomeric ("catechins"), and polymeric flavan 3-ols (proanthocyanidins, syn. condensed tannins), and flavanones, hydroxyphenolic acids (mostly hydroxycinnamic acids derived from caffeic acid and p-coumaric acid) and the p-hydroquinone-glucoside arbutin [5]. It is an established fact that phenolic compounds possess antioxidant properties and prevent oxidation of low density lipoprotein cholesterol [6].

During recent years, some researchers have been focused on analyses and comparison of the nutritional components contained in the edible part of pear fruit such as total sugars, vitamins, organic and fatty acids, amino acids, volatiles, polyphenols, minerals and so on. Except for some reported compounds, such as arbutin, chlorogenic acid, catechin, quercetin, kaempferol, various hydroxycinnamoylmalic acids and their ethyl esters, hyroxycinnamoyl malates, procyanidins and triterpenes compounds have also been found in the peel of pear [7].

In pear, the predominant phenolic constituents are chlorogenic, caffeic, p-coumaroyl quinic and p-coumaric acids, arbutin, and a number of procyanidins and flavonol glycosides, have been glycosides [8].

The variety of polyphenolic compounds and the high antioxidant capacity of pears mean that these fruits can have a significant impact on the health of the human body. This has become a premise for research on the impact of variations of the content of bioactive compounds and their antioxidant, anti-inflammatory, and antiproliferative activities [9].

In recent years, the scientists of the Kazakhstan Research Institute of Fruit Growing and Viticulture have developed the following new pear varieties: Bostandyk, Nagima, Syilyk and Zhazdyk, that have various sizes, cultivation time and organoleptic indicators [10]. The relevance of the study lies in the analysis of flavonoids and nutrients of new varieties of pears of Kazakhstan breeding.

The purpose of the research is to analyze the content of flavonoids in pears of Kazakhstan selection.

Objectives of the study: to form the design of the study, to conduct a laboratory analysis of flavonoids of four varieties of pears of Kazakhstan breeding, to conduct a comparative analysis and draw relevant conclusions.

Материал и методы исследования / Materials and method

The physicochemical properties and chemical indicators in the various pear varieties of the Kazakhstan selection were studied, such as Bostandyk, Nagima, Syilyk and Zhazdyk. Mostly the recognized and available research methods were used.

Solids content

The method is based on determining the amount 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 percent (Brix) [11].

Titratable acidity

Determination of the mass concentration of titratable acids in terms of malic, tartaric or citric acids (μg/mL) was carried out using potentiometric titration with sodium hydroxide solution to pH = 8.1. Measure the volume of solution used for titration [12].

Total sugars

The permanganate method is based on the ability 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 determined by titration with a solution of potassium permanganate [12].

Sugar-acid index

Fruits and vegetables contain mainly three types of sugars: 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 are especially rich in sugars, in average they made up to 8–12% of total mass [12].

Ascorbic acid (vitamin C) content

The method is based on the extraction of vitamin C with an acid solution (hydrochloric, metaphosphoric or a mixture of acetic and metaphosphoric)? followed by visual or potentiometric titration with a solution of sodium 2,6-dichlorophenolindophenolate until a light pink color is established. Vitamin C content was expressed in μg/mL.

Total phenolic content of compounds

The total phenolics content in the extract is determined by the colorimetric method 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 time tungsten blue is formed

Table 1. **Physico-chemical indicators of the pear varieties**

Indicator	Name of the pear varieties			
	Bostandyk	Nagima	Syilyk	Zhazdyk
Solids content	0,261	0,265	0,268	0,270
Sugars	0,065	0,067	0,069	0,075
Titratable acidity, μg/mL	1,1	1,1	1,2	1,3

Table 2. **Chemical indicators of the pear varieties**

Indicators	Name of the pear sort			
	Bostandyk	Nagima	Syilyk	Zhazdyk
Sugar-acid index	12	14	16	17
Vitamin C, μg/mL	5,3	5,4	5,7	5,8
Phenolic content, μg/mL	107	112	118	124
Flavonoids content, μg/mL	38	39	47	52

that has a characteristic absorption band with a maximum at a wavelength 765 nm and imparts a blue color to the test solution. Phenolic content was expressed in μg/mL.

Total flavonoids content

The total flavonoids content in water-ethanol extracts was measured using an extract or a standard solution of catechin, with the addition of solutions of sodium nitrite and aluminum chloride. The absorbance was measured at 510 nm. Flavonoid content was expressed as μg catechin equivalent per 100 g dry weight or μg/mL.

Pear extracts were preliminarily prepared for research. The extracts were obtained by maceration, and by steeping raw pears in a ratio of 1:10 with 70% ethanol.

Результаты и обсуждение / Results and discussion

In the presented work, the following physicochemical parameters were analyzed: solids content, total sugars and titratable acidity. The received results are shown in table 1.

As a result, it was found that among the considered pear varieties, the highest values had varieties Syilyk and Zhazdyk.

The sugar-acid index, content of ascorbic acid (vitamin C), total phenolic content and total flavonoid compounds content in the pears were determined by the spectrophotometric method. The results are shown in table 2.

The analysis of table 2 shows that, in terms of the content of polyphenols in extracts, all pear varieties have highindicators, in average ±115 μg/mL. Among them, Zhazdyk had highest values and was determined as promising pear variety. Furthermore, in the considering of the total flavonoids content, values of Syilyk and Zhazdyk are higher, than that of Bostandyk and Nagima.

For comparison, the study [7] shows the properties of 18 varieties of apples, 12 varieties of pears and 6 varieties of garden strawberries growing in the Republic of Belarus. It was found that hexyl acetate was characteristic of apples of the varieties "harovnitsa, Zaslavskoye, Belarusian Synap, Memory of Sikora and Pear, and varieties Alesya, Belana, Krasavita — butylbutanoate and hexylbutanoate. Pears that reached full ripeness contained unsaturated acid esters characteristic only for pears, giving a characteristic pear flavor, methyl-2,4-decadienoate and two isomers (cis-, trans-) ethyl-2,4-decadienoate. All studied pear varieties had a low sugar (about 7%) and organic acids (no more than 0.3%) content. This makes them also suitable for creating products for children's nutrition. The average acid content for strawberries was 9.1 g/kg. The predominant acid is citric, however, Belarusian strawberries contain less sugar than given in the databases — 52.5 g/kg [7].

Выводы / Conclusion

Thus, in the presented work following pear varieties of Kazakhstan selection were studied: Bostandyk, Nagima, Syilyk and Zhazdyk. Among them the next domestic pears Syilyk and Zhazdyk have the highest values of studied traits, specifically, physico-chemical indicators: solids content (from 0,261 to 0,27), sugars (from 0,065 to 0,075) titratable acidity (from 1,1 to 1,3). As well the best indicators are shown in biological active compounds: sugar-acid index, ascorbic acid (vitamin C) content, total phenolic content and Total flavonoids content. The polyphenols content in all pear varieties have high indicators, in the range 107–124 μg/mL. Among them, Zhazdyk have the highest values and was determined as promising pear variety. Extracts of Syilyk and Zhazdyk pears have highest values of biologically active substances, and might be recommended for the development of technology in order to obtain concentrates and to enrich the compositions of the food products.

Все авторы несут ответственность за свою работу и представленные данные.
Все авторы внесли равный вклад в эту научную работу.
Авторы в равной степени участвовали в написании рукописи и несут равную ответственность за плагиат.
Авторы заявляют об отсутствии конфликта интересов.

All authors bear responsibility for the work and presented data.

All authors have made an equal contribution to this scientific work.
The authors were equally involved in writing the manuscript and bear the equal responsibility for plagiarism.
The authors declare no conflict of interest.

ФИНАНСИРОВАНИЕ:

Авторы хотели бы выразить благодарность Министерству сельского хозяйства Республики Казахстан за финансовую поддержку научно-исследовательского проекта «Разработка технологии переработки перспективных сортов плодовых, ягодных культур и винограда отечественной селекции с целью получения биологически активных веществ и плодово-ягодных порошков для использования в пищевой промышленности» в рамках Целевого финансирования Программы № BR10764977.

FUNDING:

The authors would like to thank the Ministry of Agriculture of the Kazakhstan Republic for the financial support of the research project "Development of technology for processing promising varieties of fruit, berry crops and grapes of domestic selection in order to obtain biologically active substances and fruit and berry powders for use in the food industry" within the framework of Programme Targeted Funding No. BR10764977.

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