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STUDY OF BIOACTIVE COMPOUNDS AND RESOURCES OF SOME SPECIES OF WORMWOOD (*Artemisia abrotanum* L., *A. maritima* L., *A. pauciflora* Weber, *A. issaevii* Rzazade) DISTRIBUTED IN THE FLORA OF AZERBAIJAN

©Ibrahimova S., *ORCID: 0009-0005-8659-6507, Ganja State University, Ganja, Azerbaijan, ibrahimovas073@gmail.com*
©Ibrahimov A., *ORCID: 0009-0002-9737-6866, Dr. habil., Institute of Botany of the Ministry of Science and Education of the Republic of Azerbaijan, Baku, Azerbaijan, aliyaribragimov@mail.ru*
©Alasgarova A., *Dr. habil., Institute of Botany of the Ministry of Science and Education of the Republic of Azerbaijan, Baku, Azerbaijan, adelyaaleskerova1@mail.ru*

ИЗУЧЕНИЕ БИОЛОГИЧЕСКИ АКТИВНЫХ СОЕДИНЕНИЙ И РЕСУРСОВ НЕКОТОРЫХ ВИДОВ ПОЛЫНИ (*Artemisia abrotanum* L., *A. maritima* L., *A. pauciflora* Weber, *A. issaevii* Rzazade), РАСПРОСТРАНЕННЫХ ВО ФЛОРЕ АЗЕРБАЙДЖАНА

©Ибрагимова С. И., *ORCID: 0009-0005-8659-6507, Гянджинский государственный университет, г. Гянджа, Азербайджан, ibrahimovas073@gmail.com*
©Ибрагимов А. Ш., *ORCID: 0009-0002-9737-6866, д-р биол. наук, Институт ботаники Министерства науки и образования Азербайджанской Республики, г. Баку, Азербайджан, aliyaribragimov@mail.ru*
©Алескерова А. Н., *д-р биол. наук, Институт ботаники Министерства науки и образования Азербайджанской Республики, г. Баку, Азербайджан, adelyaaleskerova1@mail.ru*

Abstract. As a result of analysis of the literature data and our research, for the first-time distribution of the species *Artemisia abrotanum* L., *A. maritima* L., *A. pauciflora* Weber, *A. issaevii* Rzazade in different regions of Azerbaijan by obtaining bioactive compounds typical for them is confirmed in the article in detail. Distribution, resources, ecological features, as well as useful properties of wormwood (*Artemisia* L.) species found in the flora of Azerbaijan were studied by us, their possibilities of use in various fields of folk and agriculture were recommended. General distribution areas, biological and ecological features of all species were studied. Essential oil was obtained using the Ginsberg hydrodistillation method and component content was determined by the method of Gas Chromato-Mass Spectroscopy. Gas Chromato-Mass Spectroscopy was performed using Agilent 5977A MS gas chromatography and Agilent 7890 GC inert Mass Selector Detector. *A. abrotanum* L., which is new for the flora of Azerbaijan, two new substances, steroids (β-sitosterol St-1, stigmasterol St-1) was obtained from *A. maritima L.* species three substances, α-santonin, artemisin, glabellin was obtained. In the composition of the aerial part of the species *A. pauciflora* Web., 60 terpenoid compounds were identified, 17 components were detected by mass spectroscopy.

Аннотация. В результате анализа литературных данных и наших исследований впервые изучено распространение видов *Artemisia abrotanum* L., *A. maritima* L., *A. pauciflora* Weber, *A. issaevii* Rzazade в различных регионах Азербайджана с получением типичных для них биологически активных соединений. Нами были изучены распространение, ресурсы,

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биологические и экологические особенности, а также полезные свойства видов полыни (*Artemisia* L.), встречающихся во флоре Азербайджана, рекомендованы возможности их использования в различных областях народного хозяйства и земледелия. Изучены общие ареалы, биологические и экологические особенности всех видов. Эфирное масло получали методом гидродистилляции Гинзберга, а содержание компонентов определяли методом газовой хромато-масс-спектроскопии. Газовую хромато-масс-спектроскопию выполняли с использованием газового хроматографа Agilent 5977A MS и детектора инертной массы Agilent 7890 GC. Из нового для флоры Азербайджана вида *A. abrotanum* получены два новых вещества, стероиды (β-ситостерол St-1, стигмастерол St-1), а из *A. maritima* — три вещества, а именно α-сантонин, артемизин, глабеллин. В составе надземной части вида *A. pauciflora* Web. идентифицировано 60 терпеноидных соединений, методом масс-спектроскопии выявлено 17 компонентов.

Keywords: *Artemisia*, distribution, biological resources, plant ecology, bioactive compounds, spectral methods.

Ключевые слова: полынь, распространение, биологические ресурсы, экология растений, биологически активные соединения, спектральные методы.

Wormwoods were first identified by Carl Linnaeus. At the beginning of the 19th century, the author provided information on 19 species of wormwood, 7 of which (*A. annua* L., *A. vulgaris* L., *A. abrotanum* L. *A. absinthium* L. *A. dracunculus* L. etc.) were described from the Caucasus [1].

He laid the basis of the systematics of genus given by Besser. These include *Artemisia tschernieviana* Besser, *Artemisia fasciculata* Bieb. var. *iberica* Besser, *A. fasciculata* var. *armeniaca* Besser, *A. maritima* var. *hanseniana* Besser, *A. maritima* var. *szowitziana* Besser, *A. maritima* var. *erivanica* Besser, *A. maritima* var. *meyeriana* Besser [2].

After C. Linnaeus, Willdenov, Biberstein, B. Besser, C. Koch studied the main stages of the development of wormwoods. Russian scientists B. A Keller, M. F. Komarov, I. M. Krashennikov specified Eurasian wormwood species, analyzed the phylogeny of the species and enriched the systematics of the genus *Artemisia* L. [3].

In 1920-1949, during the analysis of flora of Caucasus, A. A. Grossheim noted that there are 25 species in the fundamental work “Flora of Azerbaijan”. 20 years later, R. Y. Rzazade confirmed that the number of wormwood species was 42 [4]. After a while, P. P. Polyakov noted that wormwood is represented by 17 (1 of which is cultivated) species in the flora of Azerbaijan [5].

Based on Frenecu, Qodronu, Gray, and especially Krashennikov, who well defined the Eurasian wormwoods, R. Y. Rzazadeh, who is considered the monograph of wormwoods in Azerbaijan divided the genus *Artemisia* into 4 subgenera: 1. *Dracunculus* (Bess.) Rydb., 2. *Seriphidium* (Besser) Gren et Codr., 3. *Euartemisia* (Cray) Krasch. et Codr., 4. *Artanacetum* Rzazade. Unlike Besser, the scientist discovered a new subgenus (*Artanacetum*) and combined the two sections of Besser under the name *Euartemisia* [4].

In 1961, while working on the flora of Azerbaijan (Vol. VIII) and the flora of the former USSR (Vol. XXVI), P. P. Polyakov described Besser’s four sections: 1) *Abrotanum* Bess.; 2) *Dracunculus* Bess.; 3) *Seriphidium* Bess.; 4) *Absinthium* D. C. as 4 subgenera in the *Artemisia* genus [6].

P. P. Polyakov described the sections shown in the study of the *Artemisia* genus as an *Artemisia* subgenus and the genus *Artemisia* in the flora as three subgenera — *Artemisia* L.,

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A. dracunculus L., *A. seriphidium* (Bess.) Peterm [7].

For the first time, distribution of *A. abrotanum* L. species found in the flora of Azerbaijan in Nakhchivan AR were reported [8].

The distribution volume of the genus *Artemisia* L. in Azerbaijan varies according to systematists. In doctoral dissertation, A. N. Alasgarova using chemotaxonomy — sesquiterpene lactones of 42 species of wormwood distributed in Azerbaijan as a marker studied chemotaxonomy of these species and according to her, studies were conducted on the species *Artemisia abrotanum* L., *A. maritima* L., *A. pauciflora* Web. and *A. issaevii* Rzazade in Azerbaijan. For the first time, the morphological features of these species were studied and substances completely different from the biologically active substances characteristic for them were obtained by us. As a result of studies conducted by R. Y. Rzazadeh, he gave detailed information about the distribution of these species in Azerbaijan.

Our goal, for the first time, is to provide detailed information about the morphological features of these species, their distribution area, obtaining biologically active substances specific to the species. Each species were collected from different regions of Azerbaijan and herbarium materials were prepared. For the first time, the study of these species is noted by us. According to Grossheim the flora of Azerbaijan is represented by 21 species of wormwood, according to Rzazade by 42 species, and according to Polyakov by 17 species. Substances of secondary synthesis origin of each taxon plays a significant role in resolving these complex and controversial issues.

The research was conducted in the east and west of the Greater Caucasus, in the north of the Lesser Caucasus by field routes and expeditions, as well as by appropriate methods in the cameral-laboratory conditions in 2009-2018. The studies were devoted to the study of biologically active substances obtained from species (*A. abrotanum, A. maritima, A. issaevii, A. pauciflora*) of the genus *Artemisia* of the family Asteraceae distributed in Azerbaijan and their biological resources. Field studies were conducted on 5 routes in Ganja, 2 routes in Nakhchivan AR: Julfa, Babek, Sharur, 10 routes in Absheron, 3 routes in Guba, Gusar, Shabran, Khachmaz districts with a total of 20 routes.

Materials and methods

Identification of species was based on herbarium funds — USSR, Caucasus, naming of taxa on “Caucasian Flora Conspectus”.

Life forms were studied according to Raunkiaer and Serebryakov, phenological observations to Lavrenko, floristic geobotanical indicators to Beydeman, biological reserve to Shreter, Krilov and etc., and the richness of the flora to Grossheim. Essential oil was obtained using the Ginsberg hydrodistillation method and component content was determined by the method of Gas Chromato-Mass Spectroscopy. Gas Chromato-Mass Spectroscopy was performed using Agilent 5977A MS gas chromatography and Agilent 7890 GC inert Mass Selector Detector.

More than 200 herbarium materials were collected from different regions of Azerbaijan (Absheron, Nakhchivan Autonomous Republic, Ganja, Shamkir, Guba, Khachmaz, Shabran and districts, around villages), from the plains and mid-mountain ranges. Classical and botanical, floristic, areological, ecological and statistical methods were used in the development of materials. About 15 geobotanical descriptions were made.

Results and discussion

During our study, we have found that the morphological features (structure of their leaves, roots, stems, flowers) and biologically active substances of 4 species are completely different. At

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the same time, first the study confirmed that the distribution, reserve, bioecological characteristics of the species *Artemisia abrotanum* L, *A. maritima* L., *A. pauciflora* Web., and *A. issaevii* Rzazade were different. For this purpose, the morphological features of each species are described in detail.

For the first time, A. Ibrahimov confirmed the distribution of *Artemisia abrotanum* L. as a new species in the Nakhchivan Autonomous Republic. The studied *A. abrotanum* — medicinal wormwood was collected in the budding phase around the city of Nakhchivan in 2012. The plant is semi-shrub at a height of 70-150 cm; columnar tree-like roots, fruiting stems in the upper part, leaves are double-triple pinnately divided, thread-like-linear, linear-lanceolate-elliptical, green hairy, rarely whitish densely hairy, later green bare, oval-shaped stalk 4-8 cm length and 3-6 cm wide double-triple pinnately divided. Anthodes are ovate-spherical and collected in bent scoparious inflorescence 2.5 mm wide. The outer flowers are toothed with 8. The seeds are 1.2 mm long, ovate oblong, the edges of the spathe leaflets are bordered. It blooms in VIII month and seeds in IX month (Figure 1).

As a result of the studies, for the first time, constant elements were found in the structural features of the species. It is more common in forest-meadow vegetation type, in chestnut dry soils. It is a mesoxerophyte, perennial, subshrub semi-desert herbaceous plant. It belongs to the European group. Distribution area: in LC — in Nakhchivan city (in the center of the city, around the station as a weed), as well as in all districts of Nakhchivan AR, and mostly in a large area around the Janbar spring in Sovetabad village of Julfa district, on the edge of ditches, from plain to mid-mountain belt. Besides, it is distributed in Gulustan, Yayici, Jamaldin villages of Julfa district of Nakhchivan AR, Iranian borders along Araz, Diza village, Dardagh, Hachadagh, Ashabi-Kahf massif up to Asahab-Kahf mountain. Here the plant grows mostly in forests, forest-steppe zones, riverbanks, dense and moist meadows, around deciduous dense forests, and sometimes near settlements.

It was found in several villages of Shahbuz district, around houses, on the road edge from Bichenak to Batabat, and in the forest glades as a pile, in some cases in a specific ecological condition. In Julfa district, the abundance of 5 points is an indicator of the widespread of this species in the area. Medicinal wormwood harvested during the budding phase and collected as raw material.

The second species *A. maritima* L. — sea wormwood belongs to the xeromesophyte semi-desert vegetation type and has many nonbearing branches. It belongs to the European geographical group. The lower leaf are double-triple pinnately divided, the leaves of 3-4 cm long around the flower often longer than the anthode, and the anthode is usually (2.5) 3-4 mm long (Figure 2). The flower base is usually longer than the anthode. It is mainly found in the Absheron Peninsula: Mardakan-Pirallahi-Zagulba-Shuvalan-Mashtaga, Nardaran-Khirdalan-Saray-Pirshagi, Fatmayi-Jeyranbatan-Sumgayit, Baku-Hovsan, Turkan, Shagan, Lokbatan-Ortadag, in the coastal sands in a heap. It is widespread in the plains of the Absheron district and accompanying fragrant wormwood, dominating the phytocenosis found locally. Its abundance is 3-4 points. In the coastal plain, reserves of *A. maritima* were calculated by a known method (120 hectares) and its biological reserve is 324 tons and an operational reserve is 32 tons. It blooms in IX-X months, fruits and seeds ripen in X-XI months.

It is found in 32 villages of Absheron district (Fatmeyi, Novkhani, Gala, Turkan, Hovsan, Nardaran, Buzovna, etc.). The research was conducted in two directions. The accumulation of biologically active substances — sesquiterpene lactones and steroids in plants was studied in the budding phase, and the accumulation of the main components of essential oil in the flowering phase.

Grossheim and Rzazade criticized the species *A. maritima* and noted the variations

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(*A. maritima* Bess. var. *hanseniana* (Bess.) A. Grossh., *apscheronica* Rzazade, *phyllostachys* Rzazade, *jasamalica* Rzazade) of this species. Polyakov did not accept the species and any of variations. Before us, A. N. Alasgarova, researcher of wormwood species obtained a specific sesquiterpene lactone from these variations and showed that sesquiterpene lactones obtained from the species *A. maritima* differ radically from variations.

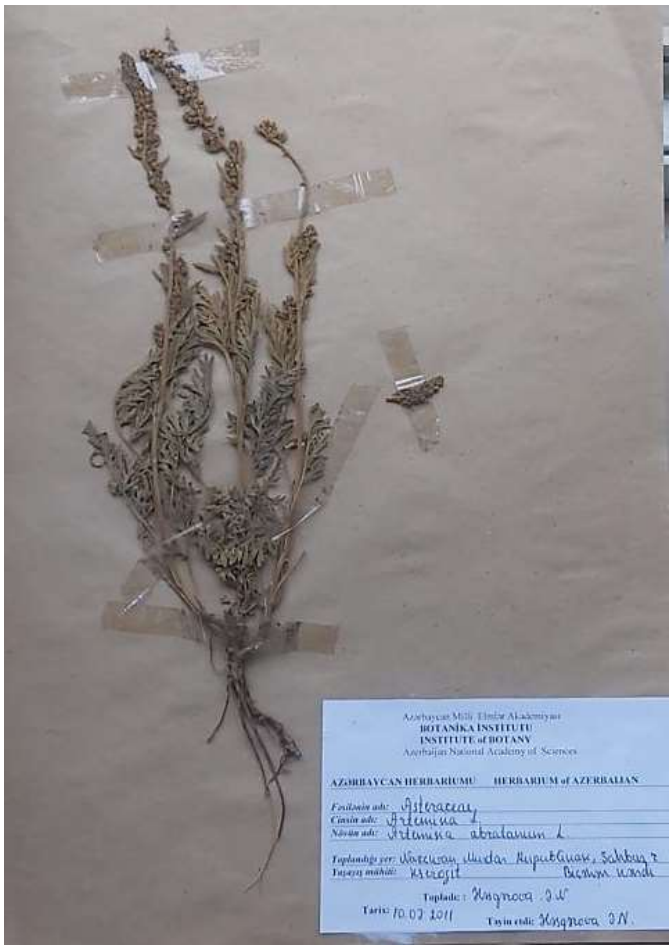

Figure 1. Herbarium of *A. abrotanum* L.

Figure 2. Herbarium of *A. maritima* L.

The third species *A. pauciflora* — (Volga wormwood according to Rzazade) few-flowered wormwood is xerophytic plant, belongs to the European geographical group. *A. pauciflora* is a dwarf subshrub of 10–25 cm high, the leaves are grayish green, the following are fast-shedding, stalked, twice-thrice-pinnately divided, the middle leaves are sessile, the upper ones are completely short (Figure 3). Anthode in broomlike inflorescence, sessile and short-legged, ovate or oblong. The crown is white or ruby-red. It blooms in VIII month and seeds in IX month. It is distributed in GC and LC, Guba, Gusar, Gazakh districts, riverbanks, gravelly rocks.

During the budding phase few-flowered wormwood was collected from Ganja-Shamkir districts, roadsides, plains and other districts.

The species of wormwood that occupies the deserts of Azerbaijan was mistakenly named as *A. meyeriana* Bess. by academician A. A. Grossheim. This plant was originally named as *A. maritima* L. var. *hanseniana* Bess. by B. Besser, famous Russian scientist. When A. A. Grossheim gave the plant the same name, he named the same combination in accordance with international botanical rules.

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Besser clearly shows that *A. hanseniana* Bess. was collected from Salyan. The second species — *A. meyeriana* is noted to be collected from Grozny and Nargin. Therefore, the species widespread in the Kur-Araz area should be named as *A. hanseniana* (Bess) Grossh. Real *A. meyeriana* Bess. is a plant that grows in the Far East and has nothing to do with the Caucasus. At the same time, the author notes that in the North Caucasus grows the famous few-flowered wormwood (*A. pauciflora* Web.), which is still unknown to Caucasian scientists [4]. This new species mentioned by Rzazadeh was collected from different regions of Azerbaijan (Ganja, Khachmaz, Shabran, etc.) and based on literature we confirm that this collected plant sample is completely new in both morphological and chemical composition.

A. issaevii Rzazade — A plant of 35 cm tall is a dwarf subshrub with woody stem. Numerous stem is rod-shaped, yellow-brown, 1–2 mm thick, with traces of the previous year's leaves, simple, weakly branched only in the upper part, with short thin off-shoot (Figure 4). The leaves are pinnately divided, rapidly pubescent thick particles is long, blunt-tipped. The elliptical anthodes are sessile or short-stalked, sparsely arranged, and are equal to or longer than the thick leaves. The leaflets of the cover are glumal, the outside is shorter than the inside, all boat-shaped, the edges glumal, back green or dark green, usually with brown spots, the inside is long, elliptical. The seeds are 2 mm long, narrowing towards an elongated oval base.

Figure 3. Herbarium of *A. pauciflora* Web.

Figure 4. Herbarium of *A. issaevii* Rzazade

The species *A. issaevii* blooms in IX-month, bears fruit in IX-X months. It was collected from the plains around the village of Gosha-diza in the Nakhchivan Autonomous Republic in the budding phase. It is an endemic species.

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The structure of the area where wormwood is spread, floristic geobotanical indicators and flora richness were marked on a 5-point Druden scale.

The essential oils of the studied plants were obtained from the aerial part of the plant when wet and dried by the method of hydrodistillation. The component content of the obtained essential oils was determined on the chromatograph of Agilent Technologies 6890N Network firm by the method of Gas Chromato-Mass Spectroscopy.

Individual obtaining of steroid compounds using the method of column chromatography from the total extractives from the species *A. abrotanum*: 10.0 g of resin-like total extractives was mixed with 50.0 g of neutral Al_2O_3 with III-IV activity and chromatographed on a glass column filled with Al_2O_3 with the same activity (h = 35, d = 3.5 cm). The volume of each fraction is 100 ml. Chromatography column was eluated with hexane, a mixture of hexane and benzene in different proportions (8:2, 7:3, 6:4, etc.); with benzene, a mixture of benzene and chloroform (9:1, 8:2, 7:3, 6:4) and chloroform, and 4 crystalline substances were obtained [9, 10].

Obtaining β-sitosterol (substance St-1)

A white crystalline substance was obtained individually from fractions 15-17 eluated with a 1:9 mixture of hexane and benzol. After recrystallization of the substance from a mixture of hexane and benzene, the substance with element content $C_{29}H_{50}O$ and m. p. 138-139°C was obtained. The Liebermann-Burchard and Zalkovsky reaction is positive. This is evidence that the substance belongs to the group of steroids. IR spectrum, ν_{max}: 3470, 3340, 1670, 1070, 980, 810 cm^{-1}.

Obtaining stigmasterol (substance St-2)

Crystalline substance was obtained individually from fractions 25-28 eluated with benzene. After recrystallization from ethanol, the element content was determined as $C_{29}H_{48}O$, m. p. 170-171°C. The Liebermann-Burchard and Zalkovsky reaction is positive.

IR spectrum, ν_{max}: 3350, 1650 cm^{-1}.

^{13}C NMR Dept 135 spectrum: 20,10; 20,30; 20,40; 20,80; 30,20; 30,40; 30,70; 30,95; 40,30 m. h.

10.0 g of resin-like total extractives is mixed with 50.0 g of neutral Al_2O_3 with III-IV activity and chromatography was performed on a glass column filled with Al_2O_3 with the same activity (*h* = 35, *d* = 3.5 cm). The volume of each fraction is 100 ml. Chromatography column was eluated with hexane, a mixture of hexane and benzene in different proportions (8:2, 7:3, 6:4, etc.); with benzene, a mixture of benzene and chloroform (9:1, 8:2, 7:3, 6:4) and chloroform, and 4 crystalline substances were obtained.

Obtaining β-sitosterol (substance St-1)

A white crystalline substance was obtained individually from fractions 15-17 eluated with a 1:9 mixture of hexane and benzol. After recrystallization of the substance from a mixture of hexane and benzene, the substance with element content $C_{29}H_{50}O$ and m. p. 138-139°C was obtained. The Liebermann-Burchard and Zalkovsky reaction is positive. This is evidence that the substance belongs to the group of steroids. IR spectrum, ν_{max}: 3470, 3340, 1670, 1070, 980, 810 cm^{-1}.

A white crystalline substance was obtained individually from fractions 15-17 eluated with a 1:9 mixture of hexane and benzol. After recrystallization of the substance from a mixture of hexane and benzene, the substance with element content $C_{29}H_{50}O$ and m. p. 138-139°C was obtained. The Liebermann-Burchard and Zalkovsky reaction is positive. This is evidence that the substance belongs to the group of steroids. IR spectrum, ν_{max}: 3470, 3340, 1670, 1070, 980, 810 cm^{-1}.

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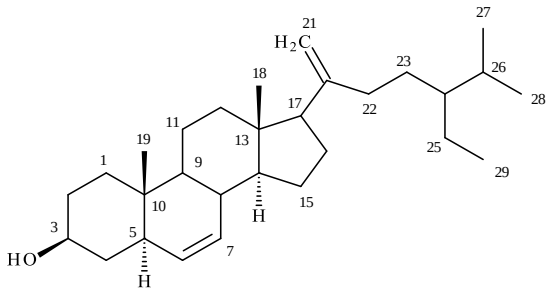
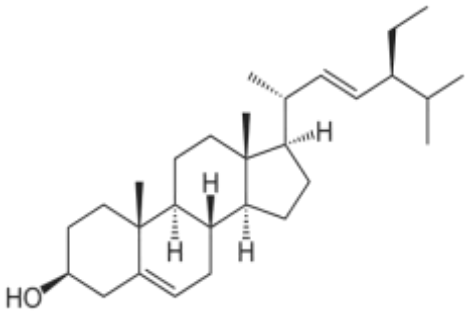


Structure of β-sitosterol



Structure of stigmasterol

Obtaining of Artabrosterin A

White crystalline substance was obtained from fractions 41-43 eluated with benzene (substance St-3). After recrystallization, the element content was determined to be $C_{29}H_{48}O$, m. p. 180-181°C. The Liebermann-Burchard and Zalkovsky reaction is positive.

Obtaining new steroid compound Artabrosterin B (substance St-4)

A white crystalline substance was obtained individually from the parent solutions of fractions 41-43 and fraction 44, which were obtained by elution of the chromatography column with benzene. After recrystallization of the substance from aqueous ethanol, the element content of the compound was $C_{24}H_{48}O$ and m. p. 185.5-188.0°C. The IR spectrum is very close to the IR spectrum of substance St-3 — artabrosterin A.

Study of the chemical composition of essential oil of the species Artemisia issaevii Rzazade (Isayev wormwood) by gas-chromato-mass spectroscopy and its practical significance

The plant material (300,0 g) collected from the plain around Diza village of Julfa district of Nakhchivan AR during budding phase in 2010 was finely chopped and dried, then boiled for 3 hours and essential oil was obtained by hydrodistillation method. Yield is 3.2g (0.11%). From 500 grams of the aerial part of the plant, an essential oil was obtained in a known manner, 2% alcohol of essential oil was used. The primary cell culture from human fibroblasts was prepared from 8-10 weeks of human abortive material by classical method. The aqueous-alcohol mixture of the essential oil did not have a toxic effect on the cells in the native state and prevented the cytopathic effect to enterovirus pathogens on primary cell culture of human embryonic fibroblasts. The studied essential oil remedy prevented enteroviruses by 50% in 72 samples, 25% in 40 samples, and 75% in 13 samples. An alcohol-water mixture of essential oil obtained from the species *Artemisia issaevii* Rzazade has antiviral activity in its native form and can be used for the prevention of some enterovirus infections [11, 12].

IR spectra are determined using vaseline oil, on Varian 640 IR spectrophotometer with Agilent Technologies 6890N Network CG System, 5975 inert Mass Selective Detector mass spectrometer using chromatograph and Split/Splitless, injection-Split, Inlet pressure 60,608 kpa, Split-100, Low Mass-40, High Mass-400, Threshold 150 were used as a detector. The analyzes were performed in temperature programming mode at a temperature of 50ºC to 280ºC at 15 ºC/min.

The temperature regime of the column:

- starting temperature of the column 50°C — 2 min, fixed;
- raising of temperature from 15°C to 200°C — 2 min, fixed;
- raising of temperature from 15°C to 280°C — 10 min, fixed;
- vacuum HiVac — 3,38e-005.

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The velocity of the gas (He) is 1 ml/min. The standard mass spectroscopic NIST library was used to identify the substances and the analysis lasted 33 minutes.

The study of essential oil obtained by hydrodistillation method from the species *A. issaevii* by gas-chromato-mass spectroscopy revealed 17 components in addition to the main components in the essential oil (camphor 37.21%, 1.8 cineol 31.73%).

1) 1-Octene-3-ol; 0,25%
2) O-Simol; 1,64%
3) 1,8-Cineol (eucalyptole); 31,73%
4) 4-Methyl-1-(1-methylethyl-bicyclo(3,1,O- hexane-3-on); 7,41%
5) Thujone; 3,47%
6) n-Menth-2-en-1-ol; 2.56%
7) Camphor; 37.21%
8) Trans-pinokarveol; 0.87%
9) 4-Methyl-1-(1-methyl-ethyl)-3- cyclohexane -1-ol; 1.90%
10) 6,6-Dimethyl- bicyclo [3.1.1] hept-2-en-2-carboxaldehyde; 0.69%
11) 4-trimethyl -3- cyclo-1- methanol; 0.23%
12) 6,6-Dimethyl-bicyclo[3.1.1.]hept-2-en-2- methanol; 1.08%
13) sis-3-Methyl-6-(1- methylethyl)-2- Cyclohexen-1-ol; 0.55%
14) 3,7,7- trimethylcyclo (4.1.0) hept-2-en; 0.72%
15) bornyl acetate; 0.73%
16) Sabinil acetate; 0.27%
17) thymol; 0,56%

Obtaining total of biologically active substances from the aerial parts of the species Artemisia pauciflora (Volga wormwood)

From the species Volga wormwood, collected on the left side of the Ganja-Shamkir highway in the budding phase in 2011, dark green resinous total extractive substances were obtained using known method. Yield is 18.56 g (9.48%). Using the gas chromatography–mass spectrometry method, 60 terpenoid compound was identified in the composition of the aerial part of Volga wormwood (*A. pauciflora*) species.

As a result of the study of the biologically active substances of *A. pauciflora* species by gas chromatography–mass spectrometry method, total extractives were determined.

1) 4-Methyl-3-penten-2-on; Element content: $C_6H_{10}O$; Molecular mass (MM): 98.
2) 4-Hydroxy-4-methyl-2-pentanone; Element content: $C_6H_{12}O_2$; MM: 116.
3) β-Simen; Element content: $C_{10}H_{14}$; MM: 134.
4) Eucalyptol; Element content: $C_{10}H_{18}O$; MM: 154.
5) τ- Terpinene; Element content: $C_{10}H_{16}$; MM: 136.
6) 2-Methyl-5-(1-methylethyl)-(α,2β,5α)-bicyclo[3,1,0]- hexane-2-ol; Element content: $C_{10}H_{18}O$; MM: 154.
7) 4-Methyl -1-(1-methylethyl)-bicyclo[3.1.0]- hexane-3-on; Element content: $C_{10}H_{16}O$; MM: 152.
8) Thujone; Element content: $C_{10}H_{16}O$; MM: 152.
9) 4-isopropyl -1-methyl-2- cyclo-exane -1-ol; Element content: $C_{10}H_{18}O$; MM: 154.
10) Trans-pinokarveol; Element content: $C_{10}H_{16}O$; MM: 152.
11) L- Camphor; Element content: $C_{10}H_{16}O$; MM: 152.

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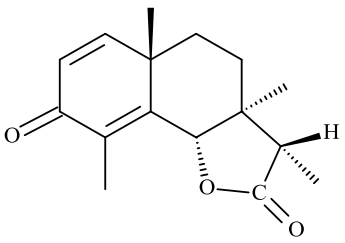
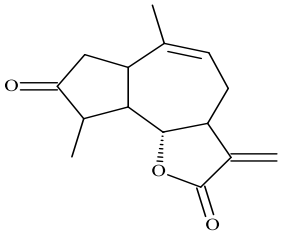
12) sabina ketone; $C_9H_{14}O$, MM:138.
13) trans-2,7-dimethyl-3,6- octadien -2-ol; Element content: $C_{10}H_{18}O$; MM: 154.
14) Isoborneol; Element content: $C_{10}H_{18}O$; MM: 154.
15) 4- Terpineol; Element content: $C_{10}H_{18}O$; MM: 154.
16) p-Simen-8-ol; Element content: $C_{10}H_{14}O$; MM: 150.
17) p-Ment-1-en-8-ol; Element content: $C_{10}H_{18}O$; MM: 154.
18) Myrtenol; Element content: $C_{10}H_{16}O$; MM: 152.
19) sis- Limonene oxide; Element content: $C_{10}H_{16}O$; MM: 152.
20) Carvone; Element content: $C_{10}H_{14}O$; MM: 140.
21) trans-2-Caren-4-ol; Element content: $C_{10}H_{16}O$; MM: 152.
22) 2-ethenyl -1,3,3-trimethyl cyclo-hexane; Element content: $C_{11}H_{18}O$; MM: 166.
23) Ascaridol; Element content: $C_{10}H_{16}O_2$; MM: 168.
24) Geranyl vinyl ether; Element content: $C_{12}H_{22}O$; MM: 180.
25) Caryophyllene oxide; Element content: $C_{15}H_{24}O$; MM: 220.
26) Hanfillin (sesquiterpene lactone); Element content: $C_{15}H_{20}O_3$; MM: 248.
27) phytol; Element content: $C_{20}H_{40}O$; MM: 296.
28) Ambrosiol (sesquiterpene lactone); Element content: $C_{15}H_{22}O_4$; MM: 266.
29) 6-isopropenyl-4,8-α dimethyl-1,2,5,6,7,8 α- octahydro-naphthalene-2,3-diol; Element content: $C_{15}H_{24}O_2$; MM: 236. [9, 10, 13-15].

Obtaining totals of biologically active substances from the aerial parts of the species Artemisia maritima (sea wormwood)

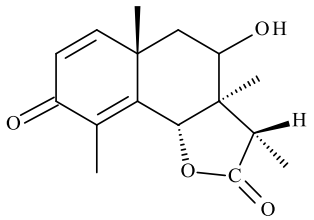
From the species *A. maritima* — sea wormwood, collected from the plain around Buzovna village of Baku in the beginning of budding phase in 2011, dark green resinous total extractive substances were obtained using a known method. Yield is 15,7 g (7,16%). 11.0 g of resin-like total extractives obtained from the aerial parts of the species *A. maritima* L. was mixed with 52.0 g of neutral Al_2O_3 with III-IV activity and chromatographed on a glass column filled with Al_2O_3 with the same activity (h = 35, d = 3.5 cm). The volume of each fraction is 100 ml. Chromatography column was eluated with hexane, a mixture of hexane and benzene in different proportions (8:2, 7:3, 6:4, etc.); with benzene, a mixture of benzene and chloroform (8:1, 8:2, 7:2, 6:4) and chloroform, and 3 crystalline substances — λ-santonin, artemisin, glabellin substances were obtained. After checking the individuality of the obtained crystalline substances, their structure was identified using modern spectral (IR-, UV-, mass-, ^1H, ^{13}C, ^{13}C Dept 135, Dept 90 NMR) methods along with chemical methods. The element content, melting temperature and IR spectrum of the obtained substance were compared with the same parameters of α-santonin, artemisin, glabellin, and it was determined that the studied substances overlap with α-santonin, artemisin, glabellin [16].



α-santonin



glabellin



artemisin

For the first time, the reserve of species (*Artemisia abrotanum* L., *A. maritima* L, *A. issaevii*

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Rzazade, *A. pauciflora* Web.) was studied. On 10 hectare of the area, the biological reserve of *Artemisia abrotanum* is 14 tons 400 kg and the operational reserve is 1 ton 440 kg; around Diza village of Julfa district, on 20 hectare of area biological reserve of *A. issaevii* is 18 tons and the operational reserve is 1ton, 800 kg, in the coastal plain on 120 hectare of area biological reserve of *A. maritima* is 324 tons and the operational reserve is 32 tons 400 kg, In Eldar plain of Samukh district on 15 hectare of area biological reserve of *A. pauciflora* is 14 tons and the operational reserve is 1 tons 700 kg [17].

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