UDC 547.913:543.2

CHEMICAL COMPOSITION OF EXTRACTS AND ESSENTIAL OILS OBTAINED FROM COMMON JUNIPER (*JUNIPERUS COMMUNIS L.*) IN AZERBAIJAN

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Received 15.12.2023
Accepted 13.02.2024

Abstract: *Juniperus communis L. (common juniper) is a widespread plant species in the Western region of Azerbaijan. The dependence of the composition and content of various biologically active substances in juniper on natural climatic conditions was studied. The results of the study of the substances obtained from the extraction of leaves and branches in ethanol were presented. The composition of volatile compounds was studied by the gas chromatography technique. In all samples, monoterpene hydrocarbons always predominated with percentages higher than 70% (from 71.12% for the plant material collected in August to 74.38% for those in September), followed in similar quantities by oxygenated monoterpenes or sesquiterpene hydrocarbons with values between 10.45% and 12.77% and between 10.50% and 12.72%, respectively. Ascorbic acid content varying from 33.1 to 123.2 mg/100 g was also determined. The investigation of the yield of essential oils in different months of the year showed that its amount varies depending on the season (3.5-4.4% of the mass of dry raw materials).*
Keywords: *common juniper, essential oils, gas chromatography, leaves, branches, terpenoids*

1. Introduction

Currently, the western region of Azerbaijan is increasingly attracting the attention of scientists, since the flora of this territory has unique characteristics in terms of plant species that are used to obtain valuable products for food and medicine fields [1, 2]. The wide distribution of the common juniper (*Juniperus communis* L., *Cupressaceae*) in the region allows us to research its bioactive compounds. The reason for the widespread use in folk medicine of preparations obtained from the leaves and branches of the common juniper is that their essential oils (EOs) and the related biologically active substances have a wide spectrum of pharmacological actions [3]. In particular, juniper berries are used to treat many infections, as well as spice and flavor in the preparation of some drinks [4]. *J. communis* has been used traditionally in folk medicine for renal suppression, acute and chronic cystitis, catarrh of the bladder, albuminuria, leucorrhea, and amenorrhea [5]. *J. communis* also has a healing effect on the forest environment, emits more phytoncides than other conifers and shapes the microclimate of the surface layer of the atmosphere [5].

The genus *Juniperus* L. consists of 67 species and 34 varieties [6]. All the taxa grow in the northern hemisphere, except *J. procera* Hochst. ex Endl., which grows along the Rift Mountains in east Africa in the southern hemisphere [7-9]. In Azerbaijan, the genus is represented by *J. foetidissima* Willd. *J. polycarpos* K. Koch, *J. oxycedrus* L. (syn.: *J. rufescens* Link), *J. excelsa* M. Bieb. (syn.: *J. sabina* L.) and *J. communis* var. *saxatilis* Pall. (syn.: *J. oblonga* M. Bieb. and *J. pygmaea* C. Koch.) along with *J. communis* [10]. Species names were verified against World Flora Online [11].

The analysis of literature data showed that numerous studies have been performed to investigate the morphology, anatomy, chemistry and biological activity of *J. communis.* Mohamedi and coauthors conducted complex studies on *J. communis* growing in natural forests obtaining information on tree biometric indicators, age structure, density, growth laws, shape diversity and morphological structure of the species [12]. In terms of antimicrobial potential, activity of its EO

has been proven against 40 different species of fungi, viruses and bacteria, including some resistant clinical strains [13]. It is an aromatic EO that possesses a light fruity fragrance considered psychologically uplifting [14].

The substances identified in *J. communis* belong to a large number of different chemical classes, such as aliphatic hydrocarbons, alcohols and acids, terpenes, sterols, polyphenols, tannins, and polysaccharides, among others. These compounds ensure protective functions, the stability and plasticity of the photosynthesis process, as well as the normal life activity of the plant as a whole [15].

However, it is known that the type and amount of molecules synthesized by plants mainly depend on the species, place and growth conditions (e.g., temperature regime, precipitation, duration of the vegetation period), and collection time [16-20]. Despite the fact that the taxonomy of the genus *Juniperus* has been well studied in Azerbaijan, data regarding the analysis of its chemical composition is lacking. Considering this, the aim of the present study was to evaluate both quantitative and qualitative differences in the chemical composition of the leaves and branches of *J. communis* from the western region during different seasons.

2. Experimental part

Plant material. The plant material (450 g) was collected from Dashkasan district (41°05′ 36" N - 45°21′ 58" E) in the first week of every month from April to December 2022.

Chemicals. All chemicals and solvents used in this study were purchased from Sigma Aldrich *(St. Louis, MO).*

Ethanol extraction. The branches with leaves (250 g) collected monthly were crushed to 2-3 mm with a laboratory mill (SM-450L, MRCLab, Israel). Ethanol extracts were obtained according to the standard method at 45-50°C for 6-7 hours in a Soxhlet extractor unit consisting of counter-cooling [21]. Each sample was settled for 16 hours at 4°C and the resinous part was filtered and separated with a separating funnel. Ethanol extracts were obtained according to the standard method at 45-50°C for 6-7 hours in a Soxhlet apparatus [22]. Each sample was then left to settle for 16 hours at 4°C to separate the resinous part destined for a characterization still in progress.

Distillation of EO. The leaves with branches (250 g) were also crushed to 2-3 mm with a laboratory mill (SM-450L, MRCLab, Israel) and EO was obtained by hydro-distillation with a Clevenger-type apparatus according to the European pharmacopeia 35 for 4 h [23]. The EO was collected, dried under anhydrous sulfate, and stored at 4ºC until used. EO yield was expressed in terms of the weight of the oil collected per gram of dry plant material.

Determination of physicochemical characteristics of EO. The considered physicochemical properties of the EO were color, transparency, odor and taste, density, kinematic viscosity, absorbance measurement. The color was determined by physical observation in daylight and under ultraviolet radiation using ultraviolet chamber [24]. The odor was determined by organoleptic evaluation following W.C. Evans [25]. The percentage oil yield was calculated according to AOAC, 2000. The refractive index was determined using a refractometer (model RL1 8056, Russia), and kinematic viscosity was determined with viscometer (model CT 72/P, Germany) [26].

Gas chromatography (GC). The qualitative composition of the ethanol extracts and EOs was determined by the gas chromatography method in an AutoSystem XL (Perkin Elmer, Canada) flame ionization detector chromatograph. A 100 m long thin quartz capillary column (diameter 250 μm x 0.5 μm) is evaporated at a temperature of 250°C. Under the influence of the carrier gas (helium) constantly flowing through this tube, the ethanol extracts and EOs in the form of vapor move through the tube. At the same time, the temperature of the column is 3-4°C/min and rises rapidly from 50°C to 200°C. The analysis and percentage of the individual components in the samples were calculated according to the next State Standards [27, 28].

Vitamin C determination. The 2, 6-dichlorophenolindophenol titrimetric method was used to determine the total ascorbic acid content from ethanol extracts [29].

3. Results and Discussion

3.1. Ethanol extract characterization

As a result of the research, monoterpenes and sesquiterpenes were found in ethanolic extracts by GC analysis (Table 1).

Table 1. Chemical composition (percentage values) of *J. communis* ethanol extracts *by GC technique*

Compounds	***April***	***May***	***June***	***July***	***August***	***September***	***October***	***November***	***December***
Monoterpene hydrocarbons									
α-pinene	32.20	32.1	31.12	30.65	31.65	33.90	32.97	32.45	32.45
camphene	2.01	1.99	2.00	2.12	1.03	2.00	2.45	2.00	2.07
ß -pinene	11.23	11.78	10.12	11.0	10.01	10.50	10.54	11.02	10.36
β-myrcene	9.23	9.00	8.89	9.21	8.89	9.62	9.95	8.78	8.00
Δ^3-karene	2.00	2.23	1.99	2.23	1.65	1.83	1.45	1.79	2.0
α-phellandrene	2.23	2.45	2.98	2.56	2.12	2.80	2.00	2.00	2.10
α-terpinene	2.05	2.2	2.54	2.89	2.64	2.50	2.12	2.56	2.78
dipentene	1.1	1.6	1.10	1.45	1.56	1.10	1.78	1.89	1.79
3-phellandrene	5.12	5.23	4.65	4.89	4.89	5.15	5.02	5.56	5.00
γ-terpinene	1.2	0.36	1.45	1.89	1.45	1.50	0.65	0.45	1.89
terpinolene	2.2	1.35	2.78	2.02	2.65	2.20	2.45	2.78	2.02
p-cymene	2.23	1.2	2.11	2.23	2.58	1.28	1.45	1.54	1.98
SUM	**72.8**	**71.49**	**71.73**	**73.14**	**71.12**	**74.38**	**72.83**	**72.82**	**72.44**
Oxygenated monoterpenes									
1,8 cineole	3.02	2.3	2.01	2.00	2.56	2.34	2.89	2.76	3.22
α-thujone	3.32	2.56	2.45	2.59	2.97	2.28	2.05	1.33	2.46
geranial	1.01	1.1	1.56	1.45	0.97	1.0	0.02	1.03	0.71
neral	0.23	0.98	1.45	0.12	0.98	0.80	0.45	0.12	0.36
longycyclene	1.23	1.32	1.65	1.02	1.35	1.12	1.06	1.40	1.09
α-terpineol	3.45	3.98	3.65	3.00	3.45	3.80	3.98	3.56	3.21
SUM	**12.26**	**12.24**	**12.77**	**10.18**	**12.28**	**11.34**	**10.45**	**12.21**	**11.05**
Sesquiterpene hydrocarbons									
chamazulene	3.29	4.14	3.9	4.67	3.97	2.90	3.78	2.45	3.89
β-caryophyllene	1.45	1.56	1.11	1.06	1.78	1.41	2.45	1.62	1.78
siberene	0.98	0.78	0.35	0.94	0.87	0.82	0.73	0.89	0.59
murolene	0.11	0.14	0.21	0.23	0.10	0.12	0.13	0.28	0.21
longifolene	0.98	0.97	0.87	0.99	0.79	0.95	0.89	0.87	0.85
α-cadinene	2.12	2.36	2.65	2.14	2.45	2.20	2.19	2.34	2.65
γ-cadinene	2.01	1.97	2.04	2.00	2.03	2.00	2.56	2.33	2.45
α-curcumene	0.1	0.65	0.12	0.20	0.12	0.10	0.11	0.21	0.3
SUM	**11.04**	**12.57**	**11.28**	**12.23**	**12.11**	**10.5**	**12.84**	**10.99**	**12.72**
Oxygenated sesquiterpenes									
farnesol	0.23	0.45	0.32	0.89	0.12	0.20	0.25	0.23	0.45
α-bisabolol	0.11	0.13	0.45	0.11	0.9	0.10	0.12	0.10	0.13
bornyl acetate	3.56	3.12	3.45	3.45	3.47	3.48	3.51	3.65	3.21
SUM	**3.9**	**3.7**	**4.22**	**4.45**	**4.49**	**3.78**	**3.88**	**3.98**	**3.79**

In all samples, monoterpene hydrocarbons always predominated with percentages higher than 70% (from 71.12% for the plant material collected in August to 74.38% for those in September), followed in similar quantities by oxygenated monoterpenes or sesquiterpene hydrocarbons with values between 10.45% and 12.77% and between 10.50% and 12.72%, respectively. Oxygenated

sesquiterpenes were present in all harvest months in small quantities, with a maximum of 4.49% in August. α-Pinene was the most abundant hydrocarbon monoterpene (30.65%-33.90%) together with ß-pinene (10.01%-11.78%), ß-myrcene (8.00%-9 .95%) and 3-phellandrene (4.65%-5.56%), while among the oxygenated monoterpenes, α-terpineol prevailed (3.00%-3.98%). The main sesquiterpene hydrocarbons were α- (2.12%-2.65%) and γ-cadinene (1.97%-2.56%). Bornyl acetate characterized the fraction of oxygenated sesquiterpenes (3.12%-3.65%).

It is known that *J. communis* synthesizes a certain amount of compounds with biological activity (EO components, chlorophylls, carotenoids, many amino acids, vitamins, and phytohormones) [30].

In this work, we managed to determine the content of ascorbic acid in alcohol extracts. These values varied from 33.1 mg/100g in April to 123.2 mg/100g in September being, however, approximately 2 times lower than those of the pines (in particular, *P. chiapensis* L.) present in the same region and characterized by values ranging from 87.8 to 210.7 mg/100g [31, 32].

3.2. Essential oil characterization

EOs are a complex combination of volatile aromatic substances belonging to various organic chemical classes, mainly terpenoids. Most EOs are characterized by the presence of monoterpenoids with medicinal properties [33].

The EO obtained from *J. communis* growing in the western region of Azerbaijan and harvested over several months was a light yellow volatile liquid.

The amount of EO in the leaves and branches of *J. communis* samples varies throughout the year and has 2 maximum percentages, respectively in spring and in autumn: in April it reached 4.3% while in September it was 4.4%. It can be seen from the graph (Fig.) that the decrease in the quantity of EO begins in May and reaches its lowest value in June, confirming EO's role in the growth of the plant [34]. The yield of *J. communis* EO and its seasonal variation have been the subject of many studies around the world. Thus, according to N.V. Gerlingin , the yield of EO from *J. communis* growing in the Middle Taiga zone was 4.46-0.81%, EO compounds in the needles of *J. Sabina* (Kazakh juniper) 2.60%; 1.80-2.10% in *J. communis* var. *saxatilis* Pall. (*Siberian juniper*), it is 1.07% in Green Sargent Juniper (*J. chinensis* Viridis) [35, 36]. It should be noted that according to D.K. Uvarovskaya in Far Eastern juniper species, EO content decreases in April-June, and increases in autumn-winter [37]. Depending on the season, the yield of EO was 3.5-4.4% (Table 2, Fig.).

Table 2. Yields of EO obtained from *J. communis* depending on the season

The months of collecting of the raw material	Volume of essential oil, (ml)	Yield of EO (%)
April	10.75	4.3
May	10.5	4.2
June	8.25	3.5
July	10.0	4.0
August	10.25	4.1
September	11.0	4.4
October	8.75	3.5
November	7.97	3.19
December	10.0	4.0

Also, during the summer and winter months, the lowest levels of EO in the plant were recorded (Fig.). The accumulation of EO from July to September is explained by the intensification of physiological processes and the activation of metabolism in conifers, the formation of which ends with the approach of autumn, in correspondence with which (October-November) the metabolic processes slow down and the plants react to the reduction of daylight hours by finding themselves in a state of forced dormancy [38].

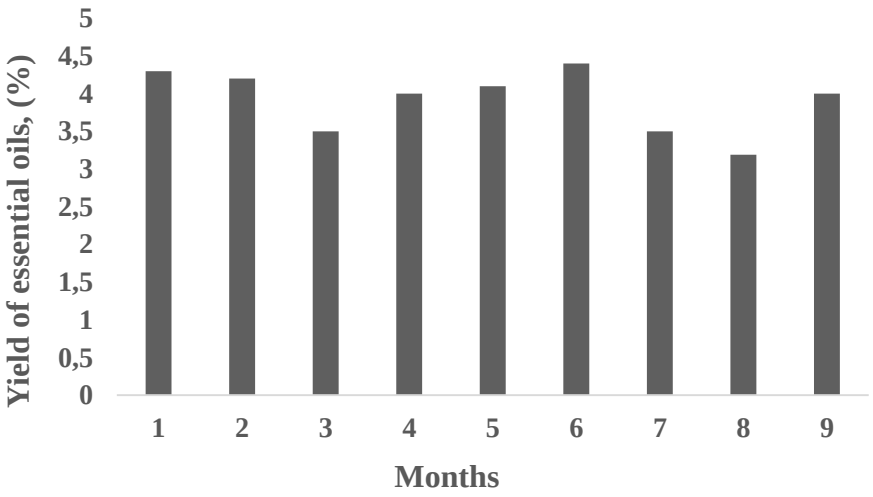

Fig. The monthly (1-April; 2-May; 3-June;-July; 5-August; 6-September; 7-October; 8-November; 9-December) dynamics of EO in *J. communis* branches and leaves

Table 3. Chemical composition (percentage values) of J. communis EO by GC technique

Compounds	***April***	***May***	***June***	***July***	***August***	***September***	***October***	***November***	***December***
Monoterpene hydrocarbons									
tricyclene	0.23	0.10	0.03	0.02	0.01	0.03	0.02	0.02	0.03
a-thujene	0.23	0.45	0.78	0.32	0.87	0.75	0.26	0.45	0.36
α-pinene	19.47	20.47	19.12	19.9	16.31	17.12	16.41	17.34	16.89
camphene	1.98	2.13	2.47	3.36	2.45	2.36	2.58	2.56	2.36
sabinene	4.69	4.95	5.46	5.45	5.22	3.83	4.87	5.42	4.45
β-Pinene	1.41	3.45	3.65	4.25	3.47	3.78	3.58	3.78	3.89
p-pinene	6.36	5.56	5.23	7.36	4.23	6.24	7.63	7.26	7.63
ß-myrcene	6.63	5.78	5.63	7.63	5.45	6.63	8.45	7.74	7.29
Δ^3-karene	2.36	2.45	2.78	3.56	2.89	2.78	1.89	1.98	1.99
α-phellandrene	3.47	2.78	2.45	3.56	3.45	3.12	3.23	3.25	2.45
α-terpinene	2.36	2.22	2.56	3.36	2.57	2.65	2.36	3.01	2.98
dipentene	1.2	1.7	2.01	2.63	1.78	1.63	2.58	2.01	1.69
3-phellandrene	5.63	5.89	5.64	6.47	5.67	4.57	5.78	5.97	4.89
γ-terpinene	1.6	1.47	0.36	1.78	1.78	1.32	1.37	0.78	2.36
terpinolene	2.7	2.56	2.97	2.36	2.6	2.89	2.45	2.97	2.47
p-cymene	2.56	2.3	2.56	2.79	2.56	2.76	1.78	1.79	1.43
SUM	**67.34**	**63.26**	**61.17**	**63.3**	**61.31**	**62.46**	**63.24**	**64.33**	**63.16**
Oxygenated monoterpenes									
1,8 cineole	3.45	2.36	3.14	2.36	3.56	2.69	2.47	2.87	3.41
α-thujone	3.45	3.47	3.12	3.12	3.24	3.46	3.74	3.44	3.14
geranial	1.20	1.45	1.78	1.78	1.69	1.77	0.47	1.55	0.66
neral	0.36	0.99	0.74	0.96	0.77	0.79	0.99	0.78	1.23
longycyclene	2.13	2.78	2.88	2.56	2.36	2.78	2.99	2.47	2.97
α-terpineol	3.44	4.2	4.44	4.78	4.69	4.78	4.02	4.78	4.44
SUM	**14.03**	**15.25**	**16.1**	**15.56**	**16.31**	**16.27**	**14.86**	**15.89**	**15.85**
Sesquiterpene hydrocarbons									
Verbenene	0.03	0.11	0.14	0.07	0.09	0.04	0.03	0.01	0.01
a-Copaene	1.23	1.63	1.78	1.48	1.79	0.58	0.74	0.25	0.99
chamazulene	3.45	3.98	4.23	4.78	4.66	3.96	3.78	3.55	4.12
ß-caryophyllene	1.23	1.63	1.45	1.77	2.31	1.88	2.93	2.36	2.47

siberene	0.36	1.32	1.45	1.58	1.02	1.69	1.47	1.27	1.44
murolene	0.12	0.36	0.47	0.33	0.74	0.96	0.47	0.33	0.47
longifolene	0.99	0.71	1.36	1.37	1.33	1.76	1.23	1.44	1.35
α-cadinene	2.98	2.56	2.74	2.36	2.77	2.33	2.71	2.91	2.31
γ-cadinene	2.33	2.47	2.77	2.69	2.37	2.71	2.34	2.66	2.10
α-curcumene	0.31	0.78	0.47	0.14	0.73	0.13	1.46	0.31	0.99
SUM	**13.03**	**15.55**	**16.86**	**16.57**	**17.81**	**16.04**	**17.16**	**15.09**	**16.26**
Oxygenated sesquiterpenes									
farnesol	1.36	0.79	0.56	0.99	0.46	0.34	0.23	0.77	0.64
α-bisabolol	0.23	0.79	0.56	0.44	0.33	0.93	0.14	0.79	0.43
bornyl acetate	4.01	4.36	4.22	3.14	3.78	3.96	4.37	4.13	3.66
SUM	**5.6**	**5.94**	**5.34**	**4.57**	**4.57**	**5.23**	**4.74**	**5.69**	**4.73**

The chemical volatile composition of *J. communis* EO investigated by GC is shown in Table 3. As a result of the research, monoterpenes and sesquiterpenes were found in the EO. In all samples, monoterpene hydrocarbons always predominated with percentages higher than 60% (from 61.31% for the plant material collected in August to 62.46% for those in September), followed in similar quantities by oxygenated monoterpenes or sesquiterpene hydrocarbons with values between 14.86% and 16.1% and between 16.04% and 16.26%, respectively. Oxygenated sesquiterpenes were present in all harvest months in small quantities, with a maximum of 5.94% in August. α-Pinene was the most abundant hydrocarbon monoterpene (16.31%-20.47%) together with ß-pinene (1.41%-4.25%), ß-myrcene (5.45%-8.45%) and 3-phellandrene (4.57%-6.47%), while among the oxygenated monoterpenes, α-terpineol prevailed (3.44%-4.78%). The main sesquiterpene hydrocarbons were α- (2.31%-2.98%) and γ-cadinene (2.10%-2.77%). Bornyl acetate characterized the fraction of oxygenated sesquiterpenes (3.14%-4.37%).

3.3. Physicochemical characteristics of *J. communis* EO

The study of various physicochemical characteristics explores the practical importance and provides bases for the suitability and usefulness of various oils of plant origin in daily life. In general, the commercial importance of oils mostly depends on these physicochemical properties, which provide baseline data to determine their suitability for consumption [39, 40]. The results of the physicochemical analysis of *J. communis* EO are presented in Table 4.

Table 4. Physicochemical properties of EOs obtained from *J. communis* depending on the collection month

№	Color	Trans-parency	Odor and taste	Density at 20°C, g/sm^3	N_D, 20°C	Kinematic visco. 20°C, mm^2/s	pH	Refractive index at 25°C	ABS (absorbance measurement)
N1	yellow	Clear	specific	0.9769	1.3645	1.741	4.25	0.5	0.959
N2	yellow	Clear	Specific	0.8162	1.2356	1.631	5.12	0.1	1.155
N3	yellow	Clear	Specific	0.8445	1.2564	1.625	6.31	1.5	1.211
N4	yellow	Clear	Specific	0.9785	1.2456	1.742	5.00	0.5	0.987
N5	yellow	Clear	Specific	0.8954	1.4235	1.623	6.12	0.5	0.963
N6	yellow	Clear	Specific	0.9745	1.3258	1.685	4.23	0.2	0.987
N7	yellow	Clear	Specific	0.9782	1.4562	1.789	5.23	0.3	0.978
N8	yellow	Clear	Specific	0.8974	1.3214	1.712	5.12	0.3	0.951
N9	yellow	Clear	Specific	0.9178	1.4789	1.754	5.47	0.5	0.914

***Note*:** N1 - April, N2 – May, N3 – June, N4 – July, N5 – August, N6 – September, N7 – October, N8 – November, N9 - December

As can be seen from Table 4, the density of EO is usually less than unity [41]. The refractive index is almost constant for all EOs and this depends on the prevalence of some compounds over others [42]. The highest refraction is characteristic of EOs with a high content of aliphatic terpenes with three double bonds which corresponds to our results, and the lowest refraction is characteristic of tricyclic terpenes [43-45].

4. Conclusion

In conclusion, due to the yield of EO from the branches with leaves of *J. communis* (in April 4.3% and in September 4.4%), it can be used as a source of raw materials for obtaining EO from that plant. Based on the medicinal properties of the components of the juniper, the obtained essential oil can be used in medicine and cosmetology in the preparation of ointments and lotions with various ingredients. At the same time, the EO obtained in April contains 67% of monoterpene hydrocarbons, which are biologically important compounds. Moreover, the ethanol extract of the plant can be used as a potential natural source for the cosmetic and drug industry.

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ХИМИЧЕСКИЙ СОСТАВ ЭКСТРАКТОВ И ЭФИРНЫХ МАСЕЛ, ПОЛУЧЕННЫХ ИЗ МОЖЖЕВАЛЬНИКА ОБЫКНОВЕННОГО (JUNIPERUS COMMUNIS L.) В АЗЕРБАЙДЖАНЕ

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Аннотация: Juniperus communis L. (можжевельник обыкновенный) – широко распространённый вид растения в западном регионе Азербайджана. Изучена зависимость состава и содержания различных биологически активных веществ в можжевельнике от природно-климатических условий. Представлены результаты исследования веществ, полученных экстракцией этанолом из листьев и ветвей. Состав летучих соединений изучали методом газовой хроматографии. Во всех образцах всегда преобладали монотерпеновые углеводороды с процентным содержанием выше 70% (от 71.12% для растительного материала, собранного в августе, до 74,38% для растительного материала, собранного в сентябре), за которыми в аналогичных количествах следовали кислородсодержащие монотерпены или сесквитерпеновые углеводороды со значениями от 10.45% до 12.77% и от 10.50% до 12.72% соответственно. Также было определено содержание аскорбиновой кислоты в пределах от 33.1 до 123.2 мг/100 г. Исследование выхода эфирного масла в разные месяцы года показало, что его количество колеблется в зависимости от сезона (3.5-4.4% от массы сухого сырья).
Ключевые слова: можжевельник обыкновенный, эфирные масла, газовая хроматография, листья, ветки, терпеноиды

AZƏRBAYCANDA BİTƏN ADİ ARDICDAN (JUNIPERUS COMMUNIS L.) ALINAN EKSTRAKTLARIN VƏ EFİR YAĞLARININ KİMYƏVİ TƏRKİBİ

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Xülasə: Adi ardıc (Juniperus communis L.) Azərbaycanın Qərb bölgəsində geniş yayılmış bitki növüdür. Ardıcın tərkibində olan müxtəlif bioloji aktiv maddələrin tərkibinin, miqdarının və onun böyüməsinin təbii iqlim şəraitindən asılılığı tədqiq olunmuşdur. Yarpaq və budaqların etanolda ekstraksiyasından alınan ektraksiya məhsullarının tədqiqinin nəticələri verilmişdir. Uçucu ekstraksiya maddələrin tərkibi xromatoqrafiya metodu ilə öyrənilmişdir. Bütün nümunələrdə monoterpen karbohidrogenləri 70%-dən yuxarı olur (avqustda yığılan bitki materialı üçün 71.12%-dən yuxarı, sentyabrda yığılanlar üçün isə 74.38%-ə qədər), eyni zamanda həmin miqdarda oksigenləşdirilmiş monoterpenlər və ya sesquiterpen karbohidrogenləri 10.45% və 12.77% və müvafiq olaraq 10.50% ilə 12.72% arasında müyyən edilmişdir. 33.1-123.2 mq/100 q arasında dəyişən askorbin turşusu da təyin edilmişdir. Efir yağlarının ilin müxtəlif aylarında məhsuldarlığının tədqiqi göstərdi ki, onun miqdarı mövsümdən asılı olaraq dəyişir (quru xammalın kütləsinin 3.5-4.4%-i).

Açar sözləri: adi ardıc, efir yağları, qaz xromatoqrafiyası, yarpaqlar, budaqlar, terpenoidlər