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DETERMINATION OF THE CHEMICAL COMPOSITION OF COUSINIA MINDSCHELKENSIS B. FEDTSCH. BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY METHOD

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Abstract: *Introduction*. Vegetation is important component and factor of the redistribution of chemical elements in the landscape. One or another type of vegetation determines the amount and nature of soil organic matter, often affects the degree of development of browning processes, affects the chemical composition of the air, is an environmental indicator. The study and isolation of physiologically active compounds from plant raw materials and the determination of the place of their demand is the most important urgent task. *Cousinia mindschelkensis* B. Fedtsch. It is a rare species from the *Asteraceae*. *Methods.* In the Research Center of Medicinal Plants of the Al-Farabi KazNU, analyses were carried out for the determination of organic compounds by gas chromatography with mass spectrometric detection and analyses of 70% of alcohol extracts of the aboveground and underground parts species by the method of high-performance liquid chromatography on a liquid chromatograph. *Results.* Some of the components identified by GC-MS are biologically active compounds. The GC-MS method revealed the presence of 55 phytochemical compounds in the aboveground and 38 in the underground part of plants that can contribute to the medicinal properties of this species. *Conclusion.* Compounds have some important biological potential for future drug development. Of the aboveground part of the plant includes bicyclo[2.2.1]heptan-2-one, 1.7.7-trimethyl-, (1S)- (9.50%), hexadecanoic acid (8.05%), cis-Vaccenic acid (7.66%), 9.12-Octadecadienoic acid (Z,Z)- (7.40%), hanphyllin (7.01%), 5.8-Dihydroxy-4a-methyl-4,4a,4b,5,6,7,8,8 a,9,10-decahydro-2(3H)-phenanthrenone (6.51%), dibutyl phthalate (5.64%), while the underground part of the plant has a spike of components such as octacosane (26.84%), β-amyrin (22.35%), β-sitosterol (12.63%), 9.12-Octadecadienoic acid (Z,Z)- (8.43%).9,12-Octadecadienoic acid (Z,Z)- it is present both in the aboveground (7.40%) and in the underground part of the plant (8.43%).

Key words: Qualitative composition, *Cousinia mindschelkensis*, GC-MS, extract, endemic species, aboveground part, underground part, alcohol extracts, vegetation, chemical elements

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1.Introduction.

The Syrdarya Karatau ridge is one of the most interesting and peculiar regions of Kazakhstan. All scientific researchers who visited the Karatau mountains noted the uniqueness of its vegetation cover in comparison with other ridges of the Tien Shan and made suggestions about the need to create a strictly protected area here [1].

There is an abundance of endemic and rare plant species and Karatau ranks first among the floristic regions of the republic in terms of the number of endemic species. Despite the small area of the region and the altitude above sea level, at least 1,500 species of higher vascular plants and more than 150 species of endemic and rare species grow here[2].

Wild plants have been used for the treatment of various diseases since the dawn of mankind. Among them were plants of the Compositae family, namely the genera elecampane, cornflower, burdock and topinambur [3,4].

Among the plant groups characteristic of the flora of the studied region are the rare, endemic species *Cousinia mindschelkensis* B. Fedtsch.

The novelty of the work, based on the results of the work carried out, the chemical composition of the species *Cousinia mindschelkensis* was studied for the first time by gas chromatography with mass spectrometric detection.

2. Experimental part

The aboveground and underground part of *Cousinia mindschelkensis* was collected in the Turkestan region, in the Sozak district, in the Syrdarya Karatau in the gorges of Kishikarakuys, Karaungir, Itmuryn and identified by the doctoral student Kenesbai Akerke. In the Research Center of Medicinal Plants of the non-commercial joint-stock company «Al-Farabi Kazakh National University», analyses were carried out for the determination of organic compounds by gas chromatography with mass spectrometric detection and analyses of 70% of alcohol extracts of the aboveground and underground parts of *Cousinia mindschelkensis* by high-performance liquid chromatography (HPLC) on a liquid chromatograph (Shimadzu LC-40) [5].

The extract was analyzed by gas chromatography with mass spectrometric detection (7890A/5975C). The sample volume is 0.5 μl, the sample input temperature is 280 °C, the flow division is 1:10. Separation was carried out using a chromatographic capillary column SLB-5MS with a length of 30 m, an inner diameter of 0.25 mm and a film thickness of 0.25 microns at a constant carrier gas velocity (helium) of 1 ml/min. The chromatography temperature is programmed from 40 ° C (5 min exposure time) with a heating speed of 10 °C/min to 280 °C (15 min exposure time). Detection is carried out in SCAN mode m/z 34-850. Agilent MSD ChemStation software (version 1701EA) was used to control the gas chromatography system, record and process the results and data obtained. Data processing included determination of retention times, peak areas, as well as processing of spectral information obtained using a mass spectrometric detector. To decipher the obtained mass spectra, the Wiley 7th edition and NIST'02

libraries were used (the total number of spectra in the libraries is more than 550 thousand).

3.Results and discussion.

The method of gas chromatography with mass spectrometric (GC-MS) detection investigated the component composition of extracts of aboveground and underground parts of plant raw materials *Cousinia mindschelkensis*. The GC-MS chromatogram recorded 55 peaks in the aboveground and 38 in the underground part. Data processing included determination of retention times, peak areas, as well as processing of spectral information obtained using a mass spectrometric detector. The results are presented below (Table 1).

Table 1 - Results of chromatographic analysis of petroleum-ether extract of the aboveground part of *Cousinia mindschelkensis*

Holding time, min	Connectios	Probability of identification, %	%
13.09	Hexanoic acid, ethyl ester	79	0.76
13.26	Ethylene glycol diglycidyl ether	67	0.21
13.51	Decane, 4-methyl	85	0.20
13.87	Eucalyptol	91	2.17
14.12	Dodecane, 2.6.10-trimethyl-	80	0.51
14.29	1.5-Dimethyl-1-vinyl-4-hexenyl butyrate	62	0.33
14.92	Dodecane	78	0.31
15.00	Nonanal	83	0.80
15.20	Bicyclo[3.1.0]hexan-3-one, 4-methyl-1-(1-methylethyl)	90	0.74
15.39	Thujone	84	0.45
15.98	Bicyclo[2.2.1]heptan-2-one, 1.7.7-trimethyl-, (1S)-	94	9.50
16.37	Bicyclo[2.2.1]heptan-2-ol, 1.7.7-trimethyl-, (1S-endo)	90	1.19
16.46	Octanoic acid, ethyl ester	63	0.70
16.55	Dodecane	85	0.93
17.45	Nonanoic acid	83	1.00
17.62	2-Cyclohexen-1-one, 3-methyl-6-(1-methylethyl)-	72	0.39
17.71	Dodecane, 2.6.11-trimethyl	76	0.36
17.95	Nonanoic acid, ethyl ester	74	0.43
18.07	Tridecane	73	0.42
18.87	Decanoic acid	75	0.68
18.98	Eugenol	77	0.48
19.06	2(3H)-Furanone, dihydro-5-propyl	65	0.37

19.36	1-Tetradecanol	68	0.30
19.47	Tetradecane	90	1.95
20.55	1.3-Dioxane-4-methanol, 4.5-dimethyl	68	0.82
20.97	Phenol, 2.4-bis(1.1-dimethylethyl	80	0.57
21.08	6.8-Dioxapentadecane	65	0.67
21.49	Dodecanoic acid	74	0.70
22.03	Phthalic acid, ethyl pentadecyl ester	64	1.61
22.75	Cyclopentaneacetic acid, 3-oxo-2-pentyl-, methyl ester	75	0.68
23.22	2-Pentadecanone	65	0.90
23.86	Tetradecanoic acid	82	1.15
24.23	Tetradecanoic acid, ethyl ester	68	0.85
24.33	Octadecane	82	0.92
24.56	Isopropyl myristate	71	0.77
25.10	Phthalic acid, hept-4-yl isobutyl ester	81	1.89
26.00	Hexadecanoic acid	86	8.05
26.09	Dibutyl phthalate	92	5.64
26.32	Hexadecanoic acid, ethyl ester	77	1.90
26.40	Eicosane	71	0.82
26.81	5.8-Dihydroxy-4a-methyl-4.4a,4b,5,6,7,8,8a,9,10-decahydro-2(3H)-phenanthrenone	72	6.51
27.27	Acetic acid, chloro-, hexadecyl ester	73	0.95
27.72	9.12-Octadecadienoic acid (Z,Z)	79	7.40
27.76	cis-Vaccenic acid	80	7.66
27.94	Hanphyllin	70	7.01
28.01	Ethyl Oleate	65	1.85
28.51	Shyobunone	63	1.58
28.57	Octadecanal	73	1.47
28.66	Tributyl acetylcitrate	74	1.14
29.16	Heptadecane, 9-hexyl	67	0.76
29.78	Oleic Acid	65	1.59
30.49	Hexadecanal	77	1.50
31.75	Diisooctyl phthalate	68	1.09
32.37	Octadecanoic acid, 17-methyl-, methyl ester	75	3.02
33.04	Octadecanal	78	3.29

Table 2 - Results of chromatographic analysis of petroleum - ether extract of the underground part of *Cousinia mindschelkensis*

Holding time, min	Connections	Probability ofidentification, %	
12.50	Heptanoic acid	73	0.17
13.09	Decane	85	0.22
13.34	Decane, 5-methyl	68	0.10
13.51	Decane, 4-methyl	83	0.14
13.87	Eucalyptol	92	0.73
14.12	Undecane	83	0.53
15.00	Nonanal	79	0.20
15.20	Thujone	87	0.31
15.39	Bicyclo[3.1.0]hexan-3-one, 4-methyl-1-(1-methylethyl)-, [1S-(1α,4β,5α)]	88	0.17
15.98	Camphor	94	4.79
16.38	endo-Borneol	88	0.42
16.55	Dodecane	87	0.59
16.67	L-α-Terpineol	81	0.32
17.44	Nonanoic acid	76	0.31
19.47	Tetradecane	90	0.68
20.97	Phenol, 2.4-bis(1,1-dimethylethyl)	84	0.34
22.03	Hexadecane	66	0.93
23.86	Tetradecanoic acid	74	0.59
24.33	Octadecane	81	0.46
24.56	Isopropyl myristate	76	0.50
24,81	2-Pentadecanone, 6.10.14-trimethyl	80	0.79
25.10	Phthalic acid, hept-4-yl isobutyl ester	83	0.46
26.00	Hexadecanoic acid	84	3.57
26.09	Dibutyl phthalate	80	2.54
26.32	Hexadecanoic acid, ethyl ester	72	0.49
26.40	Heneicosane	71	0.46
27.57	2(3H)-Furanone, 5-dodecyldihydro-	71	0.47
27.72	9.12-Octadecadienoic acid (Z,Z)	82	8.43
27.95	Octadecanoic acid	60	2.11
28.28	Eicosane	82	0.63
28.66	Tributyl acetylcitrate	81	0.68
29.78	4.8.12.16-Tetramethylheptadecan-4-olide	63	0,81
30.11	Hexacosane	70	0.66

33.04	Octadecanal	72	0.58
35.24	Stigmasterol	65	2.98
38.16	Octacosane	90	26.84
38.84	β-Sitosterol	77	12.63
41.72	β-Amyrin	87	22.35

In this work, extracts of the aboveground and underground parts of the *Cousinia mindschelkensis* plant were studied by gas chromatography with mass spectrometric detection (GC-MS), one of the most widely used methods for separating phytocomponents. GC-MS study of extracts revealed the presence of 55 phytochemical compounds in the aboveground (Table 1) and 38 in the underground part of the *Cousinia mindschelkensis* plant (Table 2), which may contribute to the medicinal properties of this plant species. The identified basic compounds have some important biological potential for future drug development. The main composition in the aboveground part of the plant *Cousinia mindschelkensis* includes bicyclo[2.2.1]heptan-2-one, 1.7.7-trimethyl-, (1S)- (9.50%), hexadecanoic acid (8.05%), cis-Vaccenic acid (7.66%), 9.12-Octadecadienoic acid (Z,Z)- (7.40%), hanphyllin (7.01%), 5.8-Dihydroxy-4a-methyl-4,4a,4b,5,6,7,8,8 a,9,10-decahydro-2(3H)-phenanthrenone (6.51%), dibutyl phthalate (5.64%), while the underground part of the plant has a spike of components such as octacosane (26.84%), β-amyrin (22.35%), β-sitosterol (12.63%), 9.12-Octadecadienoic acid (Z,Z)- (8.43%). 9.12-Octadecadienoic acid (Z,Z)- is present both in the aboveground (7.40%) and in the underground part of the plant (8.43%), but in different amounts. With the exception of the mentioned component, the main composition of the aboveground and underground parts of the plant are different.

Based on studies, some of the components identified by GC-MS are biologically active compounds. Hexadecanoic acid has some biological activities, such as antioxidant, hypocholesterolemic, nematocidal and pesticide. It is reported that (Z,Z)-9.12-Octadecadienoic acid (9.12-Octadecadienoic acid (Z,Z)-) has an inhibitory effect on some bacterial species [6]. Cis-Vaccenic acid is an omega-7 fatty acid known for its antibacterial activity and hypolipidemic effect in rats [7]. Sesquiterpene hanphyllin (hanphyllin) has shown selective activity to reduce cholesterol levels [8]. It is known that octacosane has antimicrobial, antioxidant and anti-inflammatory effects [9]. In many in vitro and in vivo studies, it has been proven that β-Sitosterol (β-Sitosterol) has various biological properties, such as anxiolytic and sedative effects, analgesic, immunomodulatory, antimicrobial, antitumor, anti-inflammatory, hypolipidemic effects, hepatoprotective, protective action against NAFLD and respiratory diseases, wound healing effect, antioxidant and antidiabetic activity[10]. α, β-amyrins have been shown to exhibit different pharmacological activity *in vitro* and *in vivo* against various health-related conditions, including conditions such as inflammation, microbial, fungal and viral infections, and cancer cells. Beta-

amyrin has been found to exhibit antifungal and antimicrobial activity against certain microbes. When studying the leaves of *Siraitia grosvenorii*, β-amyrin and other biologically active compounds were obtained, and their activity against the growth of oral bacteria of the species *Streptococcus mutans, Actinobacillus actinomycetemcomitans* and *Fusobacterium nucleatum* and yeast *C. albicans* was evaluated *in vitro*. β-amyrin showed only slight inhibition of *Streptococcus mutans* and *Fusobacterium nucleatum* [11]. Dibutyl phthalate is one of the most widely produced and used plasticizers, and it is added to plastic to make it more flexible and malleable. DBP has been found to be an environmental pollutant and is considered an endocrine disruptor. Therefore, it is crucial to develop environmentally friendly alternatives to eliminate phthalate contamination. This compound is claimed to have antibacterial and anti-tumor properties.

4. Conclusion.

Thus, the study of extracts revealed the presence of 55 phytochemical compounds in the aboveground (Table 1, Fig. 1) and 38 in the underground part of the *Cousinia mindschelkensis* plant (Table 2, Fig. 2), which may contribute to the medicinal properties of this plant species. The identified basic compounds have some important biological potential for future drug development. Based on studies, some of the components identified by GC-MS are biologically active compounds. Hexadecanoic acid (hexadecanoic acid) has some biological activities, such as antioxidant, hypocholesterolemic, nematocidal and pesticide. It is reported that (Z,Z)-9.12-Octadecadienoic acid (9.12-Octadecadienoic acid (Z,Z)-) has an inhibitory effect on some bacterial species.

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Conflict of interest: The authors declare that there is no financial or personal conflict of interest that could affect the work presented in the article.

ГАЗ ХРОМАТОГРАФИЯ – МАСС СПЕКТРОМЕТРИЯ ӘДІСІМЕН COUSINIA MINDSCHELKENSIS B. FEDTSCH. ТҮРІНІҢ ХИМИЯЛЫҚ ҚҰРАМЫН АНЫҚТАУ

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Түйіндеме. *Kipicne.* Өсімдіктер ландшафттағы химиялық элементтерді қайта бөлудің маңызды құрамдас бөлігі және факторы болып табылады. Өсімдіктердің бір немесе басқа түрі топырақтың органикалық заттарының мөлшері мен сипатын анықтайды, көбінесе бурозем түзілу процестерінің даму дәрежесіне әсер етеді, ауаның химиялық құрамына әсер етеді және экологиялық көрсеткіш болып табылады. Қазіргі уақытта өсімдік шикізатынан физиологиялық белсенді қосылыстарды зерттеу және оқшаулау және олардың сұраныс орнын анықтау ең маңызды өзекті міндет болып табылады. *Cousinia mindschelkensis* B. Fedtsch. бұл күрделігүлділер тұқымдасына жататын, тасты –

қиыршықты беткейлерде өсетін сирек кездесетін, эндемдік түр. *Әдістер.* Әл-Фараби атындағы Қазақ ұлттық университеті дәрілік өсімдіктердің ғылыми-зерттеу орталығында масс-спектрометриялық детекторлеумен газ хроматографиясы әдісімен органикалық қосылыстарды анықтауға талдау және *Cousinia mindschelkensis* B. Fedtsch түріне жер үсті және жерасты бөлігінің 70% спирттік сығындыларына талдау жүргізілді. *Нәтижелер және талқылау.* Зерттеулер негізінде GC-MS әдісімен анықталған кейбір компоненттер биологиялық белсенді қосылыстар болып табылады. GC - MS сығындыларды зерттеу жер бетінде 55 фитохимиялық қосылыстардың және жер асты бөлігінде 38-нің болуын анықтады *Cousinia mindschelkensis* бұл өсімдік түрінің емдік қасиеттеріне ықпал етуі мүмкін. *Тұжырым.* Алынған негізгі қосылыстар болашақта дәрі – дәрмек шығару үшін маңызды биологиялық әлеуетке ие. Өсімдіктің негізгі жер асты бөлігіне bicyclo[2.2.1]heptan-2-one, 1.7.7-trimethyl, (1S)- (9.50%), hexadecanoic acid (8.05%), cis-Vaccenic acid (7.66%), 9.12-Octadecadienoic acid (Z,Z)- (7.40%), hanphyllin (7.01%), 5.8-Dihydroxy-4a-methyl-4,4a,4b,5,6,7,8,8a,9,10-decahydro-2(3H)-phenanthrenone (6.51%), dibutyl phthalate (5.64%) кіреді, сондай – ақ өсімдіктің жер үсті бөлігі octacosane (26.84%), β-amyrin (22.35%), β-sitosterol (12.63%), 9.12-Octadecadienoic acid (Z,Z)- (8.43%). 9.12-Octadecadienoic acid (Z,Z) сияқты компоненттерге ие. Зерттеулер негізінде GC-MS әдісімен анықталған кейбір компоненттер биологиялық белсенді қосылыстар болып табылады. Гексадекан қышқылы (hexadecanoic acid) антиоксидант сияқты кейбір биологиялық белсенділікке ие, гипохолестеринемиялық, нематицидтік және пестицидтік.1 (Z,Z)-9.12 - октадекадиен қышқылы (9.12-Octadecadienoic acid (Z,Z)-) бактериялардың кейбір түрлеріне тежегіш әсер етеді.

Түйінді сөздер: сапалы құрам, *cousinia mindschelkensis*, HC-MS, сығынды, эндемдік түр, жер асты бөлігі, жер үсті бөлігі, алкоголь сығындылары, өсімдіктер, химиялық элементтер

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ОПРЕДЕЛЕНИЕ ХИМИЧЕСКОГО СОСТАВА *COUSINIA MINDSCHELKENSIS* B. FEDTSCH. МЕТОДОМ ГАЗОВОЙ ХРОМАТОГРАФИИ – МАСС СПЕКТРОМЕТРИИ

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Аннотация. *Введение.* Растительность является достаточно важным компонентом и фактором перераспределения химических элементов в ландшафте. Тот или иной тип растительности определяет количество и характер органического вещества почв, часто оказывает влияние на степень развития буроземообразовательных процессов, влияет на химический состав воздуха, является экологическим индикатором. В настоящее время изучение и выделение физиологически активных соединений из растительного сырья и определение места их востребования является наиболее важной актуальной задачей. *Cousinia mindschelkensis* B. Fedtsch. является редким, эндемичным видом из семейства *Asteraceae* произрастающее на каменисто – щебнистых склонах и площадках. *Методы.* В Научно-исследовательском центре лекарственных растений НАО «Казахский национальный университет имени аль-Фараби» были проведены анализы на определение органических соединений методом газовой хроматографии с масс-спектрометрическим детектированием и анализы 70% спиртовых экстрактов надземной и подземной части *Cousinia mindschelkensis* B. Fedtsch. методом высокоэффективной жидкостной хроматографии (ВЭЖХ) на жидкостном хроматографе. *Результаты и обсуждение*. На основании исследований некоторые из компонентов, выявленных методом ГХ-МС, являются биологически

активными соединениями. ГХ-МС исследование экстрактов выявило присутствие 55 фитохимических соединений в надземной и 38 в подземной части *Cousinia mindschelkensis* которые могут способствовать лечебным свойствам этого вида растений. *Заключение*: Выявленные основные соединения обладают некоторым важным биологическим потенциалом для будущей разработки лекарств. В основной состав в надземную часть растения входит bicyclo[2.2.1]heptan-2-one, 1.7.7-trimethyl-, (1S)- (9.50%), hexadecanoic acid (8.05%), cis-Vaccenic acid (7.66%), 9.12-Octadecadienoic acid (Z,Z)- (7.40%), hanphyllin (7.01%), 5.8-Dihydroxy-4a-methyl-4,4a,4b,5,6,7,8,8a,9,10-decahydro-2(3H)-phenanthrenone (6.51%), dibutyl phthalate (5.64%), в то время как подземная часть растения обладает спсиком компонентов такие, как octacosane (26.84%), β-amyrin (22.35%), β-sitosterol (12.63%), 9.12-Octadecadienoic acid (Z,Z)- (8.43%). 9.12-Octadecadienoic acid (Z,Z)- присутствует как в надземной (7.40%), так и в подземной части растения (8.43%), но в разных количествах.

Ключевые слова: Качественный состав, *Cousinia mindschelkensis*, ГХ-МС, экстракт, эндемичный вид, надземная часть, подземная часть, спиртовые экстракты, растительность, химические элементы

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