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ASSESSMENT OF QUALITY AND FOOD SAFETY OF LOCAL PLANT RAW MATERIALS FOR ENRICHMENT OF CONFECTIONERY PRODUCTS

Abstract: *The development of functional confectionery products enriched with plant biologically active substances is an important and urgent task for the food industry.*

The presented in the article data on the quality and food safety of wild berry raw materials confirm their potential for use in functional products as a source of organic compounds of various types with a variety of physiological effects. According to the information on the possibility of raw material procurement on the territory of Ile-Alatau State National Natural Park, the optimal variant is the use of local fruit and berry raw materials. This will not only expand the raw material base, but also reduce transportation costs, which will lead to a reduction in the cost of production.

The main objective of the study is to assess the quality and safety of fruits, stems and leaves of plants growing in Ile-Alatau State National Natural Park for their further use in the food industry.

The researched local plant raw materials (sea buckthorn, hawthorn, rosehip) according to the quality and safety indicators meet the established regulatory requirements for raw materials. Based on the quality and safety of local plant raw materials allows us to recommend it for use as a raw material for enrichment of confectionery products. The use of berries contributes not only to the increase in the content of BAS, but also allows to minimize or completely eliminate synthetic dyes and flavoring additives from confectionery products.

Key words: *BAS, food safety, hawthorn (Crataegus almaatensis), sea buckthorn (Hippophae rhamnoides L.), rosehip (Rosa canina L.), fruits, leaves, stem.*

Introduction

Human health depends largely on the quality of consumed products. Scientific research and practical experience confirm that to meet the needs of the human body in essential nutrients it is impossible to do without the use of biologically active substances of plant origin. Wild plants, both food and medicinal, can be an important source of vitamins and macro- and microelements. It is known that fruits of such plants contain a variety of biologically active substances, including antioxidant vitamins, minerals, polyphenols, carotenoids, organic acids, sugars, dietary fibers, including pectin, as well as other components that are necessary for daily cell synthesis and normalization of metabolic processes, as well as for many other functions of the body [1-4]. The use of phyto-additives allows not only to increase the level of BAS content, but also to minimize or completely exclude synthetic dyes and flavoring substances from the recipe of jelly candies.

In this regard, special attention is paid to the deep study and further utilization of plant raw materials with nutritional value in various sectors of economic activity. The development and production of functional food products based on wild berries of local plant raw materials is an important area for nutrition optimization and one of the key areas of research contributing to the innovative development of the region.

Sea buckthorn fruits (Hippophae rhamnoides L.) contain proteins, lipids, carbohydrates, vitamins (C and E), phenolic compounds, carotenoids, flavonoids, minerals and volatile substances, while possessing numerous health benefits [5].

Sea buckthorn berries, leaves and bark contain many bioactive substances that are valued for their nutritional and health-promoting properties. The juice from the berries is rich in solids and has a high vitamin C and carotenoid content. The pulp remaining after juice squeezing can be used to extract pigments that can serve as food coloring agents. The seed oil, consisting mainly of unsaturated fatty acids, is used for medicinal and cosmetic purposes. Sea buckthorn leaves, which contain many nutrients, macro and microelements, are occasionally used to prepare an infusion that can be consumed as a tea [6,7].

The importance of sea buckthorn is often attributed to its high antioxidant content. In addition, many positive biological, physiological and therapeutic effects of this plant have been described in detail. They include antioxidant and immunomodulatory, cardioprotective and antiatherogenic, antibacterial and antiviral actions, as well as healing effects on acute and chronic wounds, anti-radiation, anti-inflammatory, anti-diabetic, anti-carcinogenic, hepatoprotective and dermatologic actions. These properties make sea buckthorn berries, seeds and leaves widely used for both nutraceutical and medicinal purposes [6, 8].

The hawthorn is rich in carbohydrates, organic acids, vitamins and minerals, and contains more than 150 phenolic compounds, including procyanidins, flavonoids and triterpenoid acid. To this day, many beneficial properties of hawthorn have been proven, such as prevention of hypertension, angina pectoris, heart failure, arrhythmia, myocarditis, atherosclerosis, insomnia, diarrhea, urinary retention and some intestinal disorders [9,10].

Rosehip is rich in carbohydrates, phenols, flavonoids, tocopherols, terpenes, carotenoids, fatty acids, galactolipids, vitamins, minerals and tannins. About 129 chemical compounds have been isolated and identified from rosehip. This rich phytochemical composition gives rosehip a number of pharmacological properties including anti-inflammatory, antioxidant, anticancer, immunomodulatory, cardioprotective, anti-cancer, anti-diabetic, neuroprotective and antibacterial activities. In particular, rosehip powder and extract have been reported to have therapeutic effects in arthritis [11, 12].

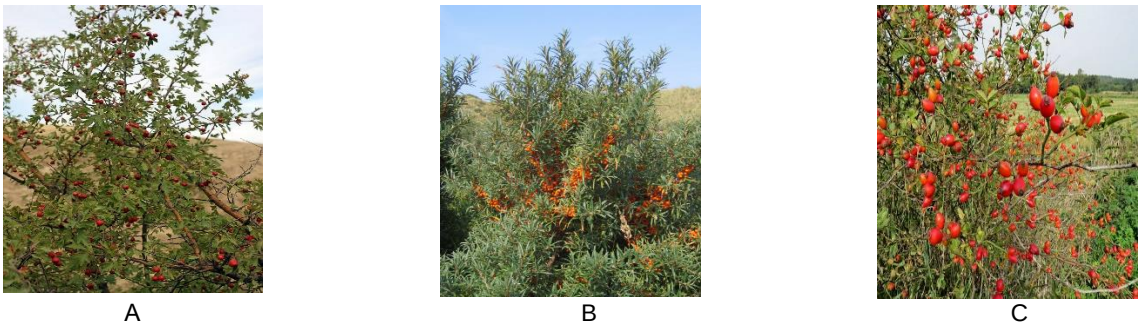
The development of functional confectionery products enriched with plant biologically active substances is an important and urgent task for the food industry. The use of plant raw materials or their components in production technologies will allow not only to diversify the range of products, but also to enrich them with useful biologically active substances.

The main purpose of the study is to assess the quality and safety of fruits, stems and leaves of plants growing in Ile-Alatau State National Natural Park for their further use in the food industry.

Object and methods of research

The objects of our research were fruits, stems and leaves of wild crops - rosehip, sea buckthorn and hawthorn, collected in the summer of 2024 from the mountainous area of Ile-Alatau State National Natural Park.

The objects of our research were fruits, stems and leaves of wild crops - rosehip, sea buckthorn and hawthorn, collected in the summer of 2024 from the mountainous area of Ile-Alatau State National Natural Park. These plants are widely spread in the park and are popular due to their active use in folk medicine. The flora of the natural park includes more than 1000 plant species, most of which belong to the flora of the forest mid-mountain belt.



A B C

Picture 1 – Berries growing in Ile-Alatau State National Natural Park national natural park
A – Hawthorn (*Crataegus almaatensis*); B – Sea Buckthorn(*Hippophae rhamnoides* L.); C – Rosehip (*Rosa canina L.*)

Acceptance of wild berries was carried out in accordance with GOST 24027.0-80 [13]. At the first stage, we carried out an external inspection of raw materials to determine their homogeneity by the method of preparation (whole, chopped, pressed), as well as by colour, odour and degree of contamination. We also checked the presence of mould, rot, persistent foreign odour, which does not disappear with ventilation, as well as contamination with poisonous plants and foreign impurities such as stones, glass and droppings of rodents and birds. At the same time, the presence of barn pests was checked using a magnifying glass with a magnification of 5-10x and the naked eye.

The following normative-technical documentation was used to conduct studies of the quality of plant raw materials: GOST 3852-93 «Hawthorn fruits»; GOST 1994-93 «Rosehip fruits»; GOST R 59661-2021 «Sea buckthorn fresh» [14-16].

The content of toxic elements was analysed using the atomic absorption spectrometer «KVANT-Z. ETA», developed and produced by KORTEK LLC. To ensure high accuracy and reproducibility of the results, standard samples and certified methods were used, meeting the requirements of regulatory documents.

Determination of the content of toxic elements was carried out in strict compliance with the national standards: GOST 26927-86, GOST R 51766-2001 and GOST 30178-96 [17-19].

Determination of pesticides hexachlorocyclohexane (HCCH: α-, β-, γ-isomers) and DDT, as well as its metabolites was carried out by chromatographic method using gas chromatograph «Kristallux-4000M», developed and produced by «NPF Meta-chrom» LLC.

The analysis was performed in accordance with the requirements of regulatory documents, including the standard ST RK 2011-2010 [20].

The content of heptachlor and aldrin was determined using the methodology regulated by GOST 30349-96 «Fruits, vegetables and their products Methods of determination of residues of organochlorine pesticides». This standard provides for the use of gas chromatography in combination with highly sensitive detectors, which allows qualitative and quantitative determination of pesticides, including heptachlor and aldrin, in various food products [21].

Studies on the safety of local plant raw materials were conducted at the Research Institute of Food Safety of Almaty Technological University.

Research results and discussion

In Kazakhstan there are no enterprises and organizations engaged in collection and complex processing of wild berries. Complex processing of wild berries will provide an opportunity to effectively use its own raw material base of the republic, to expand the range of food products, to produce products with increased biological value, to introduce waste-free production technologies and to ensure high involvement of the population of Kazakhstan in the process of collecting wild berries.

In this regard, one of the urgent scientific problems is the safety of wild berries in Kazakhstan.

The first stage of the study of local plant raw materials was to determine the quality indicators, which should meet the established requirements and norms specified in Tables 1-3.

Table 1 – Characterization and norm for hawthorn (Crataegus almaatensis)

Name of indicators	Norm according to ND	Factual
Appearance, size and structure of fruits	The fruits are apples, from spherical to ellipsoidal in shape, hard, wrinkled, 6-14 mm long, 5-11 mm wide, with a ring-shaped border on top formed by dried sepals. The pulp of the fruit contains 1-5 woody seeds of an irregular triangular, oval or laterally compressed shape. The surface of the seeds is pitted-wrinkled or grooved along the back.	Corresponds
Color	From yellowish-orange and brownish-red to dark brown or black, sometimes with a whitish coating of crystallized sugar	Corresponds, brownish-red colors prevailed
Smell	Typical for this raw material, without foreign odors	Corresponds
Taste	Sweetish	Corresponds
Mass fraction of unripe fruits (brownish-green), %, no more than	1,0	0,2
Mass fraction of fruits damaged by pests, crushed, individual stones, twigs, stalks, including those separated during analysis, %, no more than	5,0	Not found
Mass fraction of foreign impurities: organic (fruits or parts of fruits of other non-poisonous plants), %, no more than 1.0 mineral (soil, sand, pebbles), %, no more than 0.5	 1 0,5	 Not found

Table 2 – Characteristics and norms for rosehip (*Rosa canina L.*)

Name of indicators	Norm according to ND	Factual
Appearance, size and structure of fruits	Whole, cleared of sepals and stalks, false fruits of various shapes: from spherical, ovoid or oval to strongly elongated spindle-shaped; the length of the fruit is 0,7-3 cm, the diameter is 0,6-1,7 cm. At the top of the fruit there is a small round hole or pentagonal platform. The fruits consist of an enlarged receptacle (hypanthium) and numerous rootlets enclosed in its cavity. The walls of the fruit are hard, brittle, the outer surface is shiny, less often matte, more or less wrinkled. Inside, the fruits are abundantly lined with long, very hard bristly hairs. The nuts are small, oblong, with poorly defined edges.	Not cleared of sepals, otherwise consistent
Color	Bright orange-red or deep red in colour, sometimes darker red or even slightly burgundy	Corresponds, brownish-red colors prevailed
Smell	Typical for this raw material, without foreign odors	Corresponds
Taste	Sweet and sour, slightly astringent	Corresponds
Mass fraction of unripe fruits (from green to yellow color), %, no more than	5	2
Mass fraction of foreign impurities: – organic (parts of other non-poisonous plants), %, no more than 0,5 – mineral (earth, sand, pebbles), %, no more than	 0,5 0,5	Not found

Table 3 – Characteristics and norms for sea buckthorn (*Hippophae rhamnoides* L.)

Name of indicators	Norm according to ND	Factual
Appearance, size and structure of fruits	The fruits are fresh, clean, unbruised, at the stage of ripeness and color for picking, with or without stalks, free from diseases and damage by agricultural pests, free from excessive external moisture	Corresponds, orange color prevailed
Mass fraction of fruits that have not reached removable maturity and color, %.	no more than 2.0	0,3
Mass fraction of fruits wrinkled and mechanically damaged, %	no more than 5.0	1,0
Mass fraction of foreign impurities (twigs, stalks, leaves) , %,	no more than 1.0	Not found
Presence of rotten, wilted, moldy and dry fruits	Not allowed	Not found
Presence of agricultural pests and products of their vital activity	Not allowed	Not found

As the results showed, the examined plant raw materials meet the requirements of normative documents in appearance, color, odor and taste, which allows to continue further study of this raw material.

The mass fraction of unripe fruits did not exceed the permissible norm established by the standard, which amounted to -2% for rosehip and -2% for barberry.

Mass fraction of organic and mineral impurities was not detected in the tested fruits.

Safety of local plant raw materials is an important parameter determining their suitability for consumption. In this regard, we conducted experimental studies on the content of toxic elements in the laboratory of Almaty Technological University. The safety of raw materials was assessed in accordance with TR TS 021/2011 «On the safety of food products», which regulates the control of the presence of four toxic elements: lead, cadmium, arsenic and mercury (table 4).

Table 4 – Content of toxic elements in fruits, leaves and stems of local plant materials

Heavy metals, mg/kg	Norm according to ND	Sea buckthorn			Rose hip			Hawthorn		
		fruit	leaves	stem	fruit	leaves	stem	fruit	leaves	stem
Lead	6,0	Not found			Not found			Not found		
Cadmium	1,0	Not found			Not found			Not found		
Arsenic	0,5	Not found			Not found			Not found		
Mercury	0,1	Not found			Not found			Not found		

Lead is one of the most common and dangerous toxic substances. It blocks sulfhydryl groups of proteins, penetrates into the nervous, muscular, digestive systems and kidneys, having a negative impact on reproductive function [22].

The toxic effects of cadmium are associated with blocking sulfhydryl groups of proteins and enzymes, which disrupts iron and calcium metabolism in the body and can also cause kidney disease.

Mercury is one of the most highly toxic elements that can accumulate in plants. Mercury compounds block the sulfhydryl groups of proteins, which leads to the inactivation of a number of enzymes and disruption of the metabolism of ascorbic acid, proteins, copper, zinc, selenium and pyridoxine.

Arsenic is similar in toxicity to mercury. It blocks thiol groups of enzymes that regulate tissue respiration [23].

The presented information in Table 5 indicates that there are no dangerous toxic substances in wild plants that can adversely affect the organism.

Pesticides are substances of chemical and biological origin used to control insects, rodents, pathogens and other pests. Wild plants may contain residues of pesticides used in forest treatments to kill mosquito larvae, ticks, forest pests and quarantine objects [5].

The content of HCCH (α, β, γ-isomers) and DDT and its metabolites should not exceed 0.1 mg/kg, should be within the established safe limits.

Heptachlor and aldrin belong to the group of organochlorine pesticides, which have high toxic properties, do not decompose rapidly in nature and can damage ecosystems including water, soil and biota. Due to health and ecosystem hazards, their use has been restricted or banned in most countries.

Table 5 – Pesticide content in fruits, leaves and stems of local plant materials

Pesticides, mg/kg	Norm according to ND	Sea buckthorn			Rose hip			Hawthorn		
		fruit	leaves	stem	fruit	leaves	stem	fruit	leaves	stem
HCH (α, β, γ-isomers)	0,1	Not found			Not found			Not found		
DDT and its metabolites	0,1	Not found			Not found			Not found		
Heptachlor	not allowed	Not found			Not found			Not found		
Aldrin	not allowed	Not found			Not found			Not found		

The table shows that pesticides – HCCH (α, β, γ-isomers) and DDT with its metabolites, heptachlor and aldrin – were not detected in the tested samples.

Conclusion

Therefore, the studied local plant raw materials (sea buckthorn, hawthorn, rosehip) according to the quality and safety indicators meet the established regulatory requirements for raw materials. Based on the study of quality and safety of local plant raw materials allows us to recommend it for use as a raw material for enrichment of confectionery products. According to the information about the possibility of raw material procurement on the territory of Ile-Alatau State National Natural Park, the optimal variant is the use of local fruit and berry raw materials. This will not only expand the raw material base, but also reduce transportation costs, which will lead to a reduction in the cost of production. The use of berries contributes not only to increase the content of BAS, but also allows to minimize or completely eliminate synthetic dyes and flavoring additives from confectionery products.

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КОНДИТЕРЛІК ӨНІМДЕРДІ БАЙЫТУҒА АРНАЛҒАН ЖЕРГІЛІКТІ ӨСІМДІК ШИКІЗАТТАРЫНЫҢ САПАСЫ МЕН ТАҒАМДЫҚ ҚАУІПСІЗДІГІН БАҒАЛАУ

Өсімдік текті биологиялық белсенді заттармен байытылған функционалды кондитерлік өнімдерді жасау тамақ өнеркәсібі үшін маңызды және өзекті міндет болып табылады.

Мақалада келтірілген жабайы жидек шикізаттарының сапасы мен азық-түлік қауіпсіздігі туралы нәтижелер оның әртүрлі физиологиялық әсерлері бар әртүрлі типтегі органикалық қосылыстардың көзі ретінде функционалдық өнімдерде пайдалану мүмкіндігін растайды. Іле-Алатау мемлекеттік ұлттық табиғи паркінің аумағынан шикізатты жинау мүмкіндігі туралы мәліметтерге сәйкес, жергілікті жеміс-жидек шикізатын пайдалану ең оңтайлы нұсқа болып табылады. Бұл шикізат базасын кеңейтіп қана қоймай, тасымалдау шығындарын азайтады, бұл өнімнің өзіндік құнының төмендеуіне әкеледі.

Зерттеудің негізгі мақсаты – Іле-Алатау мемлекеттік ұлттық табиғи паркінде өсетін өсімдіктердің жемістерінің, сабақтарының және жапырақтарының әрі қарай тамақ өнеркәсібінде пайдалану үшін сапасы мен қауіпсіздігін бағалау.

Зерттелетін жергілікті өсімдік шикізаты (шырғанақ, долана, итмұрын) сапасы мен қауіпсіздігі бойынша шикізатқа қойылатын белгіленген нормативтік талаптарға сәйкес келеді. Зерттеулер негізінде жергілікті өсімдік шикізатының сапасы мен қауіпсіздігі оны кондитерлік өнімдерді байыту үшін шикізат ретінде пайдалануға ұсынуға мүмкіндік береді. Жидектерді пайдалану биологиялық белсенді заттардың құрамын арттырып қана қоймайды, сонымен қатар кондитерлік өнімдерден синтетикалық бояғыштар мен дәмдік қоспаларды барынша азайтуға немесе толығымен жоюға мүмкіндік береді.

Түйін сөздер: *ББЗ, тағамдық қауіпсіздік, долана (Crataegus almaatensis), шырғанақ (Hippophae rhamnoides L.), итмұрын (Rosa canina L.), жеміс, жапырақ, сабақ.*

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ОЦЕНКА КАЧЕСТВА И ПИЩЕВОЙ БЕЗОПАСНОСТИ МЕСТНОГО РАСТИТЕЛЬНОГО СЫРЬЯ ДЛЯ ОБОГАЩЕНИЯ КОНДИТЕРСКИХ ИЗДЕЛИЙ

Разработка функциональных кондитерских изделий, обогащенных растительными биологически активными веществами, является важной и актуальной задачей для пищевой промышленности.

Представленные в статье данные о качестве и пищевой безопасности дикорастущего ягодного сырья подтверждают его потенциал для использования в функциональных продуктах как источник органических соединений различных типов с разнообразными физиологическими эффектами. Согласно информации о возможности заготовки сырья на территории Иле-Алатауского государственного национального природного парка, оптимальным вариантом является применение местного плодово-ягодного сырья. Это не только расширит сырьевую базу, но и снизит транспортные расходы, что приведет к уменьшению себестоимости продукции.

Основной целью исследования является оценка качества и безопасности плодов, стеблей и листьев растений, произрастающих в Иле-Алатауском государственном национальном природном парке для дальнейшего их применения в пищевой промышленности.

Исследуемое местное растительное сырьё (облепиха, бояршник, шиповник) по показателям качества и безопасности соответствует установленным нормативным требованиям, предъявляемым к сырью. На основании исследования качества и безопасность местного растительного сырья позволяет рекомендовать его для использования в качестве сырья для

обогащения кондитерских изделий. Использование ягоды способствует не только увеличению содержания БАВ, но и позволяет минимизировать или полностью исключить синтетические красители и вкусоароматические добавки из кондитерских изделий.

Ключевые слова: *БАВ, пищевая безопасность, боярышник (Crataegus almaatensis), облепиха (Hippophae rhamnoides L.), шиповник (Rosa canina L.), плоды, листья, стебель.*

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