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АКАДЕМИИ НАУК РЕСПУБЛИКИ КАЗАХСТАН»**

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GC-MS STUDY OF ORGANIC AND MINERAL COMPONENTS IN *ARTEMISIA* SPECIES FROM KAZAKHSTAN

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Abstract. The article represent the comparable results of qualitative and quantitative analysis together with mineral composition and GC-MS based examination of liposoluble constituents of two Artemisia species: Artemisia albida and Artemisia diffusa. The genus Artemisia, one of the largest within the Asteraceae family, represents a promising source of bioactive compounds, particularly sesquiterpenoids, such as guaiac, germacran, and eudesman types. These compounds have demonstrated a range of pharmacological activities, including antimalarial, antidiabetic, antitumor, antimicrobial, anti-inflammatory, and immunomodulatory properties. In this regard, the purpose of the paper is to conduct in depth research of the phytochemical content of insufficient studied Artemisia species growing in the Republic of Kazakhstan. The results of investigation have shown the maximum content of extractive substances (20.76%), polysaccharides (2.14%), and tannins (1.52%) in the plant A. albida. The content of organic acid (1.45%), flavonoids (0.06%), alkaloids (0.60%) and coumarins

(1.60%) can be noticed in higher concentration in the plant *A. diffusa*The species *A. diffusa* showed intriguing results of elements daily needed by the human, including – K (39.19 mg/g), Ca (11.15 mg/g), Fe (0.181 mg/g) and Zn (0.043 mg/g). The liposoluble constituents in petroleum ether extract of investigated medicinal plants have been identified by GC-MS method. The results of analyses indicated that the studied plants contain a significant amount of bioactive substances, which could potentially expand the range of effective domestic phytopreparations from the Kazakhstan in the future.

Keywords: *Artemisia albida* ; *Artemisia diffusa* ;phytochemical components; macro-microelements; petroleum ether extract; liposoluble constituents, GC–MS.

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ҚАЗАҚСТАНДАҒЫ *ARTEMISIA* ТҮРЛЕРІНІҢ ОРГАНИКАЛЫҚ ЖӘНЕ МИНЕРАЛДЫ ҚҰРАМЫН ГХ-МС АРҚЫЛЫ ЗЕРТТЕУ

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Аннотация. Мақалада *Artemisia* өсімдігінің екі түрінің: *Artemisia albida* және *Artemisia diffusa* майда еритін құрамдас бөліктерінің минералды құрамы мен ГХ-МС негізіндегі зерттеуімен бірге сапалық және сандық талдаудың салыстырмалы нәтижелері ұсынылды. *Artemisia* тұқымдасы, Asteraceae тұқымдасының ең үлкендерінің бірі, биоактивті қосылыстардың, әсіресе гуаяк, гермакран және эвдесман сияқты сесквитерпеноидтардың перспективалы көзі болып табылады. Бұл қосылыстар безгекке, диабетке, ісікке, микробқа, қабынуға қарсы және иммуномодуляциялық қасиеттер сияқты бірқатар фармакологиялық белсенділік көрсетеді. Осыған байланысты *жұмыстың мақсаты* Қазақстан Республикасында өсетін *Artemisia* өсімдігінің жеткіліксіз зерттелген түрлерінің фитохимиялық құрамын терең зерттеу. Зерттеу нәтижелері бойынша, *A. albida* өсімдігі экстрактивті заттардың (20,76%), полисахаридтердің (2,14%) және таниндердің (1,52%) максималды мөлшерін көрсетті. Органикалық қышқылдың (1,45%), флавоноидтардың (0,06%), алкалоидтардың (0,60%) және кумариндердің (1,60%) концентрациясы *A. diffusa* өсімдігінде жоғары концентрацияда байқауға болады. *A. diffusa* түрі адамға күнделікті қажет элементтердің жоғары нәтижелерін көрсетті, соның ішінде – K (39,19 мг/г), Ca (11,15 мг/г), Fe (0,181 мг/г) және Zn (0,043 мг/г). Зерттелетін дәрілік өсімдіктердің мұнай эфирінің сығындысындағы майда еритін компоненттері ГХ-МС әдісімен анықталды. Талдау нәтижелері зерттелетін өсімдіктерде биоактивті заттардың едәуір мөлшері бар екенін көрсетті, бұл болашақта Қазақстанда тиімді отандық фитопрепараттардың ассортиментін кеңейтуге ықпалын тигізеді.

Түйін сөздер: *Artemisia albida*; *Artemisia diffusa*; фитохимиялық компоненттер; макро-микроэлементтер; мұнай эфирлі сығынды; майда еритін компоненттер, ГХ-МС.

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ИССЛЕДОВАНИЕ ОРГАНИЧЕСКИХ И МИНЕРАЛЬНЫХ КОМПОНЕНТОВ ВИДОВ *ARTEMISIA* ИЗ КАЗАХСТАНА МЕТОДОМ ГХ-МС

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Аннотация. В статье представлены сопоставимые результаты качественного и количественного анализа, а также минерального состава и исследования на основе ГХ-МС жирорастворимых компонентов двух видов *Artemisia*: *Artemisia albida* и *Artemisia diffusa*. Род *Artemisia*, один из крупнейших в семействе астровых, представляет собой многообещающий источник биологически активных соединений, в частности сесквитерпеноидов, таких как гваяковый, гермакран и эвдесман. Эти соединения продемонстрировали целый ряд фармакологических свойств, включая противомалярийные, противодиабетические, противоопухолевые, противомикробные, противовоспалительные и иммуномодулирующие свойства. В связи с этим целью данной работы является проведение углубленного исследования фитохимического состава недостаточно изученных видов *Artemisia*, произрастающих в Республике Казахстан. Результаты исследований показали максимальное содержание экстрактивных веществ (20,76%), полисахаридов (2,14%) и дубильных веществ (1,52%) в растении *A. albida*. А в виде *A. diffusa* можно заметить более высокое содержание органических кислот (1,45%), флавоноидов (0,06%), алкалоидов (0,60%) и кумаринов (1,60%). Вид *A. diffusa* показал впечатляющие результаты по содержанию элементов, необходимых человеку ежедневно, включая – K (39,19 мг/г), Ca (11,15 мг/г), Fe (0,181 мг/г) и Zn (0,043 мг/г). Методом ГХ-МС определены жирорастворимые компоненты в петролейном эфирном экстракте исследуемых лекарственных растений. Результаты анализов показали, что исследуемые растения содержат значительное количество биологически активных веществ, которые потенциально могут расширить ассортимент эффективных отечественных фитопрепаратов из Казахстана в будущем.

Ключевые слова: *Artemisia albida*, *Artemisia diffusa*, фитохимические компоненты, макро-микроэлементы, петролейно-эфирный экстракт, жирорастворимые компоненты, ГХ–МС.

Introduction. *Artemisia* L. includes more than 500 species belonging to the Asteraceae family, which is one of the widely distributed herbal plants all over the world. The *Artemisia* L. species are found across of different temperature regions of Asia, Africa, Australia, and North America (Pavlov, 1961). Most species have been identified in Central Asia. For instance, there are 186 species in China, among which 82 are endemic. There are more than 80 species in Russian Federation’s flora, 54 species distributed in Kyrgyzstan (1 endemic), 47 species of *Artemisia* are in Uzbekistan and 33 species with only one endemic grows in Turkmenistan. Comparing with Central Asian countries, *Artemisia* species have wide range in Kazakhstan: 81 species are registered and 19 of them are endemic (Nurlybekova, et al, 2022). Phytochemical investigations have shown that the *Artemisia* L. species from Kazakhstan contain various chemical substances such as sesquiterpene lactone, lignans, flavonoids, coumarins, polysaccharides, alkaloids, extractive substances that show variety of health benefits (Adekenov, 2016).

Artemisia albida Willd (*A. albida*) is a semi-white medicinal plant, which is occupied in Altai, Tarbagatai, Zaysan and Akmola regions of East Kazakhstan (Pavlov, 1961). Firsty, Adekenov S.M and Suleimenov E.M. studied *A. albida* Willd, from 2005 to 2008. As a result of the study, sesquiterpene lactones such as austricin, matricarin, canin and agrolide were obtained (Suleimenov, et al, 2005). In addition to this, anhydroaustricin was isolated from *A. albida* (Suleimenov, et al, 2008). These constituents possess pharmacological activities like angioprotector and antilipidemic, low activity against malaria (Plutno, et al, 1995).

Artemisia diffusa (*A. diffusa*) grows in the desert zone on sandy and sandy loam soils, along the outcrops of variegated flowers. Occurs in North Ustyurt, Muyunkum, South Ustyurt, Kyzyl Kum, Turkestan region (Baitenov, 2001). *A. diffusa* is a family of Asteraceae, a genus of Seriphidium, a plant resistant to drought and cold. Pests do not damage leaves and seeds. *Artemisia* genus has been studied chemically and presence of monoterpenes, sesquiterpenes, especially sesquiterpene lactones and essential oils were reported (Kelsey, et al, 1979).

It is clear that the pharmacological characteristics of plants that belong to the wormwood family (antimalarial, antitumor, anthelmintic, cardiotonic, anti-inflammatory, analgesic characteristics, etc.) are justified by the presence of essential oils and sesquiterpene lactones in their composition (Kupriyanov, et al, 2012; Geissman, et al, 2000; Pandey, et al, 2017). The studies on chemical composition of Iranian *Artemisia* species have been reported about the presence of monoterpenes, sesquiterpenes, especially sesquiterpene lactones and essential oils (Rustaiyan, et al, 1987; Rustaiyan, et al, 2000 a; Rustaiyan, et al, 2000 b; Rustaiyan, et al, 1989; Costa, et al, 2009).

Twenty-six compounds were identified in the oil of *A. diffusa*, which represented about 94.43% of the total composition of the oil. In the volatile oil of this species, the oxygen containing monoterpenoids represented the most abundant constituents (92.59%) (Khazraei-Alizadeh, et al, 2001; Khayyat, et al, 2004). The *in vivo* antimalarial activity of *A. diffusa* extracts was investigated and the fraction which contains sesquiterpene lactones as tehranolide showed activity against *Plasmodium berghei* on the mice model of malaria (Noori, et al, 2014; Rustaiyan, et al, 2009; Taghizadeh, et al, 2011; Rustaiyan, et al, 2011).

In current study, the medicinal plants *A. albida* and *A. diffusa* growing in Kazakhstan were analyzed on quantitative-qualitative content, mineral composition and lipophilic substituents for the first time. The research involved evaluating key biologically active components, including the determination of organic acids, flavonoids, polysaccharides, moisture content, total ash, and extractive substances. The concentrations of macro- and microelements in the plant ash were assessed using multi-element atomic emission spectral analysis. Additionally, liposoluble components in petroleum ether extracts of *A.*

albida and *A. diffusa* from Kazakhstan were identified for the first time using the GC-MS (gas chromatography-mass spectrometry) method.

Materials and methods. Plant material. Research sources such as *A. albida* were collected in September 2023 from Almaty region in Southern Kazakhstan. The aerial part of plant *A. diffusa* was collected in September 2020 from Turkestan region, Kazakhstan. Raw materials after being well dried in the shade, were crushed into small pieces in a crushing machine and preserved at room temperature.

The quantitative and qualitative profile of biologically active constituents of *A. albida* and *A. diffusa* was determined in strict accordance with the methodologies prescribed in the I edition of the State Pharmacopoeia of the Republic of Kazakhstan (2008).

The mineral composition was identified, using a Shimadzu 6200 series spectrometer. 3 g of raw material was placed in a pre-calcined and accurately weighed porcelain crucible. Then the crucible was gently heated, first letting the substance burn at the lowest possible temperature, and the flame was gradually increased. Calcination was performed at 500°C to obtain a constant mass. At the end of the calcination, the crucible was cooled in a desiccator and then the resulting ash was burned again at 600°C until a uniform gray color was obtained. The ash of plant was dissolved in 10.0 mL of 40% nitric acid by heating. After that, the resulting solution was heated to obtain wet salts. Subsequently, it was dissolved in 15.0 mL of 1 N nitric acid and transferred to a 25.0 mL volumetric flask for analysis. And so, it will need to be done with each of the three plants (Nurlybekova, et al, 2021).

GC–MS conditions. Analyses were conducted on Agilent 7890A/5975C gas chromatograph coupled to mass spectrometer equipped with a 7683B auto injector (Agilent Technologies, USA). Separation was carried out with a HP-5MS fused silica capillary column (0.25 mm x 30 m, 0.25 μm film, J&W Scientific, USA). The injection port temperature was 310°C. The injection volume was 1 μL, split ratio 5:1. Helium (99.99 %, China) was used as the carrier gas at a rate of 1.0 mL/min. The column temperature was held at 50°C for 10 min, increased by 10°C/min to 300□, and then held for 40 min. Mass spectra were obtained by electron impact (EI) ionization at 70 eV in scan mode (m/z 30-1000 amu). Solvent delay was 3 min. The detector, ion source and transfer line temperature were set to 150, 230 and 250 ºC, respectively (Adams, 1974).

Identification and quantitation. The compounds were identified using NIST14 library. Mass fraction of each detected compound was estimated using normalization of peak areas. The sample was analyzed three times. All data are expressed as the mean ± standard deviation of three replicates.

Results and Discussion. A quantitative and qualitative analysis of bioactive constituents, moisture content, total ash, and extractives was conducted on *A. albida* and *A. diffusa*. The results are presented in Table 1, Figure 1.

Moisture and ash content fluctuate within specific limits for each plant, depending on the characteristics of the plant material, as well as how it is harvested and dried. These data are essential for further calculations during analysis, making the determination of these contents necessary to confirm the high quality of *A. albida* and *A. diffusa*.

The highest quantity of extractive substances from two plant species was obtained using 80% ethyl alcohol. Therefore, this solvent is the most optimal for extraction of bioactive complexes. Identifying extractive substances with the appropriate solvent is crucial, as it indicates the quality of the plant based on its biological metabolite content.

Flavonoids are the largest class of dietary polyphenols, comprising over 4,000 different biologically active compounds synthesized during plant metabolism. Once consumed, flavonoids can contribute to a variety of beneficial biological activities in human body. Strong and consistent evidence now shows that flavonoids help maintain and enhance nitric oxide levels, improving endothelial function. Additionally, these compounds have been shown to influence blood pressure, oxidative stress, inflammation, platelet function, thrombosis, blood lipids, and glucose metabolism. These effects may help explain why flavonoids and flavonoid-rich foods are associated with cardioprotective and antineoplastic properties.

Organic acids play a key role in the taste, flavor, microbial stability, and consistency of plant-derived beverages. They are also used in food preservation due to their ability to affect bacterial growth. Polysaccharides, on the other hand, are unique substances that help retain moisture in the skin, maintain its elasticity, stimulate collagen fiber synthesis, and enhance cellular immunity.

Tannin bioactivity is related to their chemistry. Tannins have been studied during years due to their beneficial properties including anti-inflammatory, antidiabetic, antihypercholesterolemic, and anticancer activity.

In plants, alkaloids protect plants from predators and regulate their growth. Therapeutically, alkaloids are particularly well known as anaesthetics, cardioprotective, and anti-inflammatory agents. Well-known alkaloids used in clinical settings include morphine, strychnine, quinine, ephedrine, and nicotine.

Numerous coumarins possess several biological activities such as anti-inflammatory, anti-ulcers, anti-tumor, anti-microbial, anti-coagulant.

Table 1 – Quantitative and qualitative analysis of biologically active constituents of *A. albida* and *A. diffusa*

No.	Content	*A. albida*, %	*A. diffusa, %*
1	Moisture	8.19	8.08
2	Ash content	6.78	5.70
3	Extractives (80% EtOH)	20.76	14.83
4	Organic acids	0.21	1.45
5	Flavonoids	0.03	0.06
6	Polysaccharides	2.14	0.90
7	Tannins	1.52	1.91
8	Alkaloids	0.53	0.60
9	Coumarins	1.60	5.02

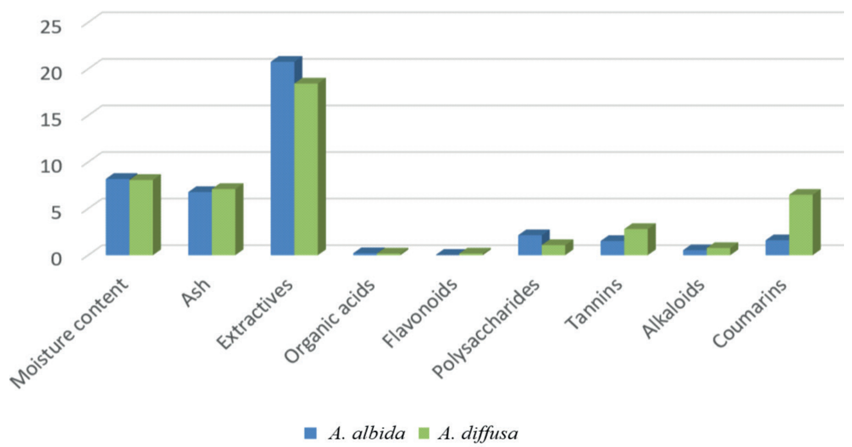


Figure 1 – Quantitative and qualitative content of biologically active constituents of *A. albida and A. diffusa*

According to the data obtained during quantitative and qualitative assays, moisture and ash content of both species have almost equivalent values, which are equal to 8.19 and 8.08 percent of moisture and 6.78 and 5.70 percent by ash content appropriately to *A. albida* and *A. diffusa*. Comparing the extractive substances concentration isolated during the extraction by 80% ethanol, *A. albida* differentiated with the higher content – 20.76% of the total plant and 14.83% of biocomplexes extracted from *A. diffusa.* The content of organic acid (1.45%), flavonoids (0.06%), alkaloids (0.60%) and coumarins (5.02%) was higher in the plant *A. diffusa*. By contrast, analysis on *A. albida* has shown the maximum content of polysaccharides and tannins, which are 2.15 and 1.52 by percent, respectively.

Eleven mineral compounds were identified from the ash of the plant that consists of seven microelements and four macroelements, as shown in Table 2 and Figure 2. These findings indicate that the two plants are excellent sources of macro- and microelements essential for the functioning of the muscular, cardiovascular, immune, and nervous systems. They also play a role in the synthesis of vital compounds, metabolic processes, hematopoiesis, digestion, and the neutralization of metabolic byproducts.

The results of our research revealed the highest content of iron (0.160 mg/g) in the plant *A. albida*. In contrast, the levels of Cd, Cu, Mn, Zn, Ca, Mg, Na, and K were found to be higher in *A. diffusa*.

Table 2 – Composition of macro-, microelements in the ash and plant of *A. albida* and *A. diffusa*

Element	Content in ash, mg/g		Content in the plant, mg/g	
	A. albida	*A. diffusa*	*A. albida*	*A. diffusa*
Microelements				
Cd	0.002	0.014	0.0001	0.001
Ni	0.039	0.208	0.002	0.011
Pb	-	-	-	-

Cu	0.037	0.458	0.002	0.025
Mn	0.413	2.676	0.026	0.145
Zn	0.099	0.801	0.006	0.043
Fe	2.573	2.468	0.160	0.181
Macroelements				
Ca	46.08	206.5	2.866	11.15
Mg	16.86	95.19	1.049	5.140
Na	4.731	5.509	0.294	0.889
K	57.87	725.8	3.600	39.19

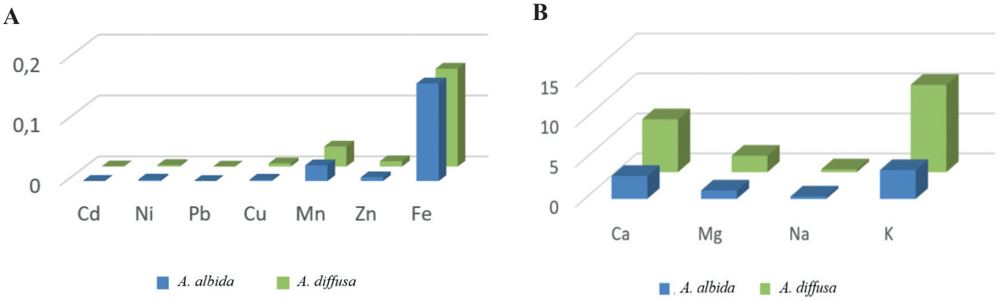
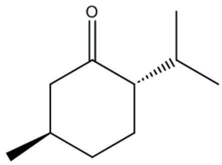
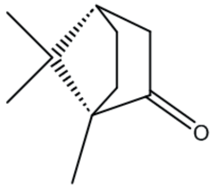
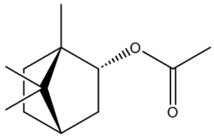
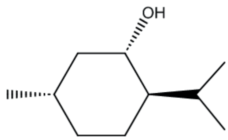
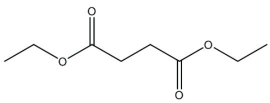
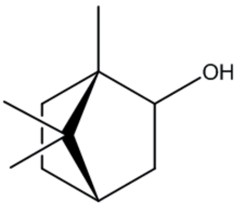
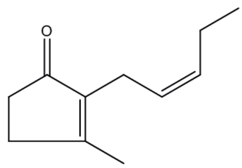
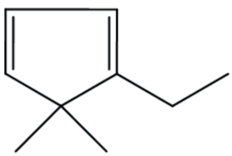


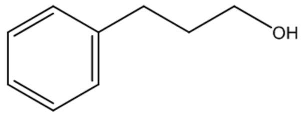
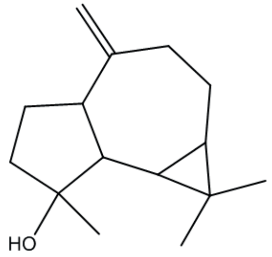
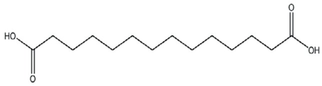
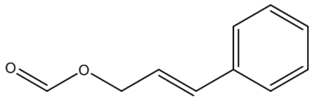
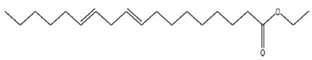
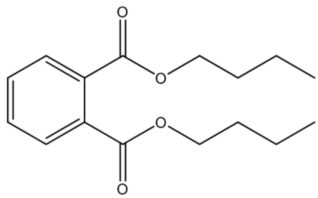
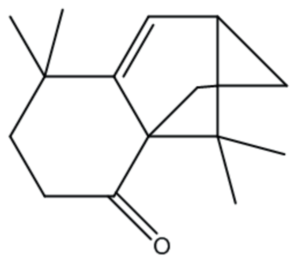
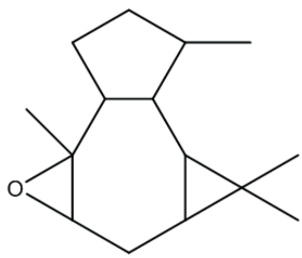
Figure 2 – Composition of micro- (**A**) and macroelements (**B**) of *A. albida* and *A. diffusa*

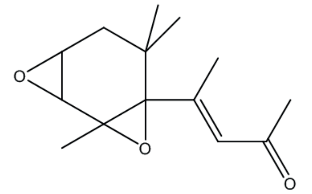
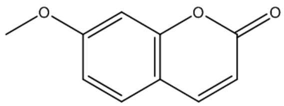
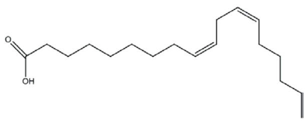
Our research revealed that the studied plants are rich in macronutrients, with K, Na, Mg, and Ca being the most abundant, while micro elements such as Cu, Fe, Zn, and Mn are present in high concentrations. Therefore, all two plants tested can be regarded as potential sources of trace elements, which could expand the potential applications of these plant materials in the future. The macro- and microelements in *A. albida* and *A. diffusa* play an important role in supporting various physiological functions. Macroelements such as calcium, magnesium, sodium, and potassium contribute to bone strengthening, improving cardiovascular and muscle function, as well as maintaining fluid balance and nerve activity. Microelements like iron, copper, zinc, and manganese support blood health, the immune system, tissue healing, and protect cells from oxidative stress. The high concentrations of these elements in *A. albida* and *A. diffusa* make them promising for the development of phytopharmaceuticals aimed at improving bone health, cardiovascular function, immunity, and metabolic processes.

The liposoluble constituents present in petroleum ether extract from *A. albida* were analyzed by GC-MS for the first time (Table 3). Twenty compounds from *A. albida* were separated and their relative contents were determined by area normalization in which the major constituents were neoisolongifolene, 8-oxo- (14.8%), cyclohexane, 1,2,3,4-bis(epoxy)-2,6,6-trimethyl-1-(pent-2-en-4-one-2-yl)- (11.5%), 2-propen-1-ol, 3-phenyl- (7.9%), (+)-2-bornanone (6.1%), 2H-1-benzopyran-2-one, 7-methoxy- (3.9%) (Figure 3).

Table 3 – The liposoluble constituents from the petroleum ether extract of *A. albida*

№	Retention time, min	Constituents	Structure	Degree of compliance, %	Content[a], %
	13.56	l-Menthone		92	0.5±0.02
	14.23	(+)-2-Bornanone		97	6.1±0.03
	16.20	Bornyl acetate		86	0.5±0.01
	17.80	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1α,2β,5α)-(±)-		95	1.1±0.02
	18.25	Butanedioic acid, diethyl ester		94	1.1±0.02
	18.72	Endo-Borneol		95	2.3±0.03
	24.00	2-Cyclopenten-1-one, 3-methyl-2-(2-pentenyl)-, (Z)-		88	0.7±0.01
	24.52	1,3-Cyclopentadiene, 5,5-dimethyl-1-ethyl-		83	0.8±0.01

	25.56	3-Phenylpropanol		90	0.7±0.03
	27.53	(-)-Spathulenol		88	0.7±0.02
	27.89	Tetradecanic acid		88	0.8±0.01
	29.77	2-Propen-1-ol, 3-phenyl-		90	7.9±0.03
	34.84	9,12-Octadecadienoic acid, ethyl ester		89	2.8±0.03
	36.65	Dibutyl phthalate		96	3.6±0.03
	36.84	Neoisolongifolene, 8-oxo-		75	14.8± 0.03
	37.57	Isoaromadendrene epoxide		83	2.3±0.03

	38.87	Cyclohexane, 1,2,3,4-bis(epoxy)-2,6,6-trimethyl-1-(pent-2-en-4-one-2-yl)-		75	11.5± 0.03
	40.17	2H-1-Benzopyran-2-one, 7-methoxy-		91	3.9±0.03
	42.93	9-Octadecenoic acid, (E)-		83	1.4±0.03
	43.54	9,12-Octadecadienoic acid (Z,Z)-		86	1.3±0.02
[a] Data are expressed as means ± standard deviation of three replicates					

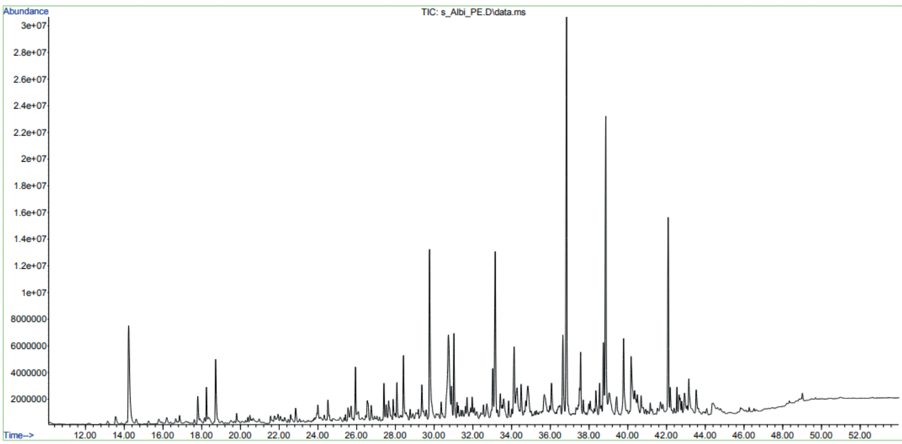
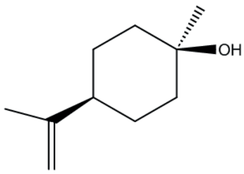
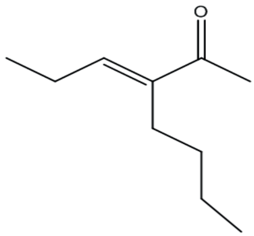
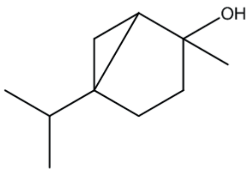
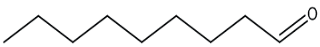
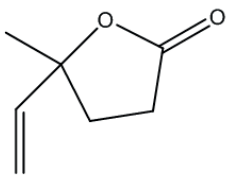
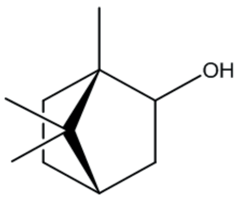
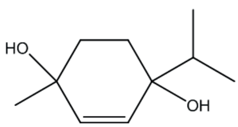
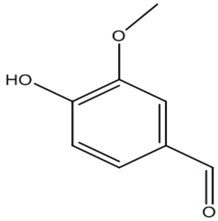
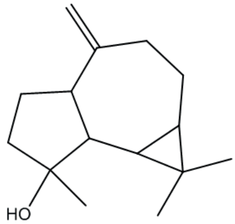
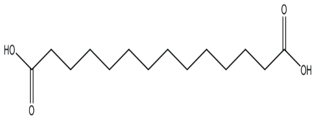
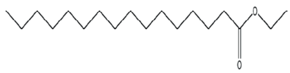
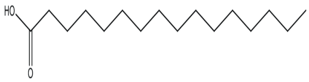
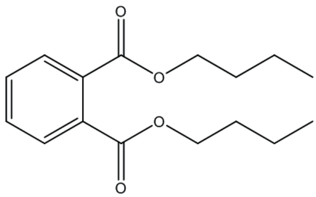
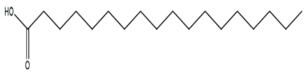
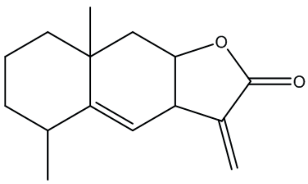


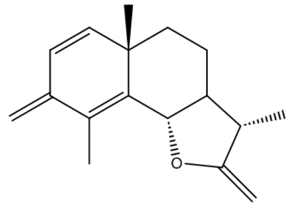
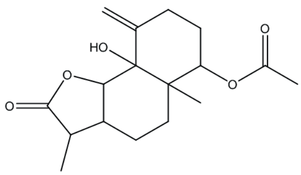
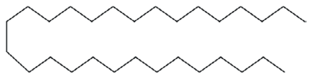
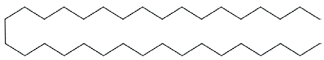
Figure 3 – Chromatogram of petroleum ether extract of *A. albida*

For the first time, the liposoluble constituents in the petroleum ether extract of *A. diffusa* were analyzed using GC-MS (Table 4). Twenty compounds were detected in the *A. diffusa* extract, and their relative contents were determined through area normalization. The major constituents identified were eudesma-5,11(13)-dien-8,12-olide (6.02%), nitrosine (4.33%), α-santonin (4.16%), nonacosane (3.71%), and hexadecanoic acid, ethyl ether (2.63%) (Figure 4).

Table 4 – The liposoluble constituents from the petroleum ether extract of *A. diffusa*

№	Retention time, min	Constituents	Structure	Degree of compliance, %	Content[a], %
	10.29	Cyclohexanol, 1- methyl-4-(1-methylphenyl)-,cis-		92	0.94±0.02
	11.33	2-Heptanone, 3-propylidene-		79	0.52±0.02
	11.41	Bicyclo[3.1.0]hexane-2-ol, 2-methyl-5-(1-methylethyl)-, (1α,2β,5α)-		89	1.05±0.02
	11.56	Nonanal		87	0.43±0.01
	12.13	2(3H)-Furanon, 5-ethinyldihydro-5-methyl-		91	1.78±0.02
	13.73	Endo-Borneol		85	0.40±0.02
	17.81	1,4-dihydroxy-p-Menth-2-ene		83	0.78±0.01

	23.07	Vanillin		86	0.66±0.01
	24.92	(-)-Spathulenol		88	1.96±0.01
	28.49	Tetradecanic acid		86	1.22±0.03
	32.26	Hexadecanoic acid, ethyl ether		89	2.63±0.02
	32.65	Hexadecanoic acid		88	2.04±0.02
	34.29	Dibutyl phthalate		92	1.68±0.02
	36.13	Octadecanoic acid		78	1.16±0.02
	40.20	Eudesma-5,11(13)-dien-8,12- olide		76	6.02±0.03
	41.18	Behenic alcohol		88	1.46±0.02

	41.77	α-Santonin		91	4.16±0.03
	43.17	Nitrosine		91	4.33±0.03
	45.87	Nonacosane		91	3.71±0.03
	48.55	Tetratricontane		92	1.77±0.02

[a] Data are expressed as means ± standard deviation of three replicates

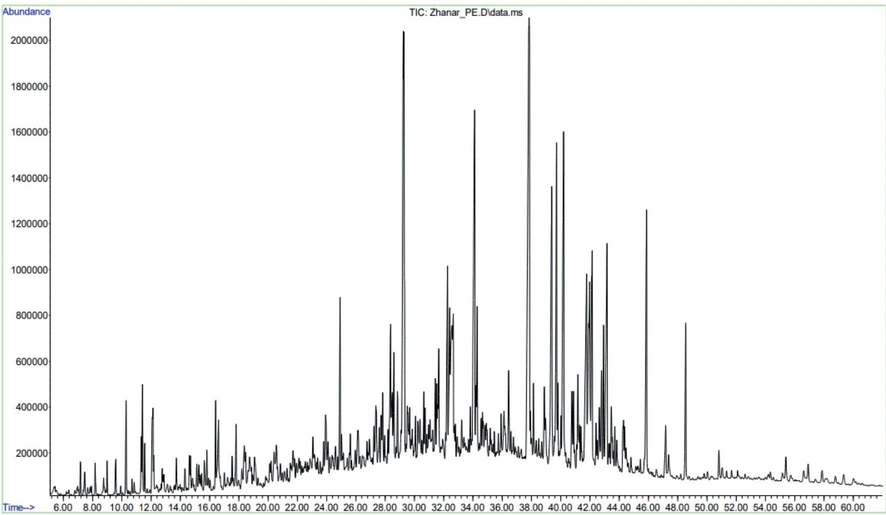


Figure 4. Chromatogram of petroleum ether extract of *A. diffusa*

By comparing the liposoluble constituent compositions of these species, it is evident that *A. albida* is chemotaxonomically related to *A. diffusa*. The results show that the differences in their volatile profiles are primarily qualitative. The liposoluble compounds present in both species exhibit anti-inflammatory, antimicrobial, and anticancer properties. Collectively, these findings imply that *A. albida* and *A. diffusa* could be crucial in the development of new plant-based pharmaceutical preparations.

In comparison to the more extensively studied species like *A. annua* (Juteau, et al, 2002) and *A. absinthium* (Akzhigitova, et al, 2018), *A. albida* and *A. diffusa* have a different, yet complementary, profile of bioactive compounds. While *A. annua* remains the gold standard for artemisinin production, both *A. albida* and *A. diffusa* contribute to the broader medicinal potential of the *Artemisia* genus with unique essential oil compositions, flavonoids, and other secondary metabolites. These species could hold untapped therapeutic potentials, especially for antimicrobial, anti-inflammatory, and antioxidant applications. Further research would be beneficial to explore these species' full phytochemical profiles and their potential medicinal uses.

In summary, the identified compounds in *A. albida* and *A. diffusa*, especially sesquiterpene lactones, flavonoids, and essential oils, show promise for a variety of therapeutic activities. Future studies can focus on conducting *in vivo* and clinical trials to further evaluate the efficacy of these compounds in treating conditions such as inflammation, infections, and cancer. Based on the identified bioactive compounds, further phytochemical research could lead to the development of targeted drugs or supplements.

Conclusion. The quantitative and qualitative analysis was conducted on the plants *A. albida* and *A. diffusa*, which were collected from the territory of the Republic of Kazakhstan. The study determined the overall quantity of biologically active components and the levels of macro- and microelements in the plant materials. Notably, the species *A. albida* and *A. diffusa* showed high concentrations of elements vital for the daily needs of the human body. The liposoluble constituents in petroleum ether extracts of *A. albida* and *A. diffusa* from Kazakhstan have been identified by GC-MS method for the first time. The presence of these bioactive constituents suggests that the plant extracts may have anti-inflammatory, antimicrobial, and anticancer properties. These findings can serve as a basis for future studies on *A. albida* and *A. diffusa*, enhancing our understanding of the plant and providing a platform for developing and exploring new ideas. Further phytochemical research on *A. albida* and *A. diffusa* holds promise for the creation of new phytopreparations. In recent years, the use of medicinal plants has been increasing due to their affordability, wide-ranging therapeutic benefits, low toxicity, and the potential for prolonged use without causing side effects. Advancing this field by integrating medicinal plants into medical practice and expanding the range of phytopharmaceuticals is highly promising.

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