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QUALIFICATION WORK

on the topic: "PHARMACOGNOSTIC RESEARCH OF HERBAL DRUGS OF SEA BUCKTHORN (HIPPOPHAE RHAMNOIDES)"

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ANNOTATION

Sea buckthorn is one of the most famous medicinal plants in the history of mankind. This plant is widespread in many countries of the world, and it is also cultivated in other places, including the USA, countries of the East, Ukraine, European countries, etc. Sea buckthorn fruits are a well-known source of vitamins and groups of biologically active substances. Sea buckthorn oil is characterized by a high content of unsaturated fatty acids, which cannot be synthesized in the human body. It is necessary to ensure the integrity of plasma membranes, the processes of growth and reproduction, oil with regular consumption normalizes cholesterol levels, reduces the risk of cardiac pathology, and activates the regeneration of epithelial cells. Therefore, the study of the fatty acid composition in order to establish the identity of the known oil, as well as the study of other classes of compounds from other organs of sea buckthorn, is relevant and meets the requirements of modern times. Other organs of sea buckthorn have not been studied enough. Therefore, the issue of pharmacognostic research of various organs of sea buckthorn, development of standardization methods for inclusion of results in the national pharmacopoeia is relevant.

The work is written on 43 pages, consists of 3 chapters, 113 literary sources, illustrated with 7 tables and 11 figures.

Key words: sea buckthorn, fatty oil, phytochemical analysis, standardization of herbal drugs and oil.

АНОТАЦІЯ

Обліпиха є однією із найвідоміших лікарських рослин у історії людства. Ця рослина поширена у багатьох країнах світу , а також її культивують в інших місцях, у тому числі США, країни Сходу, Україні, європейських країнах та ін. Плоди обліпихи – відоме джерело вітамінів та групи біологічно активних речовин. Олія обліпихи характеризується високим вмістом ненасичених жирних кислот, які не синтезується у організми людини. Вона необхідна задля забезпечення цілісності плазматичних мембран, процесів зростання та відтворення, олія при регулярному вживанні в їжу нормалізує рівень холестерину, знижує ризик виникнення кардіологічної патології, активізує регенерацію клітин епітелію. Тому дослідження жирнокислотного складу з метою встановлення тотожності відомої олії, а також вивчення інших класів сполук з інших органів обліпихи є актуальним та відповідає вимогам сучасності. Інші органи обліпихи вивчені недостатньо. Тому питання фармакогностичного дослідження різних органів обліпихи, розробка методів стандартизації для включення результатів до національної фармакопеї є актуальною.

Робота написана на 43 сторінках, складається з 3 глав, 113 літературних джерел, ілюстрована 7 таблицями та 11 рисунками.

Ключові слова: обліпиха, жирна олія, фітохімічний аналіз, стандартизація сировини та олії.

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Introduction

In recent years, along with intensively developing research on the study of biologically active compounds that are part of plants, the determination of the content of mineral substances and other biological active compounds in them has gained topical importance. This is due not only to the important biological role of many trace elements, but also to environmental factors [1, 2, 5].

The object of our research was medicinal different organ of sea buckthorn.

Sea buckthorn - Hippophaë rhamnoides L., family Elaeagnaceae, a prickly shrub or a small tree up to 6 m tall with an openwork silvery crown and reddish-brown shiny bark on the trunk.

Sea buckthorn is a medicinal plant whose seeds, fruits and leaves slow down the aging process and protect against infections. Sea buckthorn contains almost all fat-soluble and water-soluble vitamins, minerals, flavonoids, tannins, polysaccharides and other biologically active substances, the lack of which the body suffers from. The peculiarities of climatic and ecological conditions, the variety of geographical zones determine the specifics of metabolic processes occurring in plants, contribute to the synthesis and accumulation in them of biologically active substances that determine the medicinal properties of specific plants. It is known that biological active compounds and mineral component can be activators or inhibitors of the processes of growth, development of plants and regulation of their productivity; act as components of enzyme systems or their coenzymes [5].

The balance of minerals in medicinal plants is formed as a result of the functioning of complex multiphase mechanisms of concentration and accumulation of these substances, which are affected by various factors.

The presence of a number of mineral substances in the human body in strictly defined quantities is an indispensable condition for maintaining health. Mineral compounds are not synthesized in the body, they come with food products, drinking water, and air. The degree of their assimilation depends on the state of the respiratory

and digestive organs. Mineral substances are vital components of nutrition with very different physiological functions. They play an important role in plastic processes, the formation and construction of body tissues, in particular the bones of the skeleton. They are necessary for maintaining the acid-alkaline balance in the body, creating a certain concentration of hydrogen ions in tissues and cells, interstitial and intercellular fluids, as well as for giving them osmotic properties that ensure normal metabolism.

Based on the primary importance of individual mineral substances in various aspects of the organism's vital activity, it is possible to distinguish several main directions of their participation in biochemical processes of exchange: the construction of skeletal structures (calcium, phosphorus, etc.); maintenance of osmotic properties of cells and plasma (sodium, potassium); blood formation (iron, copper); are recognized as activators and cofactors of enzymes (magnesium, zinc, copper, iron, manganese, molybdenum, etc.) [5].

Sea buckthorn raw material is obtained from plants growing in different territories of Ukraine. Medicinal plant raw materials, intended for the production of phytopreparations using various methods of extraction in industrial or domestic conditions, have been little studied for their mineral composition. Therefore, the study of the trace element composition of LRS is of particular relevance [1].

PURPOSE OF THE WORK

Analysis and research of the biological active compounds of the fruits, bark, and leaves of sea buckthorn using different phytochemical methods, which is taken into account when developing pharmacopoeial indicators of the quality of plant raw materials.

Tasks

- To carry out review about sea buckthorn, description, distribution, chemical composition, application;
- To carry out analysis of aminoacids composition of different organ;
- To carry out analysis of mineral composition;
- To carry out analysis of hydroxycinnamic acid;

- To carry out analysis of fatty acids composition of sea buckthorn.

THE OBJECT OF THE RESEARCH: pharmacognostic research of herbal drugs of sea buckthorn (Hippophae rhamnoides).

THE SUBJECT OF THE RESEARCH: the study of the qualitative composition and the quantitative content of the main groups of biologically active compounds, determination of quality indicators in Hippophae rhamnoides.

Methods of the research: pharmacopoeial methods of determining the qualitative composition and quantitative content of BAC. The experiment results were processed by statistical methods according to the requirements of the State Pharmacopoeia of Ukraine.

THE PRACTICAL SIGNIFICANCE AND SCIENTIFIC NOVELTY OF THE RESULTS. The obtained results can be useful in the development of the project of quality control methods of " Hippophae rhamnoides ".

The structure and scope of the qualification work – consists of an introduction, a literature review, an experimental part, general conclusions, a list of used literary sources, laid out on 43 pages, including 7 tables, 11 figures, 113 literature sources.

CHAPTER I. REVIEW OF SEA BUCKTHORN HIPPOPHAE RHAMNOIDES

1.1. Classification of genus Hippophae

Botanical classification of genus Hippophae

Sea buckthorn belong to the genus *Hippophae*, family *Elaeagnaceae*. There are some species in the genus:

1. Altai (lat. Hippophae altaica) is a cultivated form (variety)
2. Sea buckthorn *Hippophae rhamnoides*
3. Willow sea buckthorn - *H. salicifolia*
4. Tibetan sea buckthorn - *H. tibetana*, represented by small trees or shrubs with thorny branches in Europe and temperate regions of Asia

1.2. The botanical description of the plant

Sea buckthorn - shrubs or trees, mostly thorny, from 0.1 to 3-6 m (rarely up to 15 m) in height [2].

The leaves are alternate, narrow and long, green in small dots above, grayish-white or silvery, or rusty-golden from the underside of the star-shaped scales densely covering them.

Flowers appear before leaves. They are unisexual, small, inconspicuous and sit either crowded, in short spike-shaped inflorescences at the base of young shoots (male), or one at a time (less often 2-5) in the axil of the covering scale (female); dioecious plants.

Perianth simple, bifid; in the male flower the receptacle is flat, in the female it is concave, tubular; stamens four (very rarely three); one pistil, with an upper, one-celled, one-seeded ovary, and with a two-parted stigma. The flowers are pollinated by the wind, rarely by insects.

The fruit is a sphalerocarp ("false drupe"), consists of a nutlet, dressed in a growing cup, which becomes juicy, fleshy, smooth and shiny. The fruits are orange or reddish, there are many of them, they are densely arranged and, as it were, “stick around” the branches (hence the Russian name for the plant). The fruit has a spherical or elongated shape. Plants reproduce by seeds and vegetatively.

1.3. The distribution, area, the cultivation of sea buckthorn

The area of distribution of sea buckthorn is very extensive and includes a significant part of Europe and Asia. In Russia, sea buckthorn grows in many regions, but its main massifs are in Altai, Tuva, and in the southern part of Buryatia [10]. In addition, there are large thickets in Central Asia, in the southern regions of Kazakhstan, in the Caucasus, in the Danube Delta and on the coast of the Baltic Sea [58, 65].

In order to better meet the demand for sea buckthorn fruits, in the 70–80s, comprehensive breeding work was carried out to develop new promising varieties of it, and highly productive industrial sea buckthorn plantations were created [58].

The crop cultivation technology provides for the annual felling of seven-eight-year-old low-fruiting trees and the annual pruning of one-two-year-old sea buckthorn shoots. This set of measures increases the efficiency of fruiting and facilitates the collection of fruits, but does not provide for the use of the bark of various parts of uprooted plants, as well as shoots obtained during pruning. All this cannot be considered expedient in terms of complex processing of raw materials, since both bark and shoots of sea buckthorn contain a whole complex of biologically active substances of various nature.

1.4. Herbal drugs Standardization

Pharmacopoeia monograph 42-1741-87. Fruits are drupes, juicy, spherical or elongated-elliptic in shape, 4-12 mm long, with or without a peduncle, with one

stone. Fruits are easily crushed. Fruit color ranges from yellow to dark orange. The smell is weak, reminiscent of the smell of pineapple. The taste is sweet and sour.

Quality control

Loss on drying (fresh fruits) — no more than 87%; total ash — no more than 1%; unripe fruits - no more than 1%; fruits damaged by pests - no more than 2%; branches and other parts of the plant - no more than 1%; mineral impurities - no more than 0.5%; crushed fruits - no more than 35% (provided that the juice from these fruits is preserved); the difference in acidity of whole fruit juice and free juice should not be more than 3%; the amount of carotenoids with the references into of β-carotene is at least 10 mg per 100 ml of juice.

1.5. Procurement and storage of herbal drugs

Fruits (Fructus Hippophaes), bark (Cortex Hippophaes) and leaves (Folia Hippophaes) of plants are used for medicinal purposes. Fruits are collected at the stage of full ripeness, plucking them with special wire tweezers, and after the onset of frost, they are shaken on a tarpaulin or other fabric placed under the bush. The collected fruits are used to obtain sea buckthorn oil, consumed raw, dried, processed into jam, jam and jelly, added to confectionery, juices, tinctures and liqueurs. The shelf life of frozen fruits is months. The bark is harvested in early spring, the leaves during the growing season. Sea buckthorn oil is available in pharmacies, but it can also be made at home. To do this, the crushed dry fruits or dried juices remaining after obtaining sea buckthorn juice are poured with an equal amount (by volume) of Provençal or sunflower oil (preferably refined), mixed well, and the resulting mixture is kept for 24 hours in a heated oven or in a water bath at temperature not higher than 60 °. After that, the mixture is squeezed through a kapron bag, and the resulting oil is mixed with a new portion of crushed dry fruits or dried pomace and heated in the same way. Repeating the operation three times makes it possible to obtain high-quality sea buckthorn oil. After a week of settling, the oil is filtered.

1.6. The chemical composition of sea buckthorn

According to a number of researchers, all parts of the plant, in particular, the fruits of sea buckthorn are truly a pantry of various biologically active substances [86, 113]. Sea buckthorn fruits are of great value as a rare vitamin-containing and oil-bearing raw material of industrial importance [9]. At present, the presence of 10 vitamins has been established in fruits, of which 6 are water-soluble and 4 are fat-soluble [25]. In the fruits of all studied varieties and populations of sea buckthorn, carotenoids were found, while their total content is subject to significant variability: from 0.31 to 20.0 mg%. Sea buckthorn fruit carotenoids include phytofluin, (3-carotene, y-carotene, polycis-lycopene B, lycopene, zeaxanthin, neocarotene, lutein, cryptoxanthin, isocryptoxanthin, violaxanthin, neoxanthin [54, 102]. In addition, vitamin C and B vitamins have been identified in the fruits: Bb B2, Bb, nicotinic and folic acids in small amounts, tocopherols, phylloquinones [29].

One of the most important indicators that determine the quality of fruits is the oil content, which varies widely: 1.89 ... 13.70% for fresh and 16.16 ... 41.90% for dry fruits [35, 46]. The chemical composition of sea buckthorn oil has been studied in detail, in particular, its unsaponifiable fraction, which is responsible for pharmacological activity [37, 54, 70]. At present, the fatty acid composition of sea buckthorn oil has been established [82, 83] and the ratio between individual fractions of saturated and unsaturated fatty acids [86, 96], the total number of which is 20 [79].

In the composition of the lipophilic fraction of sea buckthorn fruits, triterpenoids of the a-amirin series were found, represented by ursolic acid in an amount of 1.34–1.60% [103].

Sea buckthorn fruits contain a number of phenolic compounds, mainly phenolic acids: quinic, caffeic, and chlorogenic acids [9, 25]. The quantitative content of tannins ranges from 0.025-0.530% [104]. Sea buckthorn fruits are a rich source of flavonoids, which are mainly represented by flavonols of the quercetin and isorhamnetin subgroups in the free form and in the form of 3-O- and 7-O-glycosides

and, to a lesser extent, catechins and anthocyanidins , most of which are currently identified.

The high content of organic acids (1.04-4.46%) and sugars (1.00-3.26%), the composition of which is heterogeneous, determines the use of sea buckthorn fruits as a valuable food product [1, 9]. Pectin was also found in fruits [2].

As a result of studying the amino acid composition, alanine, phenylalanine, glutamine, cysteine, and leucine were isolated and their quantitative content was determined [92]. The study of the mineral composition made it possible to identify 15 trace elements in fruits, among which are iron, magnesium, aluminum, zinc, cobalt, manganese, copper and others, as well as salts of sodium, potassium and calcium [38]. In addition, abscisic acid [48] and saturated alcohols of the normal structure C18-C26 [140] were found.

From the foregoing, it follows that at the moment the chemical composition of sea buckthorn fruits, which are a valuable oil and vitamin raw material of industrial importance, is relatively well known. The chemical composition of other parts is not yet well understood. This applies, in particular, to the study of the underground organs of sea buckthorn. The study of the chemical composition of plant roots made it possible to detect carbohydrates, leucoanthocyanins, catechins, flavonoids, phenolcarboxylic acids, and higher fatty acids [86].

A number of works are devoted to the study of the composition of sea buckthorn leaves, which is very diverse. The lipophilic complex from the leaves is of particular interest to researchers as a potential substitute for fruit oil [52]. Qualitative and quantitative indicators of the content of fatty oil in the leaves were established and its fatty acid and triacylglyceride composition was studied. The composition of the oil includes phospholipids (1.4%), a-, (3-, y-carotenes, a-, (3-, y-tocopherols, chlorophyll a and b, higher fatty acids [76, 83].

Sea buckthorn leaves, like fruits, are rich in vitamins: vitamin C [25, 86] and E [139], carotenoids, the qualitative composition of which is somewhat poorer compared to fruits. When studying the composition of triterpene compounds in leaves, in addition to ursolic acid, the content of which varies within 0.29 - 3-amirin,

lupeol, erythrodiol, uvaol, etc.139, 168 The presence of quebrachite, as well as higher aliphatic alcohols of the normal series C18-C25, was revealed in the leaves.

As a result of studying the hydrophilic fraction of BAS leaves, a number of phenolic compounds were found: phenolcarboxylic acids and their derivatives, catechins, leucoanthocyanins, and others [9, 104]. The flavonoid composition of sea buckthorn leaves is somewhat more diverse than that of fruits. The total content of flavonoids is 3.8...4.0%. Among leaf flavonoids, the following flavonols of the kaempferol, quercetin, and isorhamnetin groups have been identified: myricetin, isoquercitrin, 3-P-D-glucofuranosyl-(3-D-glucopyranoside isorhamnetin, 3-galactosylglucoside quercetin [100], 3-O-(isorhamnetin 3-D-glucopyranoside-7-O--rhamnopyrazide and astragalin.

According to A.D. Bukshtynov, the presence of coumarins, derivatives of benzocoumarin, in particular, ellagic acid and oxycoumarins, was found in sea buckthorn leaves [25].

The content of tannins in leaves varies from 1.5 to 11.7% [104]. The study of the tannin fraction made it possible to isolate four individual substances [104].

In the leaves of sea buckthorn, as well as in the fruits, carbohydrates and related compounds were found: carbohydrates - 2.6%; pectin - 0.42% [9].

In the mid-70s, the study of sea buckthorn flowers began. It was found that the carbohydrate content is 1.2%; pectin - 0.2%. The vitamin composition of flowers is similar to the composition of other parts of sea buckthorn. The flowers contain vitamins C, E, carotenoids: a-, ß-carotene, lutein, flavoxanthin, cryptoxanthin, violaxanthin, neoxanthin. Phenolic compounds are represented by chlorogenic acid and flavonols of the isorhamnetin group and their glycosides. The content of fatty oil in flowers is 0.9% [9].

There are data in the literature on the study of the chemical composition of the bark of old plants and young shoots of sea buckthorn. So, from the bark of sea buckthorn Massagetov P.S. in 1947 he isolated two substances of alkaloid nature, one of which was named hippofain [86]. Repeated tests of Ambaye R.Y. and Indap M.A. confirmed the data on the content of alkaloids in the plant bark. Menshikov

G.P. and Petrov M.F. isolated a complex of nitrogenous bases from an extract of sea buckthorn bark, tentatively named Hr [114]. Later, the same authors succeeded in isolating one of the bases of this sum and identifying it as 5-hydroxytryptamine (serotonin) [125]. According to their data, the content of 5-hydroxytryptamine in the bark ranges from 0.3-0.4%, which significantly exceeds its content in the bark of other plants [113, 114]. In 1964, Petrova M.F., Menshikov G.P. and Kranz P.S. published a simple method for obtaining serotonin from raw sea buckthorn [115].

The fractional and amino acid composition of sea buckthorn wood green proteins was studied, among which alanine, phenylalanine, glutamine, and other amino acids were found. The content of tannins in the bark reaches 10% [25, 86].

As a result of the study of the lipophilic fraction B AB of the sea buckthorn bark, Ruchkin V.N. fatty oil was found in the amount of 3.1% with an iodine value of 56.3, but its qualitative and quantitative composition was not studied [86]. Triterpene compounds in the bark are represented by ursolic acid, the content of which varies from 0.17 to 0.22% [103].

There are over 190 identified bioactive substances found in seabuckthorn and 60 unidentified [18]. The following table outlines the major constituents of seabuckthorn.

1.7. Pharmacological properties of sea buckthorn preparations and its use in traditional and folk medicine

The use of sea buckthorn preparations has a long history. Sea buckthorn was first mentioned in the works of Theophrastus, Pliny and Dioscorides.

In ancient Indo-Tibetan treatises, there are indications of the use of various parts of the sea buckthorn "dar-bu" alone and as part of prescriptions for the treatment of various diseases. The fruits are widely used for the treatment of diseases of the gastrointestinal tract (GIT), heart, blood, lungs and throat, as well as for the treatment of diseases associated with metabolic disorders [8, 12]. The fruit oil extract

in various Indo-Tibetan recipes was used for liver diseases, inflammatory processes, digestion and absorption disorders in the gastrointestinal tract [13].

There is a rich experience in the use of sea buckthorn fruits in folk medicine in Altai, Tuva, Buryatia and other regions of Siberia, which are places of natural growth of sea buckthorn. In folk medicine, they are the main component of many dosage forms: juices, syrups, infusions, decoctions, tinctures and oils, which have long been used as an analgesic, wound healing and vitamin remedy for peptic ulcer and other stomach diseases, dysentery, cancer, and as a means of regulating metabolism. Various peoples of Siberia used sea buckthorn preparations externally for rashes, eczema, lupus and other skin diseases; for the treatment of long-term non-healing wounds, trophic ulcers, cervical erosion, burns and frostbite [90, 111].

At present, due to its high biological activity, valuable copper sea buckthorn oil, which is an official medicinal product, is recognized as a qing preparation of the plant's fruits [88]. The therapeutic effect of the oil is due to its strong regenerative, keratoplastic and epithelial properties, as well as the ability to accelerate granulation processes in wounds and ulcers. Therefore, it is recommended for external use in the treatment of burns, frostbite, bedsores, trophic ulcers, and skin diseases with sluggish epithelization processes [3, 90].

A pronounced therapeutic effect of oil in gynecological practice for the treatment of cervical erosion, colpitis and endocervicitis was revealed. The distinct regenerative properties of sea buckthorn oil, found in experiments on the cornea of the eye, explain its use for the treatment of burns and injuries of the conjunctiva, creeping ulcers of the cornea, as well as rosaceakeratitis, scrofulous keratitis, trachoma and other ophthalmic diseases. The effectiveness of using oil in practical otolaryngology in the form of inhalations for the treatment of various forms of pharyngolaryngitis, nasopharyngitis, rhinitis, otitis, sinusitis is due to the ability to enhance the granulation of mucous membranes with pronounced atrophic processes, thereby accelerating the healing process. Positive results have been obtained from the use of sea buckthorn oil in dermatology - for phlegmanous acne, eczema, psoriasis, lupus ulcer, and chronic dermatosis; in dentistry [73].

In addition, its inhibitory effect on the secretion of gastric juice, the acidity of which does not change significantly, was noted. Therefore, oral intake of sea buckthorn oil improves the condition of patients with gastric and duodenal ulcer [62, 77]. Inside, sea buckthorn oil is prescribed for radiation therapy of cancer. However, taking the oil orally is contraindicated in diseases of the pancreas, acute cholecystitis, and cholelithiasis [48].

The anti-sclerotic effect of the oil was established, due to the presence of lipophilic substances in it. The oil, acting on lipid metabolism and reducing the content of cholesterol (3-lipoproteins and total lipids in the blood serum, prevents the development of the atherosclerotic process [86]. The study revealed the antioxidant effect of sea buckthorn oil [39, 113]. It, having a pronounced anabolic effect, it stabilizes the state of cellular and subcellular biological membranes and has a protective effect in case of their damage, prevents a decrease in the concentration of DNA and RNA in the liver [39].

The hepatoprotective properties of the oil have been experimentally proven in toxic hepatitis caused by the introduction of chloroform, alcohol or their combined use [84]. A distinct antibacterial effect of the oil against gram-positive and gram-negative bacteria, typhoid and paratyphoid salmonella, staphylococcus, streptococcus, Escherichia was also noted [40, 46].

From the foregoing, it follows that due to the wide spectrum of action, sea buckthorn oil is used in various fields of medicine. In addition, combined preparations have been created on its basis, one of the most important aspects of the pharmacological action of which is their ability to stimulate regeneration processes. These are Oblecol collagen films, Olazol and Hypozol aerosol preparations, and Statizol film-forming preparation [74]. At the same time, new possibilities for the use of sea buckthorn oil are currently emerging, for example, the use of pastes with oil in dentistry for the treatment of pulpitis and periodontitis; candles with oil in proctology; extracts from sea buckthorn fruits - to obtain cosmetic preparations [73, 86].

It is shown that unofficial preparations of fruits - juice, extract, water extract - deserve close attention and further study. Sea buckthorn juice has hemostatic and wound healing activity [5], exhibits vascular strengthening properties [53]. It is recommended for the treatment of toxic liver damage [27, 39], since it has a positive effect on the protein-forming function of the liver [4], reduces fat and cholesterol in fatty liver, stabilizes the activity of a number of enzymes, while slowing down the development of dystrophic and necrotic processes in the liver [39].

Intensive research is underway to study the pharmacological properties of other parts of the plant, in particular, leaves. In folk medicine, a decoction of leaves and branches is used to treat enterocolitis, colitis, and other gastrointestinal diseases [31]. There are data on the use of various dosage forms from sea buckthorn leaves for the treatment of skin diseases and rheumatism [33, 46].

The diverse composition of biologically active substances in leaves and the widespread practice of using leaf preparations in folk medicine necessitate further study of them as sources of new drugs: antimicrobial, wound healing, antiulcer, and capillary strengthening [12, 25, 63].

The pharmacological activity of the lipid fractions of the leaves is close in many respects to that of pharmacopoeial sea buckthorn oil, which indicates a real prospect of expanding the raw material base for the production of sea buckthorn oil [67]. So, for the complex use of sea buckthorn raw materials and increasing the production of oil on the basis of CJSC "Altai-vitamins", two preparations were developed and introduced into production - oil from the fruits and leaves of sea buckthorn (VFS 42-1698-87) and an oil preparation from the waste of post-harvest sorting of sea buckthorn (TU 64-5-62-80), used in cosmetic creams and toothpaste. In addition, under experimental conditions, non-standard sea buckthorn oil B was obtained from low-carotene raw materials of sea buckthorn fruits, enriched with fruit flavonoids, which had a more effective wound healing, anti-inflammatory and regenerative effect compared to pharmacopoeial preparations [89].

Since ancient times, the attention of healers has been drawn to the healing properties of the woody parts of the plant - bark, branches and wood. Thus, ancient

Indo-Tibetan treatises mention the use of sea buckthorn wood as an effective hemostatic, antipyretic and analgesic agent, and wood ash for intestinal colic [12].

Of great interest is the antitumor effect of the sea buckthorn bark extract, which has a cytotoxic effect, which was originally associated with the presence of tanides in the plant bark. Studying the antitumor effect of extracts purified from tannins, researchers took the path of isolating individual substances responsible for the antitumor effect. As a result of the research, a preparation of sea buckthorn bark was obtained, which is a mixture of two base hydrochlorides, which had a strong toxic effect [114, 116]. Subsequently, work was carried out to purify one of the isolated bases, identified, as mentioned above, with 5-hydroxytryptamine, and study the mechanism of its pharmacological action. However, sea buckthorn bark preparations have not been used, since they had a pronounced side effect and high toxicity [30, 113].

Thus, in official domestic medicine, a wealth of experience has been accumulated in the use of sea buckthorn preparations - oil of fruits and leaves and its derivatives. It has been established that one of the most important aspects of the pharmacological action of sea buckthorn oil is its ability to stimulate regeneration processes, on which its use in gastroenterology, in particular, for the treatment of peptic ulcer, is largely based. It is believed that the pharmacological activity of fruit oil is determined by the presence of an unsaponifiable fraction. However, the fact that the addition of hydrophilic substances, such as flavonoids, to the oil, significantly increases the activity of the pharmacopoeial oil, is noteworthy. In addition, a high reparation activity of unofficial preparations of fruits - juice and extract containing hydrophilic substances, which is comparable to the biological activity of sea buckthorn oil, has been established.

CHAPTER II. MATERIALS AND RESEARCH METHODS

2.1. Analysis of fatty acids composition

To study the content of fatty acids, the leaves, fruit pulp, seeds, and bark of sea buckthorn were used, which were harvested at the botanical garden of the National University of Pharmacy (2018). After collection, the raw materials were dried, brought to a standard state in accordance with the general requirements of GACP [108-113].

Determination of the qualitative composition of fatty acids of herbal drugs of sea buckthorn was carried out by the method of GC/MS of methyl esters of fatty acids on an Agilent 6890N / 5973 inert gas chromatography-mass spectrometric system (Agilent Technologies, USA). HP-5ms capillary column (30 m × 0.25 mm × 0.25 μm, Agilent Technologies, USA). The evaporator temperature is 250 °C, the interface temperature is 280 °C. The separation was carried out in the temperature programming mode - the initial temperature of 60 °C was maintained for 4 min, raised with a gradient of 4 °C/min to 250 °C, maintained for 6 min, raised to 300 °C with a gradient of 20 °C, maintained for 5 min.

Weighing 500 mg of the drug (accurate weighing) was placed in a glass vial and the reaction mixture was added (methanol R -toluene - sulfuric acid R (44: 20: 2) 3.3 ml per sample and a solution of the internal standard in heptane in the amount of 1.7 ml. The studied sample was kept at a temperature of 80 °C for 2 h, cooled to room temperature, centrifuged for 10 min at 5000 rpm. 0.5 ml of the upper hexane phase containing methyl esters of fatty acids was taken.

The sample with a volume of 1 μl was introduced in the mode of flow division 1:20. Detection was performed in SCAN mode in the range (38-400). The carrier gas flow rate through the column is 1.0 ml/min. The identification of fatty acid methyl esters of the studied mixture was carried out by comparing the retention time of a standard mixture of fatty acid methyl esters (Supelco, USA). Quantitative analysis was performed by adding a solution of the internal standard to the tested

samples. Undecanoic acid solution was used as an internal standard [108-113]. The content of fatty acids in herbal drugs of sea buckthorn was calculated according to the formula:

$$X = \frac{S_x \cdot m_{inst} \cdot 1000}{S_{ist} \cdot m}$$, where

m_{inst} - mass of internal standard per sample

m - mass of herbal drug

S_x - area of the studied compound

S_{inst} - area of the internal standard

2.2. Analysis of amino-acids composition

The object of the study was the herbal drugs of sea buckthorn of the buckthorn variety “Sweet Woman”, harvested at the of the Botanical Garden of the National Academy of Sciences (2018-21), in accordance with the requirements of the GACP [108-113].

Preliminary analysis of the qualitative composition of amino acids was carried out by the method of paper chromatography. The analytical sample of the herbal drugs was crushed to a particle size of 1-2 mm. Next, 10.0 g of the crushed herbal drugs was placed in a flask, filled with 70% alcohol (1:10) and extracted in a water bath. The obtained extract was evaporated in a vacuum to the state of a thick extract and applied to the chromatogram.

Chromatographic analysis was carried out by the ascending chromatography method on "Filtrak" FN-4 paper in the solvent system n-butanol-acetic acid - water (4:1:2). A reference solution of amino acids (TU 6-09-3147-83) at a concentration of 0.1% was used for comparison. After passing through the solvent system, the chromatograms were treated with a 0.2% alcoholic solution of ninhydrin in acetone and placed in a drying cabinet, where they were dried at a temperature of 60-80 ° C. Amino acids were identified by the color of the spots and the value of Rf in comparison with authentic samples.

Analysis of amino acid content was carried out on an Agilent Technologies 1200 liquid chromatograph (Agilent technologies, USA). Zorbax AAA column 150 mm long, 4.6 mm internal diameter, 3 μm sorbent grain diameter. Mobile phase A - 40 mM Na2HPO4 pH 7.8; B - ACN:MeOH: water (45:45:10, v/v/v). The separation mode is gradient with a constant flow rate of 1.5 ml/min. The temperature of the column thermostat is 40 0C. Pre-column derivatization was performed in automatic programmed mode using FMOC reagent (Agilent 5061-3337) and OPA reagent (Agilent 5061-3335). Detection of derivatized amino acids was implemented using a fluorescent detector. Sample preparation and analysis of plant raw materials:

a. Free amino acids. A portion of the drug was placed in a vial, 2 ml of an aqueous solution of 0.1N hydrochloric acid was added and kept in an ultrasonic bath at 50°C for 3 hours.

b. Common amino acids. A portion of the drug was placed in a vial, 2 ml of an aqueous solution of 6 N hydrochloric acid was added and placed in a thermostat at 110 0C. Hydrolysis was carried out for 24 hours.

0.5 mL of the centrifuged extract/hydrolyzate was evaporated on a rotary evaporator, washing three times with distilled water to remove hydrochloric acid. Resuspended in 0.5 ml of distilled water and filtered through regenerated cellulose membrane filters with 0.2 μm pores. Obtaining fluorescent derivatives was carried out in automatic programmed mode before introducing the sample into the chromatographic column. Identification of amino acids was performed by comparing retention times with a mixture of amino acid standards (Agilent 5061-3334). The content of bound amino acids was determined by subtracting the content of free amino acids from their total content [108-113].

Calculation of the content of amino acids (X, μg / mg) was carried out according to formula

$$X = \frac{C \cdot Vsol}{m_{hdr}}$$, where

C is the concentration in μg/ml, obtained from the calculation of the chromatogram of the comparison solution and the tested solution;

V sol - volume of solvent for extraction, ml;

M hdr - weight of herbal drugs, mg [108-113].

2.3. Analysis of mineral composition

The object of the research was crushed fruits, leaves and bark of sea buckthorn variety “Sweet woman” (zoned in Ukraine, state register No. 98078003), collected at the botanical garden of the National University of Pharmacy at different times of the year (2018-2021), in accordance with the rules of herbal drugs harvesting GASP [108-1133].

On the basis of the scientific-technological complex "Institute of Monocrystals" of the National Academy of Sciences of Ukraine, herbal drugs of sea buckthorn (bark, leaves, fruits) was studied for the content of mineral substances.

To determine the mineral substances in the samples, one of the modern and highly sensitive methods of analysis was used - the atomic emission spectrographic method, which is based on the evaporation of plant ash in an arc discharge, photographic registration of the radiation decomposed into a spectrum, and measurement of the intensity of the spectral lines of individual elements.

Preparation of the sample for analysis consisted in careful charring of the plant material when heated in a muffle furnace at a temperature of no more than 500 °C with preliminary treatment of the samples with diluted sulfuric acid. Evaporation of samples of leaves, fruits, bark, and extracts was carried out from the craters of graphite electrodes in the discharge of an alternating current arc (source of excitation of spectra of type IVS-28) at a current of 16 A and an exposure of 60 s. A DFS-8 spectrograph with a diffraction grating of 600 str/mm and a three-lens slit illumination system was used to obtain spectra and record them on photographic plates. The intensity of lines in the spectra of analyzed samples and calibration samples (GZ) was measured using a MF-1 microphotometer. Spectra were

photographed under the following conditions: alternating current arc current - 16A, ignition phase - 600 0C, pulse ignition frequency - 100 discharges per second, analytical interval - 2 mm, spectrograph slit width - 0.015 mm; exposure - 60 s.

Spectra were photographed in the wavelength range of 230-330 nm. With the help of standard samples of solutions of metal salts (ISORM-23-27) in the range of measured concentrations, calibration graphs were constructed, according to which the ego content in the ash was determined for each element and calculated according to the formula:

$$X = \frac{a \cdot m}{M};$$

where, m is the mass of ash, g; M - mass of raw material / extract, g; a - element content in ash, %.

2.4. Analysis of hydrohyxycinnamic acids

The objects of the study were fruits, leaves, fruit juice and fruit pulp, buckthorn bark collected at the pharmacopoeial garden of the National University of Pharmacy (2018). After collection, the raw materials were dried and brought to standard conditions in accordance with the requirements of the GACP [108-113].

The preliminary analysis of the qualitative composition of hydroxycinnamic acids was carried out by the method of paper and thin-layer chromatography. The analytical sample of herbal drugs was crushed to a particle size of 1-2 mm. Next, 10.0 g of the crushed raw material was placed in a flask, poured with 70% alcohol (1: 100) and extracted in a water bath. The obtained extract was evaporated under vacuum to a thick extract and applied for chromatography. Chromatographic analysis was performed by ascending paper chromatography in the solvent system glacial acetic acid: water (15:85) and (2:98). A reference solution of hydroxycinnamic acids at a concentration of 0.1% was used for comparison. After passing through the solvent system, substances were determined by fluorescence

under UV light at a wavelength of 254 nm or 365 nm before and after spraying with reagents and in comparison with reference solution [108-113].

Analysis of the content of hydroxycinnamic acids was carried out on an Agilent Technologies 1200 liquid chromatograph. Methanol (A) and a 0.1% solution of formic acid in water (B) were used as the mobile phase. Elution was performed in gradient mode: 0 min -A (25%): B (75%); 25 min - A (75%): B (25%); 27 min - A (100%): B (0%); 35 min - A (100%): B (0%). The separation was carried out on a Zorbax SB-Aq chromatographic column (4.6 mm ± 150 mm, 3.5 μm) (Agilent Technologies, USA), mobile phase speed 0.5 ml / min., column thermostat temperature 30 0C, injection volume. Detection was carried out using a diode-matrix detector with signal registration at 250 and 275 nm and fixation of absorption spectra in the range of 210-700 nm [108-113].

Identification and quantitative analysis was carried out using standard solutions of phenolic compounds (gallic, hydroxyphenylacetic, chlorogenic, caffeic, syringic, coumaric, trans-ferulic, sinapic, trans-cinnamic, quinic acids), by comparing the retention time of the peaks on the chromatogram of the tested solution with the retention time substances - standards on the chromatogram of the comparison solution [2, 4, 6].

CHAPTER III. RESULTS OF EXPEIMENTAL PART

3.1. Results of analysis of fatty acids composition of sea buckthorn

Goal. To study the qualitative composition and content of fatty acids in medicinal plant raw materials of sea buckthorn using the chromatographic method. To reveal the characteristic feature of the fatty acid composition for the possible establishment of the identity of the sea buckthorn raw material.

Results and their discussion. As a result of the research, it was found that there are 9 fatty acids in the sea buckthorn leaf, of which 2 are unsaturated and 7 are saturated. In the flesh of the fruit, 9 fatty acids were found, including 5 unsaturated and 4 saturated fatty acids, the bark also has 7 fatty acids, of which 3 are unsaturated and 4 are saturated, and the seed has 8 fatty acids, 4 of which are unsaturated and 4 are saturated.

Samples of GC/MS chromatograms obtained during the analysis are shown in Figures 1, 2, 3, 4, and the summary results of determination of fatty acids are shown in Table 1.

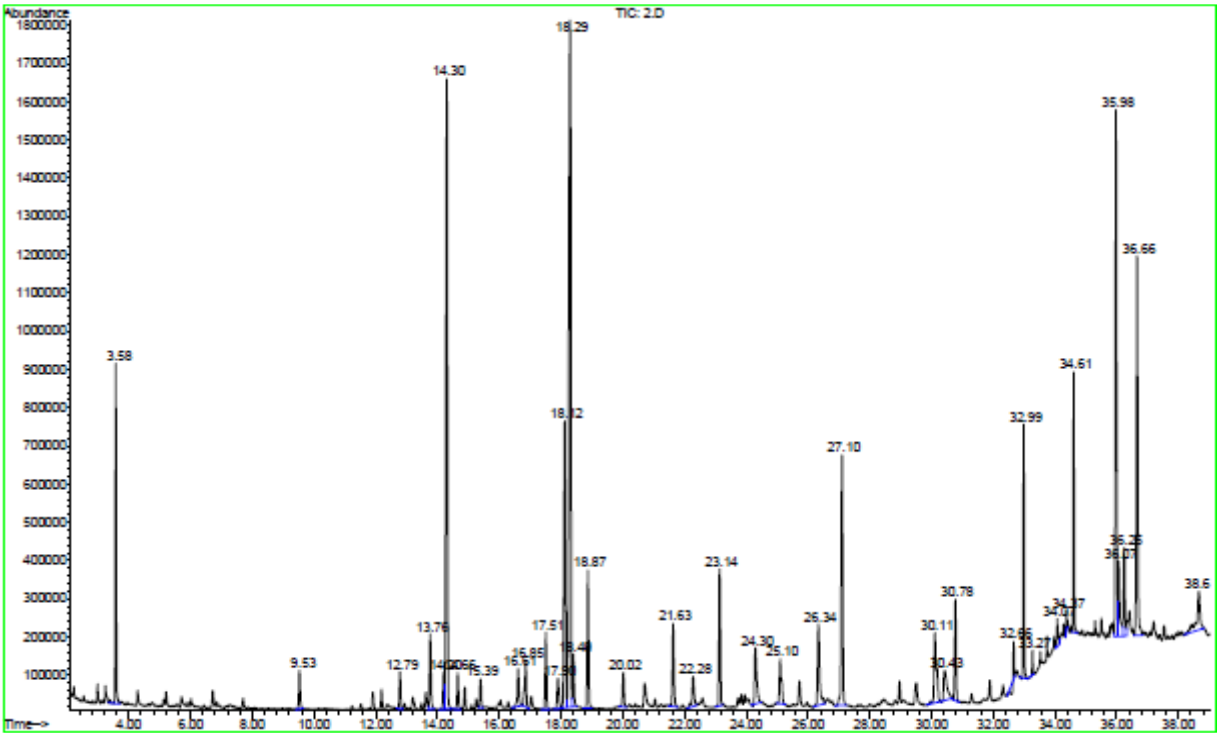

Fig. 1. Chromatogram of fatty acid composition of sea buckthorn leaves

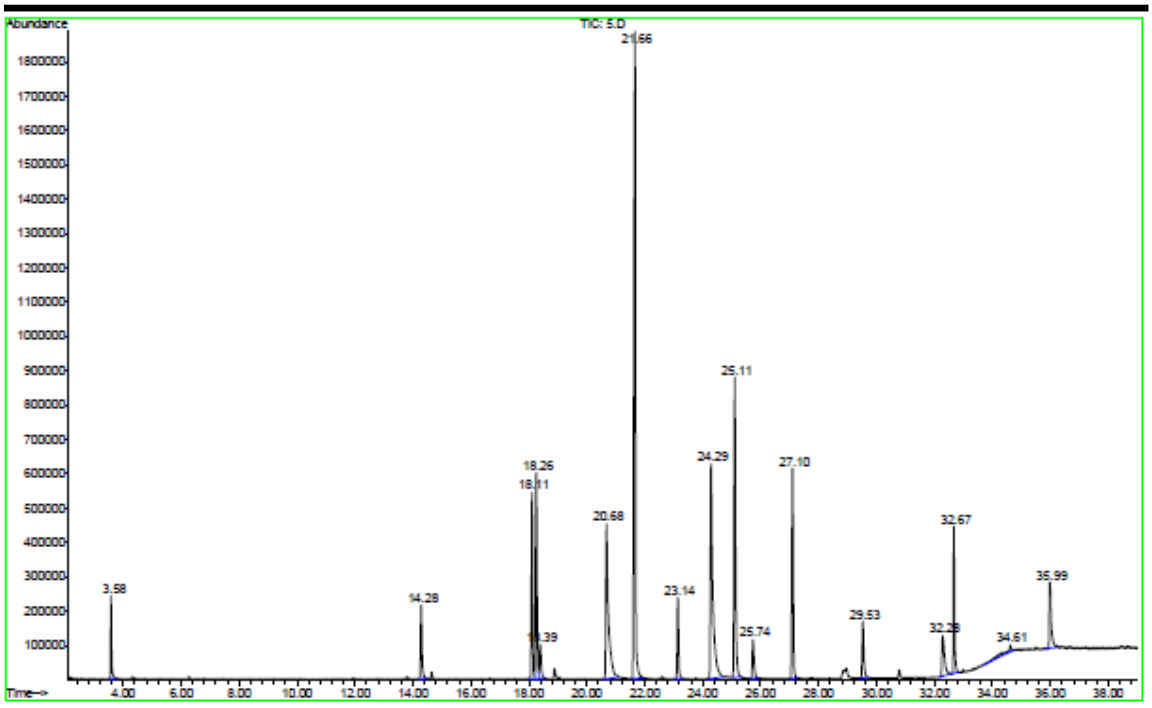

Fig. 2. Chromatogram of fatty acid composition of sea buckthorn buck

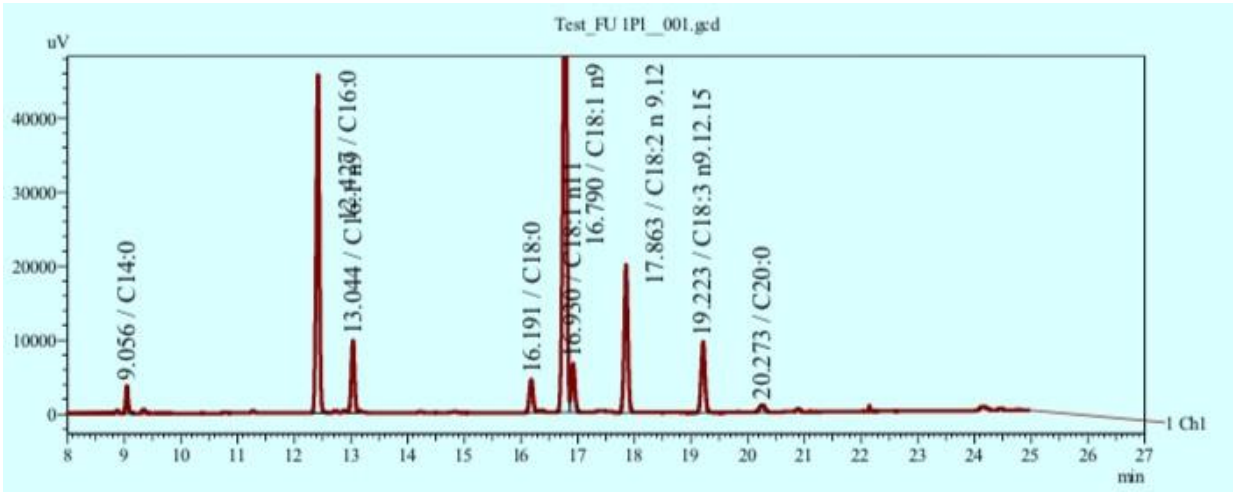

Fig. 3. Chromatogram of fatty acid composition of sea buckthorn flesh fruits

Among the identified fatty acids in the sea buckthorn leaf, there are significant amounts of fatty acids: from saturated fatty acids - palmitic acid (5.33 mg/g), behenic acid (1.07 mg/g), stearic acid (1.03 mg/g) , arachinous (0.91 mg/g), lignocerinous (0.78 mg/g), margarinic (0.32 mg/g), myristic (0.28 mg/g); from unsaturated ones - oleic (7.79 mg/g), linoleic (2.42 mg/g). The fatty acids of sea buckthorn bark are

saturated with arachinic (20.85 mg/g), palmitic (2.14 mg/g), erucic (2.09 mg/g), geneicocilic (1.87 mg/g), behenic (1 .38 mg/g) acids and unsaturated oleic (5.75 mg/g) and linoleic (4.86 mg/g) acids.

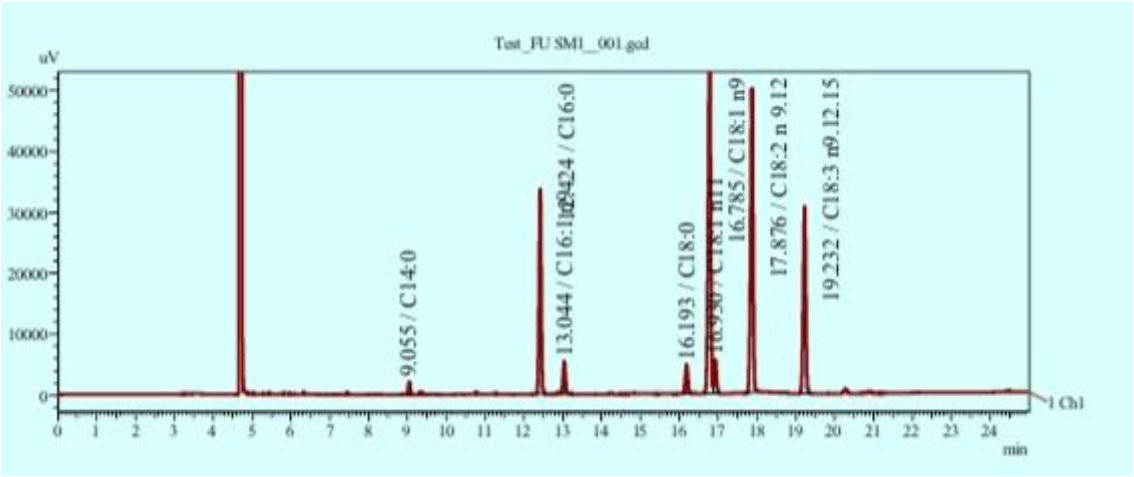

Fig. 4. Chromatogram of fatty acid composition of sea buckthorn seeds

9 fatty acids have been identified in the pulp of sea buckthorn fruits. Palmitic (23.55 mg/g) in large quantities, stearic (2.68 mg/g), myristic (1.36 mg/g), arachinic (0.87 mg/g) acids in smaller amounts, from unsaturated acids oleic (44.42 mg/g), linoleic (12.49 mg/g), linolenic (5.96 mg/g), palmitoleic (5.16 mg/g) and vaccenic (3.79 mg/g) were identified. Buckthorn seeds contain 8 fatty acids. Three of them are saturated: palmitic (15.89 mg/g), stearic (2.51 mg/g), myristic (0.71 mg/g) and five unsaturated acids: oleic (31.41 mg/g) , linoleic (27.03 mg/g), linolenic (17.00 mg/g), vaccinal (2.86 mg/g) and palmitoleic (2.56 mg/g). Leaves and bark, unlike fruit pulp and seeds, do not contain palmitoleic and vaccinic acids, which are a characteristic feature when obtaining sea buckthorn oil from fruits. The fatty acid composition of sea buckthorn seeds and pulp is characterized by a high content of unsaturated fatty acids compared to sea buckthorn leaves and bark

Table 1

Fatty acids composition of sea buckthorn herbal drugs

Fatty acid	Content (mg/g)			
	Leaves	Bark	Flesh fruit	Seeds
myristic	0,28	-	1,36	0,71
margarinic	0,32	-	-	-
palmitic	5,33	2,14	23,55	15,89
linoleic *	2,42	13,82	12,49	27,03
oleic*	7,79	5,75	5,96	31,41
stearinic	1,03	-	2,68	2,51
arachinic	0,91	20,85	0,87	-
begenic	1,07	1,38	-	-
lignicerinic	0,78	-	-	-
geneicocilic	-	1,87	-	-
erucic *	-	2,09	-	-
palmitoleic*	-	-	5,16	2,56
vaccinic*	-	-	3,79	2,86
linolenic*	-	-	5,96	17,00
Total unsaturated fatty acids *	10,21	21,66	33,36	80,86
Total saturated fatty acids	9,72	26,24	28,46	19,11

« * » unsaturated fatty acids

«-» unidentified fatty acid

3.2. Results of analysis of aminoacids composition

Research results and their discussion. The preliminary results of the chromatographic analysis of herbal drugsof sea buckthorn amino acids are presented in Table 2.

Table 2

Chromatography charactaristic of aminoacids

Aminoacids	General formula	Molecular Mass	Rf* value
Essential aminoacids			
Phenylalanine	$C_9H_{11}NO_2$	165	0,36
Valin	$C_5H_{11}NO_2$	117	0,45
Isoleucine	$C_6H_{13}O_2N$	131	0,74
Leucine	$C_6H_{13}NO_2$	146	0,65
Lizin	$C_6H_{14}N_2O_2$	146	0,06
Methionine	$C_5H_{11}O_2NS$	149	0,38
Threonine	$C_4H_9NO_3$	119	0,19
Nonessential aminoacids			
Alanine	$C_3H_7NO_2$	89	0,04
Arginine	$C_6H_{14}N_4O_2$	174	0,25
Asparaginic	$C_4H_7NO_4$	133	0,16
Histidine	$C_6H_9N_3O_2$	155	0,16
Glycine	$C_2H_5NO_2$	75	0,24
Glutaminic	$C_5H_9NO_4$	147	0,17
Proline	$C_5H_9NO_2$	115	0,26
Serin	$C_3H_7NO_3$	105	0,15
Tyrosine	$C_9H_{11}NO_3$	181	0,59

System of solvents for chromatography: butanol-acetic acid-water 4:1:2

Table 3

Content of aminoacids in sea buckthorn

Aminoacids	Leaves, mg/100g			Fruits, mg/100g		
	Free	Bound	Total	Free	Bound	Total
Asparaginic	87,7	1833,4	1921,1	4,1	413,8	418,0
Glutamine	15,1	2516,3	2531,4	4,9	1124,1	1129,0
Serin	41,6	1165,0	1206,6	1,9	496,2	498,1
Histidine	45,6	666,5	712,0	0	462,0	462,0
Glycine	15,7	1116,6	1132,3	1,4	707,2	708,6
Threonine	30,4	934,5	964,9	1,2	220,2	221,3
Arginine	38,7	1564,3	1603,0	4,5	1183,2	1187,7
Alanin	59,2	1232,5	1291,7	5,4	363,3	368,7
Tyrosine	29,5	818,0	847,5	1,2	242,8	244,1
Valin	45,5	847,2	892,7	1,5	64,0	65,5
Methionine	36,0	218,5	222,1	0	0	0
Phenylalanine	47,7	885,8	933,5	4,6	301,5	306,2
Isoleucine	29,5	1003,7	1033,2	0,8	289,4	290,3
Leucine	20,3	1753,5	1773,8	2,0	515,6	517,6
Lizin	24,1	825,0	849,1	0	235,5	235,5
Proline	61,2	53,9	115,1	1,6	45,0	46,6
Total	595,4	17434,6	18030,0	46,2	6653,0	6699,2

Chromatographic characteristics of amino acids identified on an Agilent Technologies 1200 liquid chromatograph in the leaves and fruits of sea buckthorn are given in Table 3 and Figures 5, 6.

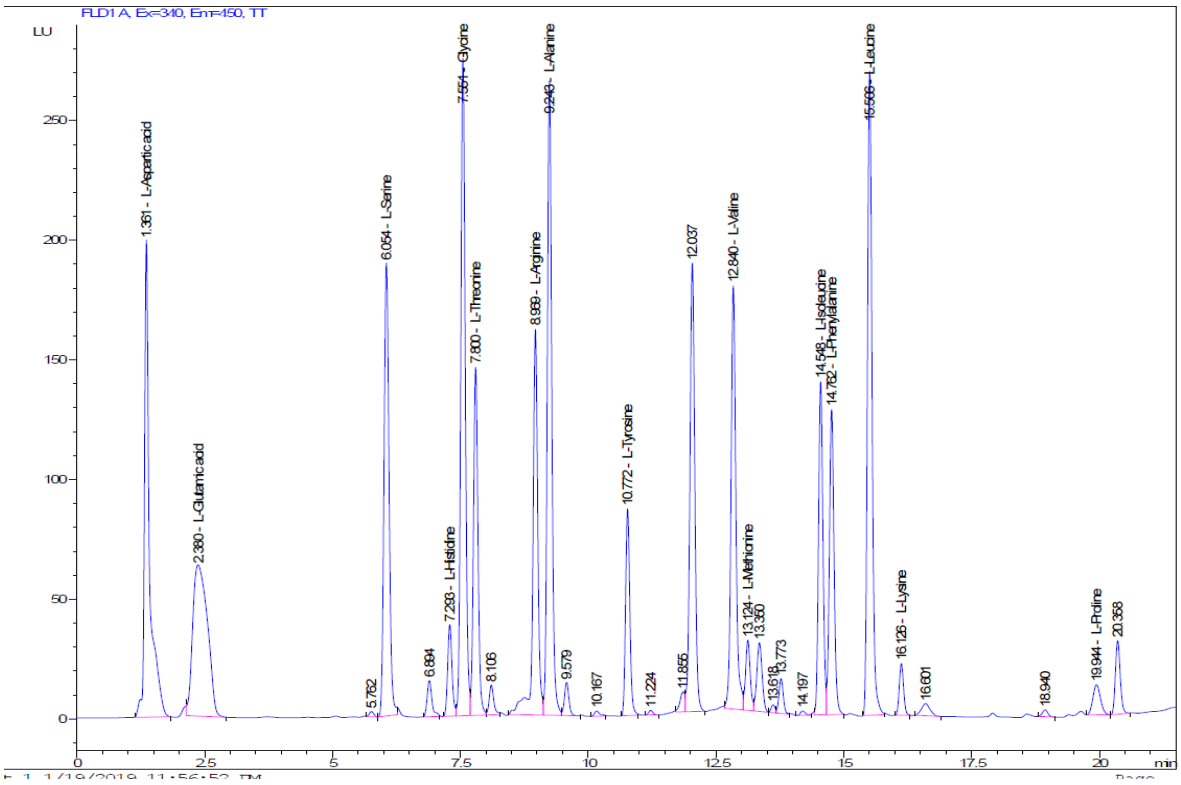

Fig. 5. HPLC chromatogram of aminoacids of sea buckthorn fruits

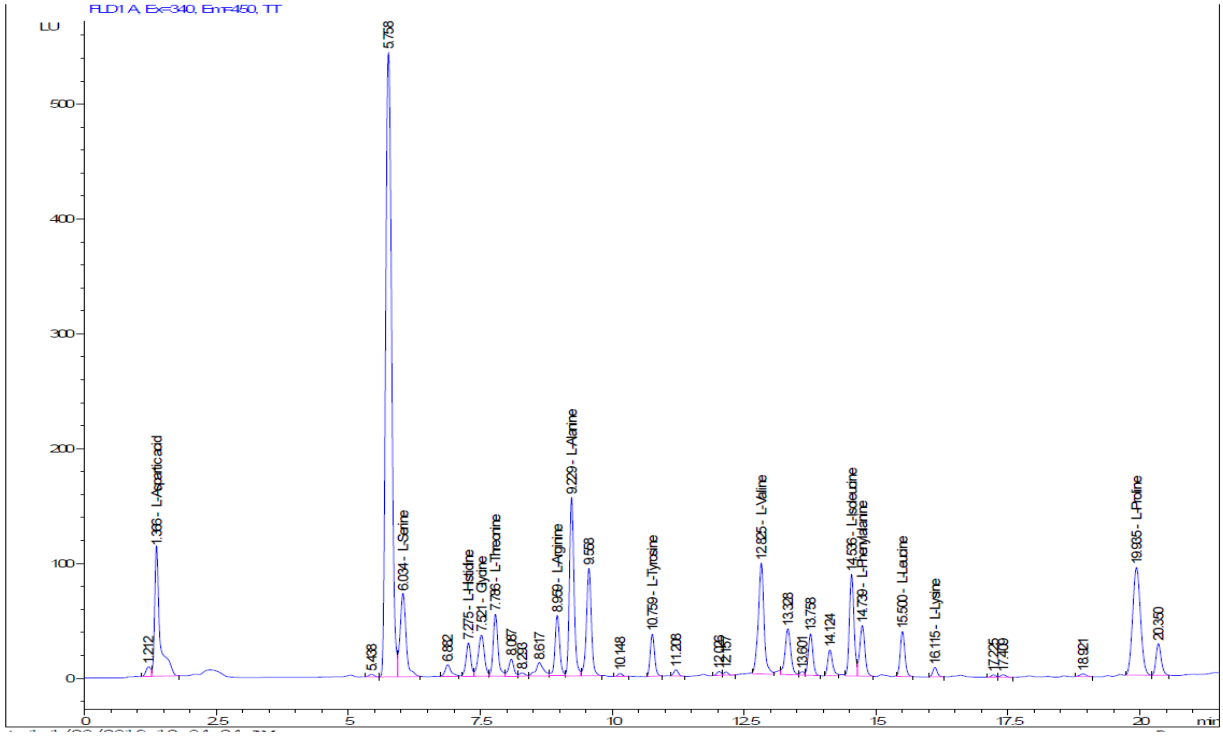

Fig. 6. HPLC chromatogram of aminoacids of sea buckthorn leaves

Analysis of the results of the HPLC-chromatograms (fig. 5 and 6), which are taken away with the indicated amino acids and the data presented in Table 4 serine,

histidine, glycine, threonine, arginine, alanine, tyrosine, valine, methionine, phenylalanine, isoleucine, leucine, lysine, proline, all of which are essential (valine, isoleucine, lysine, leucine, methionine, trephenolanine), fruits of sea buckthorn 15 amino acids. The amino acid methionine is indispensable in our warehouse every day. The number of amino acids in the linked and random views is shown in Table No. **2**. At what, the leaves of sea buckthorn can be all known, as well as links of amino acids, and in the fruits there are two daily acids, such as histidine and lysine. The stench is less known to the connected person, its quantity in mg / 100g: histidine - 462.0, lysine - 235.5. The largest amount of amino acids is observed in the leaves of sea buckthorn, in trich, the number of amino acids outweighs the number of amino acids, which are found in fruits.

The pattern of accumulation of amino acids may be the following in mg/100g: leaf (glutamine 2531.4 > asparagine 1921.1 > leucine 1773.8 > arginine 1603.0 > alanine 1291.7 > serine 1206.6 > glycine 1132.3 > 03 ,2 > threonine 964.9 > phenylalanine 933.5 > valin 892.7 > lysine 849.1 > tyrosine 847.5 > histidine 712.0 > methionine 222.1 > proline 115.1; fetuses (arginine 1187.7 > glutamine 1129.0 > glycine 708.6 > leucine 517.6 > serine 98.1 > histidine 462.0 > asparagine 418.0 > alanine 368.7 > phenylalanine 306.2 > isoleucine 290.3 > tyrosine 244.1 > lysine 235.5 > threonine 221.3 > valine 65.5 > proline 46.6 > methionine 0).

3.3. Results of analysis of mineral composition

Ash is a non-combustible residue of inorganic substances obtained after burning and calcining raw materials. The studies were carried out in accordance with the requirements of the State Pharmacopoeia [2, 3, 4].

The total ash was determined on the basis of the scientific and technological complex "Institute of Single Monocrystals" of the National Academy of Sciences of Ukraine. The results are shown in Table 4**.**

Table 4

Ash content in herbal drugs of sea buckthorn

Sample	Ash, %
Sea buckthorn leaves (summer)	6,50
Sea buckthorn leaves (autumn)	7,60
Sea buckthorn fruits (summer end)	3,60
Sea buckthorn fruit (autumn)	4,20
Sea buckthorn bark (spring)	2,90

The results of the study of the mineral composition of the ash samples of sea buckthorn are shown in Table **5.** In the studied objects, 15 elements were found, 5 macro- (Na, K, Ca, Mg, P) and 10 micro-elements (Fe, Si, Al, Mn, Pb, Ni, Mo, Cu, Zn, Sr).

The results of the study indicate that the fruits and leaves collected in the autumn period have more minerals than those collected in the summer, which is due to different periods of the plant's vegetation. It should be noted that according to the results of the analysis, sea buckthorn fruits are characterized by a high level of potassium, leaves - calcium and magnesium, iron, manganese, which increases the therapeutic significance of sea buckthorn raw materials and preparations.

According to the results obtained, the following pattern can be established for the concentration of minerals: in leaves collected in summer: K>Ca>Si>Mg>Na>P>Fe=Al>Mn>Zn>Sr>Cu>Ni>Mo; in leaves collected in autumn: K>Ca>Si>Mg>Na>P>Al>Fe>Mn>Zn>Sr>Cu>Mo>Ni; in summer harvest fruits: K>Ca>Na>Mg>P>Si>Fe>Zn>Sr>Al>Mn>Cu>Ni>Mo; in the fruits of the autumn period: K>Ca>Mg>Na>Si>P>Al>Fe>Zn>Mn>Cu>Sr>Ni>Mo; in the bark of sea buckthorn harvested in spring: Ca>Na>Mg>P>Si>K>Al>Mn>Sr>Fe>Mo>Ni.

Table 5

Mineral composition of sea buckthorn herbal drugs

Mineral	Content, mg/100g				
	Leaves (summer)	Leaves (autumn)	Fruits (summer end)	Fruits (autumn)	Bark (spring)
Sodium (Na)	160,00	177,00	130,00	86,00	180,00
Potassium (K)	1150,00	1155,00	1295,00	1500,00	84,00
Calcium (Ca)	640,00	690,00	220,00	150,00	240,00
Magnesium (Mg)	225,00	245,00	105,00	130,00	110,00
Phosphorus (P)	96,00	100,00	74,00	70,00	105,00
Silicon (Si)	290,00	370,00	55,00	77,00	90,00
Iron (Fe)	32,00	42,00	5,50	9,50	10,50
Aluminium (Al)	32,00	46,00	0,60	13,00	27,00
Zinc(Zn)	42,00	5,80	1,50	1,90	0,60
Copper (Cu)	0,25	0,23	0,18	0,64	0,13
Manganese (Mn)	25,60	23,10	0,65	1,00	4,20
Molybdenum (Mo)	0,06	0,06	0,15	0,14	0,12
Lead (Pb)	<0,03	<0,03	0,04	<0,03	<0,03
Nickel (Ni)	0,13	0,08	0,09	0,18	0,07
Strontium (Sr)	2,20	2,30	0,70	0,40	1,80
Total	2695,27	2856,60	1889,22	2039,64	853,45

All samples of sea buckthorn herbal drugs contain an insignificant amount of heavy metals (Mo, Pb, Ni), which can be explained by their accumulation in the process of plant ontogenesis, but they are within the normal range according to State Pharmacopoeia [4].

Of the macroelements in herbal drugs, potassium predominates, which plays an important role in many metabolic processes, including: in the formation of the

cell membrane potential, regulation of water and electrolyte balance, stabilization of osmotic pressure, reduces allergy symptoms, muscle rigidity, and normalizes blood pressure. Calcium helps to strengthen the immune system, improves the processes of hematopoiesis and detoxification of the body; magnesium is involved in the metabolism of glucose, fats, proteins and affects the stability of cell membranes, has neuromuscular, cardiovascular and hormonal activity.

Of the trace elements, iron predominates, which normalizes the functioning of the hematopoietic system, lungs, central nervous system, skeletal system, kidneys and female genital organs; iron improves the immune system, central nervous system, metabolic processes and plays an important role in the hematopoietic system; zinc affects the activity of sex and gonadotropic hormones of the pituitary gland, increases the activity of phosphatase, the synthesizing ability of the liver, promotes the breakdown of fats [108-113].

The given mineral composition is very diverse, which may be the basis for its use as part of herbal medicines for the treatment and prevention of various disorders of the macro- and microelement balance in the body.

3.4 Results of analysis of hydroxycinnamic acids in sea buckthorn

Table 6 shows the results of research of sea buckthorn raw materials using paper chromatography and TLC in solvent systems: 1 system - 15% acetic acid: and 2 system - 2% acetic acid [108-113].

Chromatographic characteristics of hydroxycinnamic acids, which were identified in different types of sea buckthorn raw materials, are given in Table 6 and in Figures 7-11, and the results of quantitative analysis in Table **7.**

Table 6

Chromatographic characteristics of hydroxycinnamic acids of sea buckthorn

№ spouts	Hydroxycinnamic acids	Rf $_1$ *	Rf $_2$ *	Color in UV light	
				Before spraying NH_3	After spraying NH_3
1	Caffeic	0,43	0,55	blue	Blue-green
2	Ferulic	0,55	0,48	blue	blue
3	Chlorogenic	0,93	0,85	blue	Blue-green
4	Galic	0,40	0,49	colorless	yellow
5	Hydroxyphenylacetic	0,30	0,35	blue	Bright-blue
6	Sinapic	0,50	0,62	violet	Bright-violet
7	Cinnamic	0,32	0,40	blue	blue

*System of solvents for chromatography 1 - 15 % acetic acid ; 2 - 2 % acetic acid.

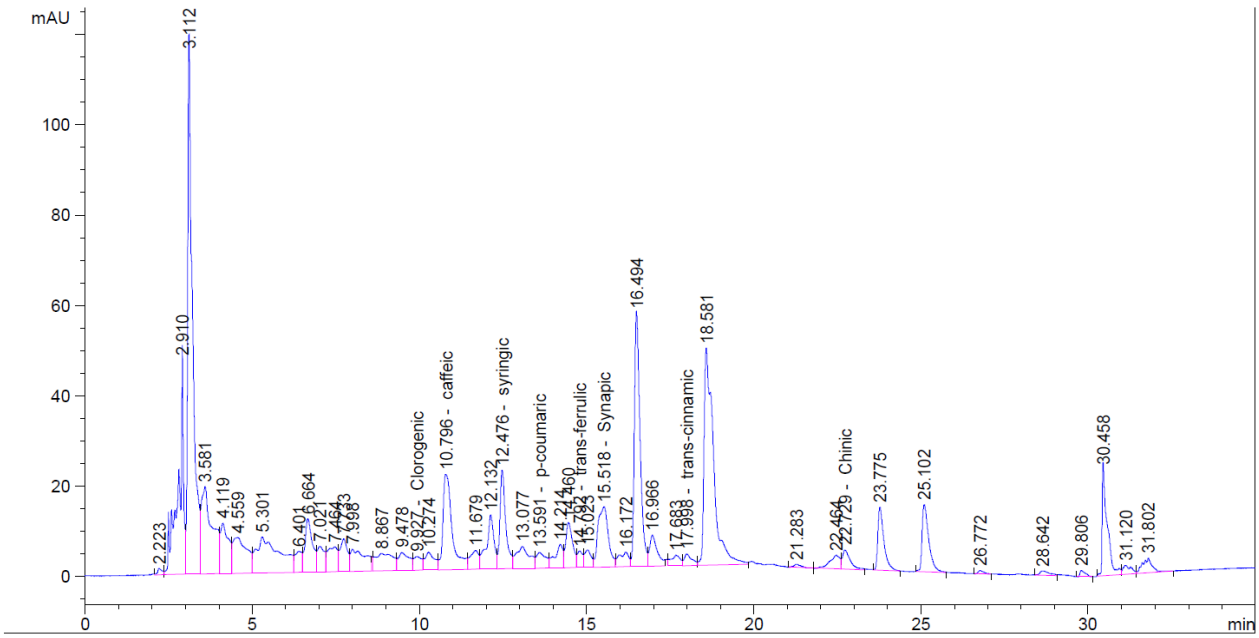

Fig. 7. HPLC – chromatogram for fruits of sea buckthorn

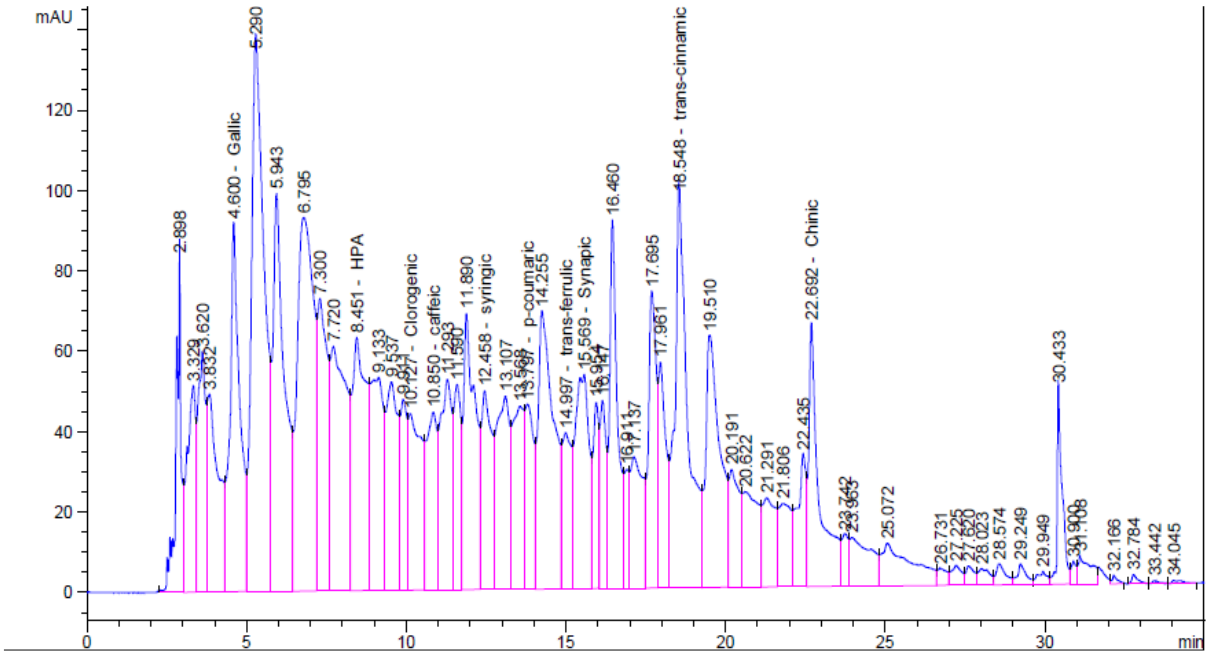

Fig. 8. HPLC – chromatogram for leaves of sea buckthorn

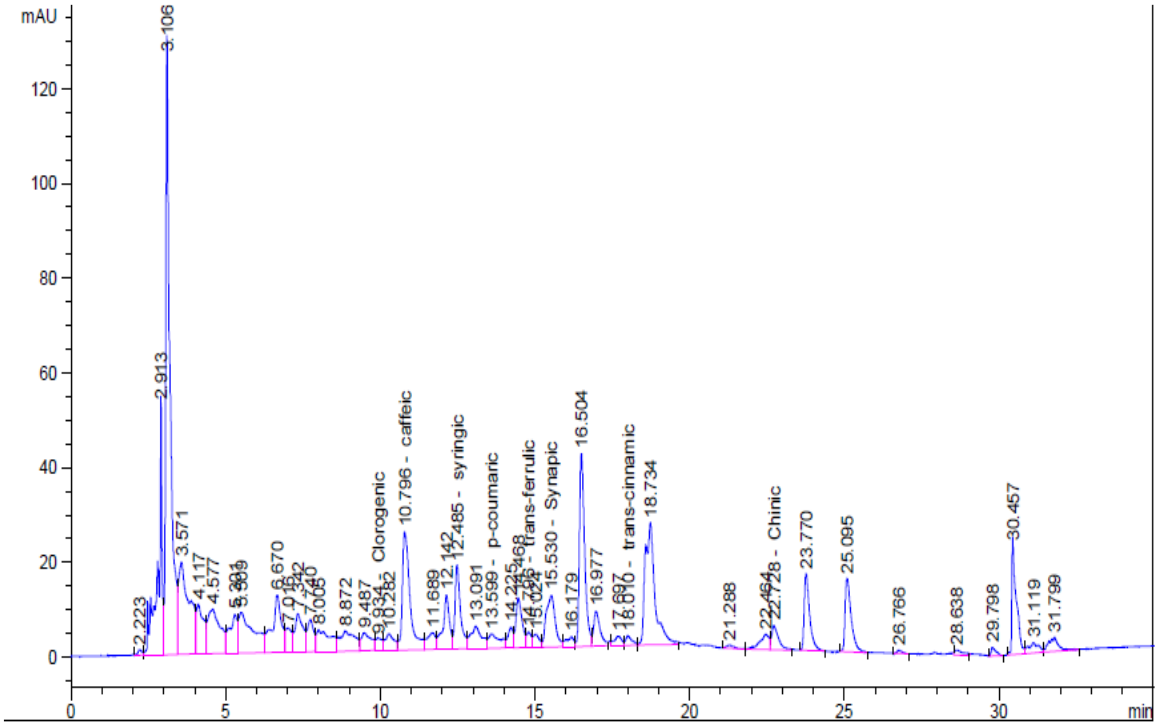

Fig. 9. HPLC – chromatogram for fruits-cake of sea buckthorn

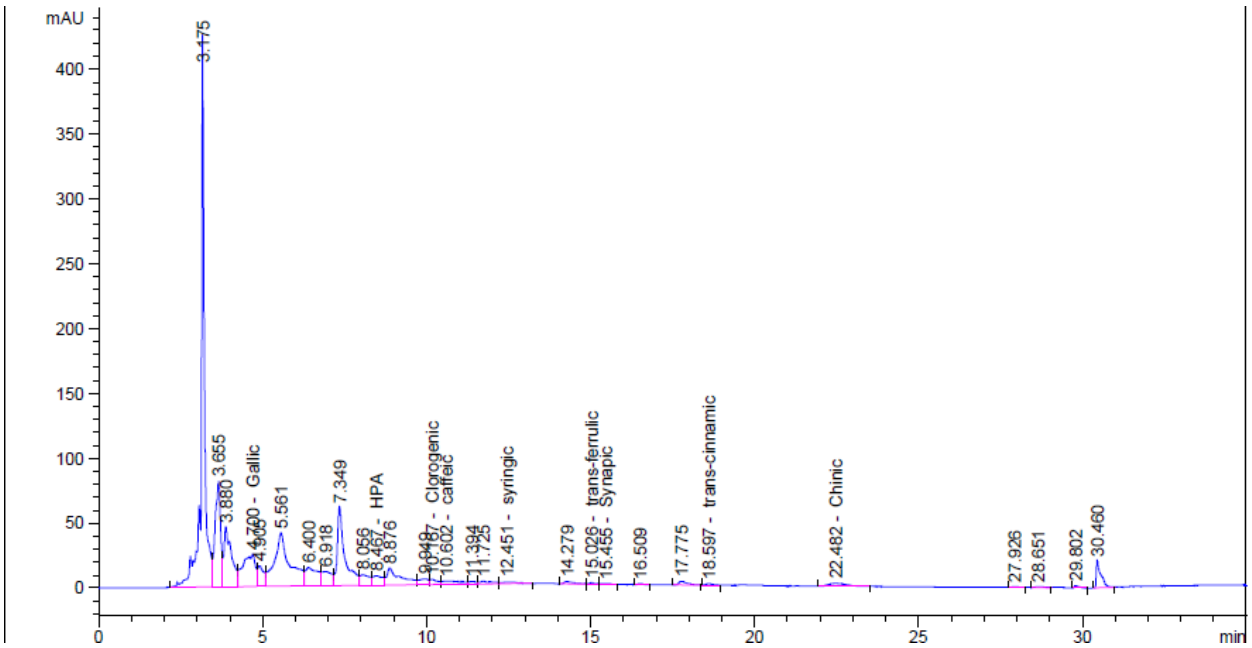

Fig. 10. HPLC – chromatogram for bark of sea buckthorn

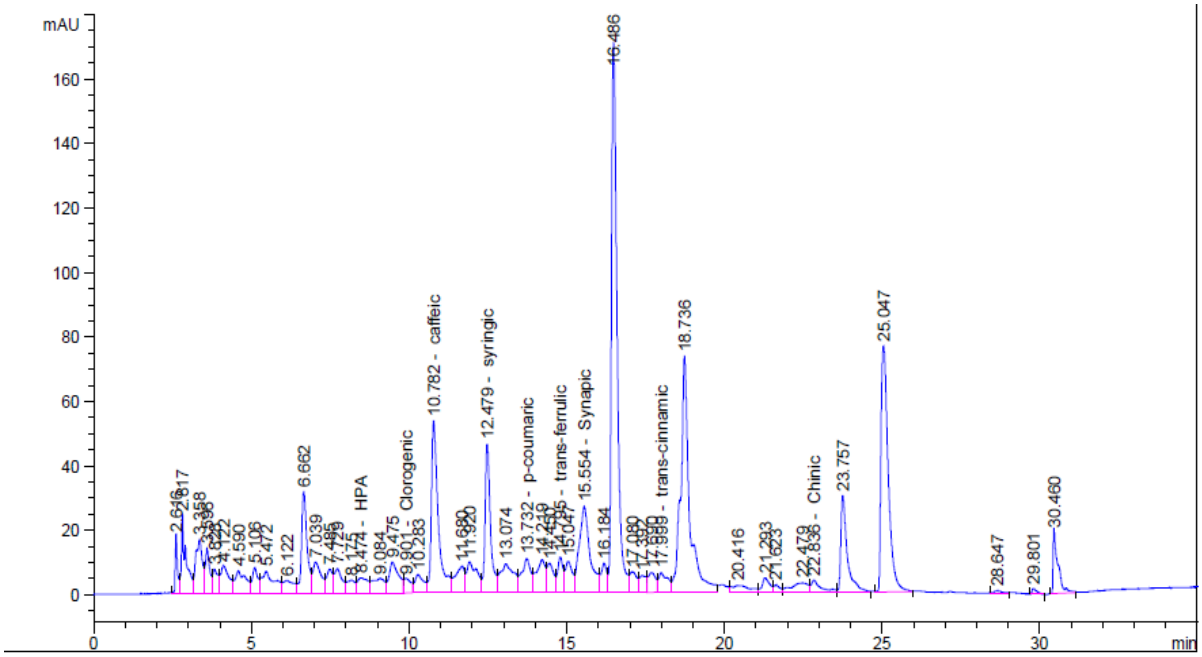

Fig. 11. HPLC – chromatogram for juice of fruits of sea buckthorn

Table 7

Hydroxycinnamic acids in herbal drugs of sea buckthorn

№ п.п.	Acid	Content (mkg/g)				
		leaf	fruit	fruitcake	bark	juice
1	galic	1342,88	-	-	414,02	-
2	hydroxyphenylacetic	1452,53	-	-	107,06	71,19
3	chlorogenic	4369,85	198,97	206,96	231,97	227,16
4	caffeinic	1038,11	435,37	579,95	106,10	737,91
5	syringinic	630,90	153,75	158,49	23,00	263,89
6	coumaric	567,42	43,90	60,38	-	110,20
7	ferulic	468,26	25,52	29,48	8,80	71,74
8	synapic	806,27	143,53	138,80	7,23	266,48
9	cinnamic	656,55	9,85	8,84	4,88	24,25
10	quinic	65572,75	2644,47	3932,31	3401,74	2565,15
11	total	76905,52	3655,36	5115,21	4304,06	4337,97

The analysis of the results of HPLC chromatograms (Table 6, 7, Figs. 7-11) shows that MRM of sea buckthorn of the buckthorn variety Sweet Woman contains 10 hydroxycinnamic acids: gallic, hydroxyphenylacetic, chlorogenic, caffeic, syringic , coumaric, ferulic, sinapic, quinnic and cinnamic.

It is noted that the content of quinic acid is high in all types of raw sea buckthorn. The regularity of accumulation of this acid has the following form in μg/g: leaves 65572.75 > fruit pulp 3932.31 > bark 3401.74 > fruits 2644.47 > fruit juice.

Next in terms of content in μg/g are: chlorogenic (leaves 4369.85 > bark 231.97 > fruit juice 227.16 > fruit pulp 206.96 > fruits 198.97), caffeine (leaves 1038.11 > fruit juice 737, 91> fruit cake 579.95 > fruit 435.37 > bark 106.10), mustard (leaves 806.27 > fruit juice 266.48 > fruit 143.53 > fruit cake 138.80 > bark 7.23), cinnamon (leaves 656.55> fruit juice 24.25> fruits 9.85> fruit cake 8.84> bark

4.88) ,52 >bark 8.80), syringic (leaves 630.90 > fruit juice 263.89 >fruit pulp 158.49 >fruits 153.75 >bark 23.00), hydroxyphenylacetatic (leaves 1452.53> bark 107.06 >fruit juice 71.19) and gallic acid, it is contained only in leaves 1342.88mkg/g and bark 414.02mkg/g.

CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

1. Using chromatographic methods, the qualitative composition and content of fatty acids were determined in medicinal plant raw materials (leaves, fruit pulp, seeds, bark) of domestic varieties of sea buckthorn. As a result of the study, it was found that sea buckthorn leaves contain 9 fatty acids, of which 2 are unsaturated and 7 are saturated. The flesh of the fruit also found 9 fatty acids, including 5 unsaturated and 4 saturated fatty acids, the peel contains 7 fatty acids, of which 2 are unsaturated and 5 are saturated, and the seed has 8 fatty acids, 5 of which are unsaturated and 3 are saturated.

2. The largest amount of fatty acids is found in the pulp of sea buckthorn fruits. It is 100.28 mg/g, the seeds have a smaller amount - 99.97 mg/g, in the bark the amount is 47.9 mg/g, and the amount of fatty acids in the leaves is 19.93 mg/g.

3. A characteristic feature of sea buckthorn raw materials is the presence of palmitoleic and vaccinal fatty acids in its composition, which are present in the pulp and seeds of sea buckthorn fruits. The fatty acid composition of sea buckthorn seeds and pulp is characterized by a high content of unsaturated fatty acids compared to sea buckthorn leaves and bark.

4. The obtained data indicate a sufficiently diverse and rich composition of fatty acids of medicinal plant raw materials of sea buckthorn, which can be used as a promising source for the creation of dietary supplements and phytopreparations based on it for the correction and treatment of various diseases of the human body.

5. As a result of the analysis, the following amino acids were determined in the studied herbal drugs: aspartic, glutamic, serine, histidine, glycine, threonine, arginine, alanine, tyrosine, valine, methionine, phenylalanine, isoleucine, leucine, lysine and proline.

6. The largest amount of amino acids is in the leaf. Their total free and bound mass is 18030.0 mg/100g. In fruits, the amount is almost three times smaller, only 6699.2 mg/100g. And the amino acid methionine is also missing. Histidine and lysine are found only in the bound form.

7. The results of the analysis indicate that herbal drugs of sea buckthorn can be used as a raw material for the creation of medicines and dietary supplements based on it, which will have anti-stress, anti-tumor, general strengthening activity.

8. For the first time, the mineral composition of leaves, fruits, bark of sea buckthorn was determined by atomic emission spectrophotometry. 15 macro- and microelements were identified in the samples of raw materials of the domestic variety of sea buckthorn Sweet woman.

9. The obtained experimental data indicate a rather diverse and rich mineral composition in the studied raw material. 5 macro- (Na, K, Ca, Mg, P) and 10 microelements (Fe, Si, Al, Mn, Pb, Ni, Mo, Cu, Zn, Sr) were determined, the content of heavy metals corresponds to HFCs.

10. Quantitatively, the largest amount of mineral substances is characterized further - (mg/100g): sea buckthorn leaves collected in autumn - 2856.60; sea buckthorn fruits harvested in autumn - 2039.64; sea buckthorn leaves collected at the end of summer - 2695.27; sea buckthorn fruits harvested at the end of summer - 1889.22; sea buckthorn bark, harvested in spring - 853.45.

11. As a result of the analysis, 10 hydroxycinnamic acids were determined in the studied raw materials: gallic, hydroxyphenylacetic, chlorogenic, caffeic, syringic, coumaric, ferulic, sinapic, cinnamic, and henna.

12. The largest amount of hydroxycinnamic acids is contained in the leaves of sea buckthorn 76905.52 μg/g, then in the pulp of the fruit 5115.21 μg/g, then in the juice of the fruit 4337.97 μg/g, in the bark 4304.06 μg/g and in the fruit 3655.36 μg/g

13. Among the acids, quinic acid accumulates the most, its amount in the leaf is 65572.75 μg/g.

14. The results of the analysis indicate that the herbal drugs of sea buckthorn, distributed in Ukraine, can be used as a raw material for the creation of medicines and dietary supplements based on it, which have pronounced antioxidant and immunostimulating activity.

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Ф А 2.2.1–32-366

National University of Pharmacy

Faculty for foreign citizens' education
Department chemistry of natural compounds and nutriciology
Level of higher education master
Specialty 226 Pharmacy, industrial pharmacy
Educational program Pharmacy

APPROVED
The Head of Department
chemistry of natural compounds and nutriciology
Victoria KYSLYCHENKO
"28" September 2022

ASSIGNMENT
FOR QUALIFICATION WORK
OF AN APPLICANT FOR HIGHER EDUCATION

Sammi EL HEDDARI

1. Topic of qualification work: «Pharmacognostic research of herbal drugs of sea buckthorn (Hippophae rhamnoides)», supervisor of qualification work: Dr. Pharm. Sc, prof. Natalia POPOVA

approved by order of NUPh from "06" of February 2023 № 35

2. Deadline for submission of qualification work by the applicant for higher education: April 2023.

3. Outgoing data for qualification work: sea buckthorn is well known wild and cultivated tree, fruit of which is officinal herbal drug in medicine and pharmacy, other organ is not used and bad investigated. That why the research of different organs of sea buckthorn is actual.

4. Contents of the settlement and explanatory note (list of questions that need to be developed): It was carried out research of fatty acids composition, aminoacids composition, mineral composition as well analysis of hydrohycinnamic acids composiyion.

5. List of graphic material (with exact indication of the required drawings):
Tables – 7, pictures –11

6. Consultants of chapters of qualification work

Chapters	Name, SURNAME, position of consultant	Signature, date	
		assignment was issued	**assignment was received**
1	Prof. Natalia POPOVA, review about sea buckthorn, distribution, chemical composition, application	28.09.22 assignment was issued	28.09.22 assignment was received
2	Prof. Natalia POPOVA. Collection, drying and standardization of herbal drugs	3.10.22 assignment was issued	3.10.22 assignment was received
3	Prof. Natalia POPOVA. Analysis of fatty acids composition	10.10.22 assignment was issued	10.10.22 assignment was received
3	Prof. Natalia POPOVA. Analysis of fatty aminoacids composition	14.11.22 assignment was issued	14.11.22 assignment was received
3	Prof. Natalia POPOVA. Analysis of mineral composition	19.12.22 assignment was issued	19.12.22 assignment was received
3	Prof. Natalia POPOVA. Analysis of hydroxycinnamic acids composition	20.03.23 assignment was issued	20.03.23 assignment was received

7. Date of issue of the assignment: “28” _September_ 2022

CALENDAR PLAN

№ з/п	**Name of stages of qualification work**	**Deadline for the stages of qualification work**	**Notes**
1	Botanical characteristic of sea buckthorn, distribution, chemical composition, applicatiom	29.09.22-2.10.22	**done**
2	Collection, drying and standardization of herbal drugs	3.10.22-9.10.22	**done**
3	Analysis of fatty acids composition	14.11.22-18.12.22	**done**
4	Analysis of fatty aminoacids composition	19.12.22- 29.01.23	**done**
5	Analysis of mineral composition	30.01.23-19.02.23	**done**
6	Analysis of hydroxycinnamic acids composition	20.02.23-6.03.23	**done**
7	Writing of qualification work	7.03.23-5.04.23	

An applicant of higher education _____ Samie EL HEDRI

Supervisor of qualification work _____ prof. Natalia POPOVA

ВИТЯГ З НАКАЗУ № 35
По Національному фармацевтичному університету
від 06 лютого 2023 року

нижченаведеним студентам 5-го курсу 2022-2023 навчального року, навчання за освітнім ступенем «магістр», галузь знань 22 охорона здоров'я, спеціальності 226 – фармація, промислова фармація, освітня програма – фармація, денна форма здобуття освіти (термін навчання 4 роки 10 місяців та 3 роки 10 місяців), які навчаються за контрактом, затвердити теми кваліфікаційних робіт:

Прізвище студента	Тема кваліфікаційної роботи		Посада, прізвище та ініціали керівника	Рецензент кваліфікаційної роботи
• **по кафедрі хімії природних сполук**				
Ель Хаддарі Самія	Фармакогностичне дослідження рослинної сировини обліпихи (*Hippophae rhamnoides*)	Pharmacognostic research of herbal drugs of Sea buckthorn (*Hippophae rhamnoides*)	проф. Попова Н.В.	проф. Перехода Л.О.

Підстава: подання декана, згода ректора

Ректор

Вірно. Секретар

Ф А2.8-47-110

ВИСНОВОК

Комісії з академічної доброчесності про проведену експертизу

щодо академічного плагіату у кваліфікаційній роботі

здобувача вищої освіти

№ 112663 від « 27 » квітня 2023 р.

Проаналізувавши випускну кваліфікаційну роботу за магістерським рівнем здобувача вищої освіти денної форми навчання Ель Хаддарі Самія, 5 курсу, _____ групи, спеціальності 226 Фармація, промислова фармація, на тему: «Фармакогностичне дослідження рослинної сировини обліпихи (*Hippophae rhamnoides*)/ Pharmacognostic research of herbal drugs of Sea buckthorn (*Hippophae rhamnoides*)», Комісія з академічної доброчесності дійшла висновку, що робота, представлена до Екзаменаційної комісії для захисту, виконана самостійно і не містить елементів академічного плагіату (компіляції).

Голова комісії,

професор **Інна ВЛАДИМИРОВА**

1%

31%

Ф А 2.2.1-32-353

REVIEW

of scientific supervisor for the qualification work of the level of higher education master of the specialty 226 Pharmacy, industrial pharmacy

Samia EL HEDDARI

on the topic: "Pharmacognostic research of herbal drugs of sea buckthorn (Hippophae rhamnoides)"

Relevance of the topic. The use of medicinal plants has deep roots in many countries of the world. They are used for the prevention, supportment and treatment of various diseases, which are special for subtropical region. Plants of genus Hippophae are very known and very spread in many part of the world. Sea buckthorn are wild and cultivated in many countries of the world as for food industries as for medicinal one. Research for chemical composition of herbal drugs of Sea buckthorn (Hippophae rhamnoides) as modern medicinal plant to develop method of identification for draft of pharmacopoeia's monograph is actual.

Practical value of conclusions, recommendations and their validity. Analyzed and summarized the literature data on the botanical characteristics, chemical composition and pharmacological properties of plants of the genus Hippophae. The presence of biological active compounds such as different types of liphophilic compounds, organic acids, phenol carbonic acids, aminoacids and mineral composition, as well definite technological parameters of herbal drugs and, content of BAC and quality indicators of herbal drugs he was determined.

In the process of performing the qualification work, mastered the methods of phytochemical analysis and identification methods is of medicinal plant raw materials.

Assessment of work. Samia EL HEDDARI qualification work was performed at a high scientific level. When conducting phytochemical analysis on the topic of the applicant's work, various methods of analysis were used.

Statistical processing of the results of quantitative determination of biological active compounds and quality indicators in accordance with the requirements of the State Pharmacopoeia of Ukraine

General conclusion and recommendations on admission to defend. Qualification work of Samia El HEDDARI on the topic: "Pharmacognostic research of herbal drugs of sea buckthorn (Hippophae rhamnoides)" can be submitted for defense to the State Examination Commission.

Scientific supervisor _____ prof. Natalia POPOVA

«05» of April 2023

Ф А 2.2.1-32-356

REVIEW

for qualification work of the level of higher education master, specialty 226 Pharmacy, industrial pharmacy

Samia EL HEDDARI

on the topic: " Pharmacognostic research of herbal drugs of sea buckthorn (Hippophae rhamnoides)"

Relevance of the topic. The use of medicinal plants at this time, when developed pharmacology and pharmaceutical industry, remains relevant. Therefore, the search for new promising medicinal plants, herbal drugs and well known plants with a rich chemical composition and sufficient raw material base is relevant. Such plants include Sea buckthorn or Hippophae rhamnoides, which is widespread and cultivated not only in Ukraine but in other countries of the world and is used in folk medicine. Information on the chemical composition of this species is fragmentary, information about other organ of this plant is deficiency. Therefore, the topic of the work is relevant.

Theoretical level of work. The author of the qualification work analyzed the literature on botanical characteristics, distribution area, chemical composition and use of plants of the genus Hippophae, make analysis of pharmacological activities and methods of determination of the quality of herbal drugs in many countries.

Author's suggestions on the research topic. The results of the research can be used in the development of draft pharmacopoeia's monograph of Hippophae rhamnoides (fruits, seeds, leaves, bark) or oil (identification methods).

Practical value of conclusions, recommendations and their validity. The author studied the qualitative composition of biologically active compounds in the studied herbal drugs (fruits and other organs of plants). The content of the main groups of BAC and quality indicators of the studied raw materials are determined as well it was developed identification methods for oil togethers with some technological parameters.

Disadvantages of work. In the work there are bad expressions, spelling mistakes

General conclusion and assessment of the work. The proposed work is of practical importance and meets the requirements for qualification work. qualification work of Samia EL HEDDARI on the topic: "Pharmacognostic research of herbal drugs of sea buckthorn (Hippophae rhamnoides)" can be submitted for defense to the examination commission

Reviewer _____ prof. Lina PEREKHODA

«11» of April 2023

Витяг
з протоколу засідання кафедри хімії природних сполук і нутриціології
Національного фармацевтичного університету
№ 4 від 18 квітня 2023 року

ПРИСУТНІ: Бурда Н.Є., Журавель І.О., Кисличенко В.С., Комісаренко А.М., Король В.В., Новосел О.М., Попик А.І., Попова Н.В., Процька В.В., Скребцова К.С., Тартинська Г.С., Хворост О.П.

Порядок денний:

1. Щодо допуску здобувачів вищої освіти до захисту кваліфікаційних робіт у Екзаменаційній комісії.

СЛУХАЛИ: про представлення до захисту в Екзаменаційній комісії кваліфікаційної роботи на тему «Фармакогностичне вивчення рослинної сировини обліпихи (Hippophae rhamnoides)» здобувача вищої освіти випускного курсу Фм18(5,0д)і-02 групи Саміе ЕЛЬ ХЕДДАРІ.
Науковий керівник: професор Наталія ПОПОВА
Рецензент: професор Ліна ПЕРЕХОДА

УХВАЛИЛИ: рекомендувати до захисту в Екзаменаційній комісії кваліфікаційну роботу здобувача вищої освіти Фм18(5,0д)і-02 групи Саміе ЕЛЬ ХЕДДАРІ на тему «Фармакогностичне вивчення рослинної сировини обліпихи (Hippophae rhamnoides)».

Завідувачка кафедри хімії природних
сполук і нутриціології Вікторія КИСЛИЧЕНКО

Секретар кафедри ХПСіН Надія БУРДА

Ф А2.2.1-32-042

НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ

ПОДАННЯ
ГОЛОВІ ЕКЗАМЕНАЦІЙНОЇ КОМІСІЇ
ЩОДО ЗАХИСТУ КВАЛІФІКАЦІЙНОЇ РОБОТИ

Направляється здобувач вищої освіти Самія ЕЛЬ ХЕДДАРІ до захисту кваліфікаційної роботи
за галуззю знань 22 Охорона здоров'я
спеціальністю 226 Фармація, промислова фармація
освітньою програмою Фармація
на тему: «Фармакогностичне дослідження рослинної сировини обліпихи (Hippophae rhamnoides)».

Кваліфікаційна робота і рецензія додаються.

Декан факультету _____ / Світлана КАЛАЙЧЕВА /

Висновок керівника кваліфікаційної роботи

Здобувач вищої освіти Самія ЕЛЬ ХЕДДАРІ засвоїла основні методи фітохімічного аналізу, дана кваліфікаційна робота має практичне значення та відповідає вимогам, що висуваються до роботи певного рівня.

Керівник кваліфікаційної роботи

_____ проф. Наталія ПОПОВА

«05» квітня 2023 року

Висновок кафедри про кваліфікаційну роботу

Кваліфікаційну роботу розглянуто. Здобувач вищої освіти Самія ЕЛЬ ХЕДДАРІ допускається до захисту даної кваліфікаційної роботи в Екзаменаційній комісії.

Завідувач(ка) кафедри хімії природних сполук і нутриціології

_____ Вікторія КИСЛИЧЕНКО

«18» квітня 2023 р

Qualification work was defended

of Examination commission on

« ___ » _____ 2023

With the grade _____

Head of the State Examination commission,

DPharmSc, Professor

_____ / Oleh SHPYCHAK /