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КАТАЛИЗ ЖӘНЕ ЭЛЕКТРОХИМИЯ ИНСТИТУТЫ» АҚ

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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

АО «ИНСТИТУТ ТОПЛИВА, КАТАЛИЗА И
ЭЛЕКТРОХИМИИ ИМ. Д.В. СОКОЛЬСКОГО»

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OF THE REPUBLIC OF KAZAKHSTAN

JSC «D.V. SOKOLSKY INSTITUTE OF FUEL,
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♦
СЕРИЯ ХИМИИ И ТЕХНОЛОГИИ
♦
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АЛМАТЫ, ҚР ҰҒА АЛМАТЫ, НАН РК ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of chemistry and technologies scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of chemistry and technologies in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of chemical sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Химия және технология сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Химия және технология сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді химиялық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия химии и технологий» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по химическим наукам для нашего сообщества.

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Институт органического катализа и электрохимии им. Д. В. Сокольского,
каб. 310, тел. 291-62-80, факс 291-57-22, e-mail:orgcat@nursat.kz
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A.Zh. Kaldybekova, A.T. Amangazyeva, Z.B. Halmenova, A.K. Umbetova

Kazakh National University named after al-Farabi, Almaty, Kazakhstan
A_Arai_95@mail.ru, zaure.halmenova@mail.ru, alma_0875@mail.ru, amangazyeva.a@mail.ru

DEVELOPMENT OF TECHNOLOGY FOR THE COMPLEX ISOLATION OF BIOLOGICAL ACTIVE SUBSTANCES FROM PLANTS OF THE GENUS HAPLOPHYLLUM A. JUSS

Abstract: In this study, a complex study of plants of the genus Haplophyllum A.Juss of a sort H. Perforatum Kar et Kir. The main parameters or raw material quality: preparation raw material (grinding, sieve analysis); humidity, total ash, ash is insoluble 10 % HCl, sulphate ash, extractives.

Macro- and microelement composition of total ash is analyzed. Qualitative reactions and chromatographic analysis methods, the main classes of natural compounds in raw materials and their quantitative contents have been identified.

Keywords: Rutaceae, Haplophyllum, moisture, ash, coumarins, Perforatum, flavonoids, terpenoids.

Introduction

The stirpes Rutaceae includes 150 genera and about 900 species are widely distributed in tropical, subtropical and heat-sensitized regions of both hemispheres. Most of the representatives of the stirpes grow in the South of the USA (California, Florida) in the Mediterranean countries (Spain, Italy, Morocco, etc.), Brazil, Argentina, Japan, China, South Africa and the arid regions of Australia [1; 201].

Rutaceae - occur mainly as evergreen trees or bushes, sometimes lianas, very rarely perennial (ruta - Ruta, ash - Dictamnus, haplophyllum - Haplophyllum) and annual grasses [2; 240].

Plants of the genus Haplophyllum A. Juss (stirpes Rutaceae) on a global scale are represented by approximately 70 species, which are distributed from the Mediterranean to Western Siberia. There are 23 species of Haplophyllum growing on the territory of the Central Asian countries [3; 229].

The main active components of the plant genus Haplophyllum A. Juss are:

- coumarins (collinin, obtusifol, obtusinin, obtusinol, obtosozid, daurosid D, ostol, 6-methoxy-7-(3',3'-dimethylallyloxy) coumarin, 5-hydroxy-7-methoxycoumarin, scopoletin, isoskopoltin, bungenediol, skimianin , umbelliferone, and daurozides A and B);
- flavonoids (haplozid A, 7-O-glycoside haplogenin, haplozid D, haplozid F, 7-O-β-D- (6acetyl-'), glucopyranoside 3,5,4'-trihydroxy-8,3' - dimethoxyflavone, 7-O-α-L-rhamnopyranosyl, glycosides of quercetin, kaempferol, isoramnetin, 7-glucoside of 3'-methyl ester of gossipetin);
- alkaloids (acetamide, folifin, evoxin, haplotin, candecin, palmatin, magnophlarin, haplophin, buharaine, bucharidine, robustin, folimin, 4-methoxy-N-methylquinolone-2, robustinine, dictamnin, skimmianin, dubinin, dubamine, haplopherin, foliosin);
- terpenoids;
- steroids (sitosterol, stigmasterol, camperterol);
- essential oils;
- carboxylic acids;
- lignans (eudesmine, variantcoside, diphyllin, pluviatil, suicilactone, yusticidin B, daurinol);
- tannins;
- amides;
- carbohydrates (glucose, galactose, mannose, xylose, arabinose, rhamnose);

- saponins;
- higher aliphatic alcohols (n-triacontanol) and a number of other BAS (Biologically active substances) [4; 13].

Table 1 - the biologically active substances of plants of the genus Haplophyllum [5; 6].

Kind of plant	Dedicated connections		
	Coumarins	Flavonoids	Lignans
Haplophyllum Perforatum Kar et Kir	scopoletin, scopiolin, haploperoside A, haploperoside B, x haploperoside C, haploperoside D, haploperoside E	haplogenin, limocitrine, limocitrine-7-O-β-D- (6 "-O-acetyl) -glucopyranoside, haplozid A, haplozid B, haplozid C, haplozid D, haplozid E	eudesmine
Haplophyllum Obtusifolium Ledeb	scopoletin, 6-methoxy-7-γ, γ-di-methylal-liloxicumarin, obtusinol, obtusinin, otosozid, feruloylskopolin fraxetin, kapensin, obtusicin, obtusiprenin, otusiprenol, obtusidine, obtusipholine, fraxetine-7-O-glucoside		yusticidin B, diphyllin
Haplophyllum Davuricum (L.) G. Don	umbelliferon, scopoletin, 5,7-dihydroxyquarium, skimmin, daurozide A, daurozide B, daurozide D	haplogenin, haplozid B, haplozid D	yusticidin B, diphyllin daurinol
Haplophyllum Latifolium Kar et Kir	-	haplogenin, haplozid B, haplozid D	-
Haplophyllum Versicolor Fisch. Et Mey	-	-	variantcoside

From the data presented in Table 1, the common feature of all the species of studied for the content of coumarins is the presence of scopoetin, scopolin, haploperoside *Haplophyllum Perforatum Kar et Kir*, haploperoside B, haploperoside C, haploperoside D, haploperoside E. The content of flavonoids: haplogenin, limocitrine, limocitrine-7-O-β-D- (6 "-O-acetyl) -glucopyranoside, haplozid A, haplozid B, haplozid C, haplozid D, haplozid E. Content of lignans: eudemin.

Table 2 - the quantitative content of coumarins during flowering and fruiting [5; 7].

Coumarins	The yield of coumarins (in% of the weight of an air-dry plant)	
	Flowering period	Fruiting period
scopoletin,	-	trace amounts (<0,004%)
6-methoxy-7-γ, γ-dimethyl-lyloxycoumarin	0,023	trace amounts (<0,004%)
Obtusinol		
Obtusinin	trace amounts (<0,004%)	-
Obtusoside	0,08	0,19
Feruloylskopolin	0,054	0,27
Thraxetine	-	0,005
Capensin	0,018	0,14
Obtusicin	0,84	0,17
Obtusiprenin	0,025	0,26
Obtusiprenol	-	0,023
Obtusidine	-	0,025
Thraxetine-7-O-glucoside	-	0,013
	-	0,006

The data obtained by us and other researchers show that the qualitative and quantitative compositions of coumarins of the studied plant species vary greatly depending on the ecological-geographic, soil-

climatic conditions, as well as the vegetation period and the plant organ. The same species of this genus, growing in different geographical areas, may contain different in quality and quantity composition of coumarins.

As can be seen from the data presented in Table 2, the greatest amount of coumarins is extracted during the flowering period, rather than during the fruiting period, since during the fruiting period the yield of coumarins decreases.

In the flora of Kazakhstan, there are more than 70 species of plants, many species have plant medicinal plants and may be required for the pharmaceutical industry of the Republic. Therefore, the study of the chemical composition of pensions is not only scientific, but also practical [4; 12].

Various species of Haplophyllum (H.Dubium, H.Bucharicum, H.Bungei, H.Davuricum, H.Foliosum, H.Obtusifolium, H.Latifolium H.Perforatum and others) have long been used in folk medicine for the treatment of skin, as well as an antidote for poisoning, antipyretic, analgesic, laxative, for diseases of the stomach and spleen. Extracts of some species show antitumor and cytotoxic activity. Therefore, they attract the attention of researchers as potential sources of biologically active substances. The objects of our study are the species Haplophyllum Perforatum [4; 14].

In plant resources under the editorship of Sokolov P.D. information on the chemical composition and useful properties of this plant species is presented. Phenyl carboxylic acids and their derivatives: methyl ester of n-coumaric (n-hydroxycinnamic) acid. Lignans: (8R, 8'R 4, 4'-dimethylglylignolide-9.9 ".The plant roots contain alkaloids (in %) 0.047, skimianin 0.009, evoxin, haplopin. Containment in the aerial part of plants: steroids (in %) sitosterol 0.07; alkaloids (in %) 0.04-0.05; skimianin 0.14, haplatin 0.001, evoxin 0.04, haplopin 0.001, haplamide 0.003, haplamidine, glycopein, 7-isopentenyloxy-γ-pharagin. Phenyl carboxylic acids and their derivatives: methyl ester of n-hydroxycinnamic (n-coumaric) acid. In the stems of the plant contain: alkaloids 0.23%. In the leaves of the plant contain: alkaloids (in %) 0.04-0.6, skimianin 0.005-0.6, hapsolein 0.06, dubamine, haplatin.

Useful properties. The content of n-hydroxycinnamic acid methyl ester in the aerial part of plants shows estrogenic activity [5; 13].

And in plant resources under the editorship of Budantsev A.L. information on the chemical composition and useful properties of this plant species is also presented. The roots contain:

- terpenoids (fraksinellon);
- alkaloids (robustin, dictamnin, γ-pharagin, skimianin, evoxin, haplozidine 0.01%, haplosinin 0.003%);
- coumarins (seselin);
- flavonoids (haplogenin, limocitrin, haplozid C).

The leaves of the plant contain:

- flavonoids (7,3'-dimethyl ether of dihydroquercetin, 3,6-dimethyl ester of quercetin (axillarin), 3,5,7-trimethyl ester of kaempferol, 7-O-β-D-methyl glucuronide of 3'4'-dimethyl ester of lutheline , 7,3'-dimethyl ether and 3'-methyl esters of luteolin).

In the flowers and fruits are found essential oil in its composition includes monoterpenoids, hydrocarbons.

Water extract is used externally for dermatoses, eczema, varicose veins, alopecia, asthenia, anemia [6; 234,235].

Result and Discussion

The size of the medicinal plant material is determined by the method of sieve analysis.

The investigated plants were crushed to a particle size within 0.5mm in flowers (420.759), 1mm in stems (316.488), according to the regulatory documentation.

Good quality - compliance of medicinal raw materials, products, medicines with technical requirements of NTD.

All indicators of good-quality were determined by the methods of the GF RK, the European Pharmacopoeia and other literary sources.

Table 3 - Sieve analysis of H.Perforatum plant

Sifter №	Mass (*H.Perforatum*) = 600g		Mass (*H.Perforatum*) = 500g	
	H.Perforatum (flowers)		*H.Perforatum* (stems)	
	Mass, g	%	Mass, g	%
10	-	-	-	-
8	-	-	-	-
6	9,545	1,59	21,352	4,27
4	19,696	3,28	27,640	5,53
2	35,348	5,89	40,552	8,11
1	72,443	12,07	316,488	63,3
0,5	420,759	70,13	28,263	5,65
0,3	12,928	2,15	24,499	4,9
0,2	9,863	1,64	16,020	3,2
0,25	6,454	1,08	11,125	2,23
0,1	5,132	0,86	7,085	1,42
Remain	3,552	0,59	2,120	0,42
Losses	4,280	0,71	4,856	0,97

Table 4 - Numerical indicators of benignity of a plant of H. Perforatum species

Indicators of good quality	Plant H. Perforatum	
	Flowers	Stems
Humidity, %	5,74	5,83
Total ash, %	6,74	6,38
Sulphated ash, %	11,25	12,43
Ashes insoluble in 10% HCl	9,56	10,18
Containment of detective substances (70% alcohol)	44,06	32,59

As can be seen from the data presented in table 3, the moisture content in the stems (5.83%) is greater than for the flowers of the plant (5.74%). The total ash of the plant was 6.74%. The ash insoluble in 10% HCl was 9.56% in flowers, 10.18% in stems. And the distribution of extractive substances in the plant was H. Perforatum in flowers 44.06%, stems 32.59%.

The solvent, which should be taken when extractives are determined, is indicated in the relevant specification for this type of raw material. Usually, it is the same solvent that is used when preparing a tincture or extract from this raw material.

Extractive substances show the content of the likely active substances in the raw materials, which can later be processed. As can be seen from the data, the greatest amount of extractive substances is extracted by the flowers of this plant. The obtained data testify to the quality of the raw materials and the profitability of using the BAS complex. Figure 1 shows a benign chart of the distribution of H. Perforatum Kar.et Kir.

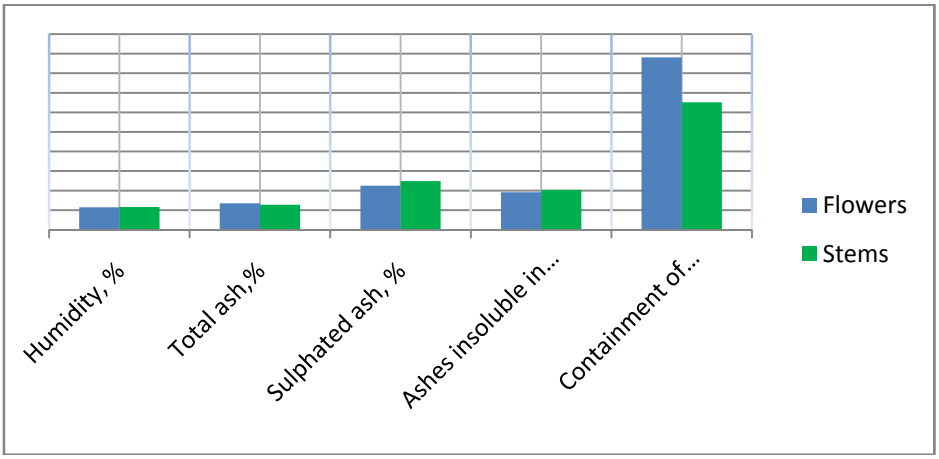

Figure 1 - Diagram of the assimilation of Haplophyllum Perforatum.

In the plant raw material, the ash of total, sulfate ash, ashes is insoluble in 10% HCl, which is the residue after treatment with the total HCl ash and consists mainly of silicates, which are a natural component for some objects, but more often the result of contamination of the raw materials with sand, earth and stones.

Mineral elements by their content in the plant are divided into macro elements, microelements and ultra microelements. Macroelements include Na, K, Ca, Mg, Cl, P; their content in the ashes is measured in hundredths of a percent. Microelements: Zn, Cu, Ni, Mn, Cu. Along with the "biometals" - elements that make up living organisms (for example, sodium, potassium, calcium, magnesium, iron, zinc), they can be referred to heavy metals - cadmium, lead, chrome, mercury and other d-elements, content which, according to the gradation of Vinogradova A.P., corresponds to the level of microelements in plants.

The study was carried out by the method of atomic absorption analysis on the basis of the Center for Physical and Chemical Methods of Research and Analysis (CPCMRA). The data are presented in table 5.

Table 5 - Macro- (K, Ca, Na, and Mg) content and microelements (Cu, Cd, Pb, Fe, Mn, Ni, Zn) in the plant H. Perforatum

Microelements	Flowers of a plant, %	The stems of the plant, %
Cd	$0{,}0227 \cdot 10^{-3}$	0
Pb	$0{,}1636 \cdot 10^{-3}$	$0{,}1487 \cdot 10^{-3}$
Fe	$5{,}2048 \cdot 10^{-3}$	$3{,}3864 \cdot 10^{-3}$
Mn	$0{,}6036 \cdot 10^{-3}$	$0{,}2767 \cdot 10^{-3}$
Ni	$0{,}2569 \cdot 10^{-3}$	$0{,}2301 \cdot 10^{-3}$
Zn	$2{,}7284 \cdot 10^{-3}$	$208{,}680 \cdot 10^{-3}$
Cu	$0{,}3671 \cdot 10^{-3}$	$0{,}3691 \cdot 10^{-3}$
Macroelements		
K	$473.370 \cdot 10^{-3}$	$432.30 \cdot 10^{-3}$
Ca	$395.880 \cdot 10^{-3}$	$157.890 \cdot 10^{-3}$
Na	$23.5525 \cdot 10^{-3}$	$28.2150 \cdot 10^{-3}$
Mg	$91.180 \cdot 10^{-3}$	$45.7025 \cdot 10^{-3}$

The largest number of macro and microelements is the flowers of the plant. In the stems and flowers of the plant, the dominant macro elements are K. In the flowers and stems of the plant, there is an increased content of macroelements like K, Ca. And the content of macroelements K, Ca, Na is explained by the fact that in saline conditions the Na +, K + concentration is increased, and they diffuse rapidly into the interior and easily saturate the cell sap.

A comparative phytochemical analysis for qualitative reactions and chromatographic analysis for the main classes of biologically active substances was carried out. The results are shown in Table 6.

Table 6 - Phytochemical analysis of the plant Haplophyllum A. Juss

BAS	*Developers*	Flowers	Stems
Carbohydrates	o-Toluidine	Light-brown envelope	Light-brown envelope
Tannins	JAK	Blue shading	Black-blue staining
Phenolic compounds	$FeCl_3$, 3%	Green	Dark green
Flavonoids	NH_3, 5%	bright yellow	yellow-green
	$AlCl_3$	pale yellow	bright yellow
	SiHNO	-	-
	$AgNO_3$, 1%	reddish-brown	reddish-brown
	NaOH, 5%	-	-
Carotenoids	$KMnO_4$ (Potassium permanganate)	decolorization	decolorization
	Phosphorus-molybdic acid	blue	green
Amino acids	$C_9H_6O_4$	pale purple	light purple
Carboxylic acids	(ninhydrin)	yellow-brown	brown
	CH_4N_2O (urea)	-	-
	$MgAc_2$	-	-

As can be seen from the data presented in table 6, in the accumulation of Haplophyllum A. Juss there are the main groups of biologically active substances. Carbohydrates, phenolic compounds, tannins, flavonoids, carotenoids, amino acids and carboxylic acids were found.

The method of the two-story paper chromatography in the use of reliable samples in flowers, and packages from flavonoids were occupied by quercetin and rutin; from the corners – cane sugar and glucose; from amino acids - as the so-called and all-alone α-amino acids.

An important parameter for obtaining the plant extract is the ratio of raw materials and solvent from 1:4 to 1:8. For 5 grams of raw material (flowers and stems of H. Perforatum Kar.et Kir) Pour in different volumes and different percentages of ethyl alcohol, when using a curing agent 1:6, and instill 24 hours without decontamination at a temperature of 24-25°C. These parameters are presented in table 7.

Table 7 - Determination of the optimum extragent for extraction

Mass of raw material, g *const*		5	5	5
*Solvents (*extragents*)*		30% ethanol	50% ethanol	70% ethanol
Extraction temperature, ˚C const		24-25°C	24-25°C	24-25°C
Weight of dry extract, g	Flowers	0,1253	0,1625	0,0941
	Stems	*0,3442*	*0,5661*	*0,3824*
Extraction amount, %	Flowers	2,51	3,25	1,88
	Stems	6,88	11,32	7,65

As a result of comparative studies it was found that the optimal extragent is 50 % ethyl alcohol for flowers, 70 % ethyl alcohol for stems. When the ratio of raw materials: extragent 1: 6, the amount of dry extract in flowers was 3.25 %, and in stems 7.65 %.

One of the important parameters in the technology of obtaining extracts is also the ratio of the selected extragent to the raw material. To determine the optimum volume, the ratio of raw materials and solvent is changed from 1:4 to 1:8, pouring on 5 g of vegetable raw materials 70 % and 50 % ethyl alcohol. At this time constant of extraction (24 hours) and temperature (24-25° C), the following results were obtained. This is presented in the form of a table 8.

Table 8 - Determination of the optimal ratio

Mass of raw material, g *const*		5	5	5
Ratio of raw materials (g) and extraction (ml)		1:4	1:6	1:8
Extraction temperature, ˚C const		24-25°C	24-25°C	24-25°C
Weight of dry extract, g	Flowers	0,291	0,1625	0,2462
	Stems	0,1001	1,234	*0,3824*
Extraction amount, %	Flowers	5,82	3,25	4,92
	Stems	2,002	24,68	7,65

The data presented on the table show that the ratio of 1:6 with the extragent chosen was optimal, in flowers the amount of extract was 3.25%, and in stems 7.65%.

Table 9 - Determination of the optimal time

Mass of raw material, g *const*		5	5	5
Extraction time		12	24	48
Extraction temperature, ˚C const		24-25°C	24-25°C	24-25°C
Weight of dry extract, g	Flowers	1,618	0,1625	1,1125
	Stems	0,9864	1,8515	*0,3824*
Extraction amount, %	Flowers	32,36	3,25	22,25
	Stems	19,73	37,03	7,65

As a result, it was found that the optimal time was 24 hours with the extragent selected, the mass of the dry extract was 0.11625g in flowers and 0.3824g in stems.

The carried out researches allowed to determine the optimum values of the parameters influencing the extraction of biologically active substances from the plant H. Perforatum Kar.et Kir. stirpes Rutaceae.

Conclusions

Based on the results of the study, the following conclusions can be drawn:

The numerical parameters of the raw materials are determined: sieve analysis, moisture content, total ash, fly ash soluble in 10 % HCl, sulfate ash, extractives regulating the quality of raw materials complies with the norms of the State Pharmacopoeia of the Republic of Kazakhstan.

Methods of spectral analysis established for the plant H. Perforatum 4 macro- and 7 microelements. Qualitative methods of analysis include carbohydrates, tannins, flavonoids, phenolic compounds, carotenoids, amino acids and carboxylic acids.

The technology of extraction of the extract from the studied type of raw material, its ratio, temperature and time is worked out. The following parameters were chosen as the optimal condition: extragent 50 % ethyl alcohol in flowers, 70 % ethyl alcohol in stems, extraction ratio 1:6, extraction time 24 hours, temperature 24-25°C.

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А.Ж. Қалдыбекова, А.Т. Амангазиева,
З.Б. Халменова, А.К. Үмбетова

Әл-Фараби атындағы Қазақ Ұлттық Университеті, Алматы, Қазақстан

HAPLOPHYLLUM A. JUSS ШӨБІНЕН БИОЛОГИЯЛЫҚ БЕЛСЕНДІ ЗАТТАРДЫҢ КЕШЕНДІ БӨЛІНУ ТЕХНОЛОГИЯСЫН ДАМЫТУ

Аннотация. Бұл зерттеуде Rutaceae тұқымдасына жататын *Haplophyllum A.Juss* өсімдігінің *H.Perforatum Kar et Kir* түріне комлексті зерттеу жүргізілді. Шикізат сапалылығының маңызды параметрлері қаралды. Олар: шикізат дайындау (майдалау, електен өткізу зерттеуі); ылғалдылық, жалпы күлділік, 10 % HCl-да ерімейтін күлділік, сульфатты күлділік, зерттелініп отырған өсімдік түрлерінен экстрагенттің табиғатын, оның шикізатпен қатынасын, экстрактілеу уақыты мен жиілігін өзгерте отырып, биологиялық белсенді кешенді алу технологиясы өңделді.

Жалпы күлділіліктің макро- және микроэлементтік құрамы зерттелді. Сапалық реакция және хроматографиялық талдау әдісімен шикізаттағы табиғат қосылыстарының маңызды класстары жіктелді және олардың сапалық құрамы анықтады.

Түйін сөздер: Rutaceae, Haplophyllum, ылғалдылық, күлділік, кумариндер, Perforatum, флаваноидтар, терпеноидтар.

А.Ж. Калдыбекова, А.Т.Амангазиева, З.Б. Халменова, А.К. Умбетова

Казахского Национального Университета имени аль-Фараби, Алматы, Казакстан

РАЗРАБОТКА ТЕХНОЛОГИИ КОМПЛЕКСНОГО ВЫДЕЛЕНИЯ БИОЛОГИЧЕСКИХ АКТИВНЫХ ВЕЩЕСТВ ИЗ РАСТЕНИЙ РОДА HAPLOPHYLLUM A. JUSS

Аннотация. В данном исследовании проведено комплексное исследование растения рода *Haplophyllum A.Juss вида H. Perforatum Kar et Kir.* Рассмотрены основные параметры качества сырья: подготовка сырья (измельчение, ситовой анализ); влажность, общая зола, зола не растворимая в 10 % HCl, сульфатная зола, экстрактивные вещества.

Проанализирован макро- и микроэлементный состав общей золы. Качественными реакциями и хроматографическими методами анализа идентифицированы основные классы природных соединений в сырье и определено их количественные содержание. В сырье определены основные технологические параметры получение экстракта.

Ключевые слова: Rutaceae, *Haplophyllum*, *влажность, зольность, кумарины, Perforatum, флаваноиды, терпеноиды.*

Information about authors:

Kaldybekova Araylym Zhunibekyzy - Second year master of the Kazakh National University named after al-Farabi faculty of "Chemistry and Chemical Technology";

Khalmenova Zaure Beisentaevna - Ph.D. Associate Professor of Organic Chemistry and Technology of Organic Substances of the Chemistry of Natural Compounds and Polymers;

Umbetova Almagul Kendebaevna - Ph.D. Associate Professor of Organic Chemistry and Technology of Organic Substances of the Chemistry of Natural Compounds and Polymers;

Amangazieva Asem Talgatovna - A fourthyear student of the Kazakh National University named after al-Farabi faculty of "Chemistry and Chemical Technology".

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