Plant & Fungal Research (2022) 5(1): 32-40
https://doi.org/10.30546/2664-5297.2022.1.32.

June 2022

Antimicrobial activity and phytocoenotic features of some rare and endemic plant species of Azerbaijan flora

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Abstract: The article presents the results of the antimicrobial activity study of methanolic extracts obtained from previously unexplored six rare and endemic species (*Alcea kusariensis, Cladochaeta candidissima, Sedum caucasicum, Iris reticulata, Platanus orientalis*, *Zelkova carpinifolia*) of the Azerbaijani flora. The extracts were evaluated for their antimicrobial activity against strains of *Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus, Bacillus anthracoides and Candida albicans* that are part of the normal human microflora and are considered opportunistic. This study has established that methanol extracts obtained both from whole plants and from different organs, both individually and in different combinations with each other, have sufficiently pronounced antimicrobial properties. Phytocoenosis of the growth sites of these species was also studied and described, and a corresponding GIS map was compiled.

Key Words: *biological activity, flora, medicinal plants, microorganisms, plant extracts, phytocenosis*

INTRODUCTION

The flora of Azerbaijan is characterized by a variety of medicinal herbal raw materials, many of which can be used on an industrial scale. In the modern world, biologically active substances obtained from plants are used to create medicines, food additives, products of the cosmetology, perfume industry and agricultural products [Viviane, Clenilson, 2014]. Medicinal plants have been used since ancient times either as extracts or in other forms [Salmerón-Manzano, 2020].

The spread of drug-resistant pathogens is one of the greatest threats to the successful treatment of infectious diseases. Phytopreparations possesing antimicrobial properties with anti-inflammatory and regenerative effects can contribute to the solution of the problem.

Study involves various plants grown on the territory of Azerbaijan and that have been used in local traditional medicine, such as *Alcea kusariensis* (Iljin) Iljin., *Cladochaeta candidissima* (M. Bieb.) DC., *Sedum caucasicum* (Grossh.) Boriss., *Iris reticulata* M. Bieb., *Platanus orientalis* L. and *Zelkova carpinifolia* (Pall.) K. Koch.

All organs of the *Alcea kusariensis* (Iljin) Iljin. contain mucilage. Carbohydrates (polysaccharides, respectively 2.08-2.5 and 3-5.3%) were found in the roots and stems [Imanova et al., 1979]. In traditional medicine of Azerbaijan, flowers brewed in milk are used for colds and coughs. Experimental studies revealed the antitumor activity of polysaccharides isolated from the roots and stems in relation to solid forms of tumors [Kozhina, 1975]. O.D. Barnaulova and O.A. Manicheva [Barnaulov, Manicheva, 1981] established that polysaccharides isolated from stems reduce the acidity of gastric juice.

Tea from the aerial parts of the *Cladochaeta candidissima* in traditional medicine of Azerbaijan is used as a means of stimulating regula [Medicinal plants of Azerbaijan, 1942].

In the aerial parts of this *Sedum caucasicum,* V.G. Zaitsev et al. [1993] found alkaloids, tannins, coumarins (esculetin), flavonoids and organic acids [Gnedkov, Shreter, 1977]. In folk medicine of Dagestan and Georgia, roots and leaves are used for skin diseases and inflammatory processes, as an anti-inflammatory as well as a central nervous system stimulating agent [Alekseev, 1964; Eristavi,1971]. Leaves are used in impotence, as well as wound healing, anti-cynogenic, hemostatic, as fungicidal during dermatophytosys [Alekseev, 1964]. Juice has prothistocidal properties [Plant resources…,

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Received 13.04.2022; Received in revised form 28.04.2022; Accepted 18.05.2022

1990] leaves of the plant are also used as food to make salads, cabbage soup and for fermentation. The plant is an effective melliferous herb [Kos, 1948; Glukhov, 1974].

There is no information on the chemical composition and therapeutic properties of *Iris reticulata* in the literature.

The fruits of *Platanus orientalis* were found to contain triterpenoids, higher aliphatic acids and higher fatty acids [Catalano, 1987]. In traditional medicine of medieval Azerbaijan, decoctions of bark, leaves and fruits were used for arthritis, stomatitis, purulent wounds and to stop bleeding [Alekperov, 1999]. Laboratory studies showed that extracts from various parts of the tree exhibited antioxidant, anti-inflammatory [Indirabi et al., 2016], good inhibition activity against AChE and BuChE, significant anticancer, antimicrobial [Ucar et al., 2018], and antihepatotoxic [El-Alfy Taha et al., 2008] activities.

D.E. Giannasi [Giannasi, 1978] reported to find flavonoids such as kaempferol, quercetin and myristin in the leaves of *Zelkova carpinifolia.* In traditional medicine of Medieval Azerbaijan, leaves were used as a wound healing agent [Alekperov, 1992].

The aim of the research is to study the effect of extracts obtained from some endemic and rare species of medicinal flora of Azerbaijan on the drug-resistant microorganisms.

MATERIAL AND METHODS

The collection of plant raw materials for obtaining extracts was carried out in the Guba, Gusar, Khachmaz, Ismailli, Lankaran and Lerik districts in April and August-September 2018 (Fig. 1). Considering that investigated plants are rare and endemic species, they were collected in various regions in minimally enough amounts to preserve their population (Fig. 1).

The description of phytocoenoses was carried out according to the methods generally accepted in geobotany [Field Geobotany, 1964; Ipatov, Kirikova, 1998; Mirkin et al., 2001].

Endemic plants were given according to V.M. Ali-zade et al. [2014], rare species according to Red Book of Azerbaijan [2013].

Latin names of species are given in accordance with the "Flora Azerbaijana" [Flora of Azerbaijan, 1950-1961] and new taxonomic status is given according to the Euro+Med Plantbase database [The Euro+Med Plantbase Project].

Before reflux extraction leaves of all plants have been treated with n-hexane to remove chlorophyll. All aerial and underground plant organs were cut in small pieces and subjected to reflux extraction with pure methanol for 1 hour in ratio of 1:20 (plant material:methanol). After extraction the extracts were filtered and evaporated until dryness under reduced pressure. Dry extracts were weighed and stored at -18 ºC until used.

Antibacterial activity of the extracts was evaluated using disc diffusion method in Petri dishes [Bauer et al., 1966]. Extracts were tested against *Candida albicans, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Bacillus anthracoides*. The microorganisms were provided by the Department of Medicinal Microbiology and Immunology of the Azerbaijani Medical University from their local culture stock. Bacteria were cultivated on meat peptone and *C. albicans* was cultuvated on Sabouraud dextrose agar culture media. Petri dishes were inoculated from stock suspensions of 500 mln/mL cultivated for 24 hours prior to the experiment. Sterile papers discs of 6 mm in diameter were imprignated with 0.1 ml of diluted extracts and transferred on the surface of the agar. Petri dishes were incubated for 18-24 h at 37°C and result were recorded by observing the sterile zones around the discs.

RESULTS AND DISCUSSION

Alcea kusariensis (Iljin) Iljin. (Malvaceae Juss.) is an endemic plant of the Caucasus and also a rare species (Fig. 2A). Perennial rod-root plant is 50-150 cm tall. The leaves are petiolate, the leaf plate is 5-7 lobed. The flowers are single bright-colored in a spaced inflorescence. It blooms in June-August, bears fruit in July-September. Distributed in the regions Guba part of the Greater Caucasus, Eastern Greater Caucasus, Samur-Devechi and Caspian lowlands. It grows in forests (along the edges, in clearings) among shrubs and in weeds from the lowland to the middle mountain belt.

Aerial and underground parts of *A. kusariensis* were collected from waste ground of the surroundings of the Isnovgyshlaq, a settlement of the Guba district (228 m above the sea level), on the meadows in the surroundings of Gidjan village of the Gusar district (1487 m above the sea level), along the fork of road form Guba to Khachmaz district, and surroundings of Mugtadyr village of the Khachmaz district (– 23 m below the sea level).

In the mentioned areas *Alcea kusariensis* can be found in various plant communities, usually 3-5 species in each community. Thus, in Guba district, along with *A.*

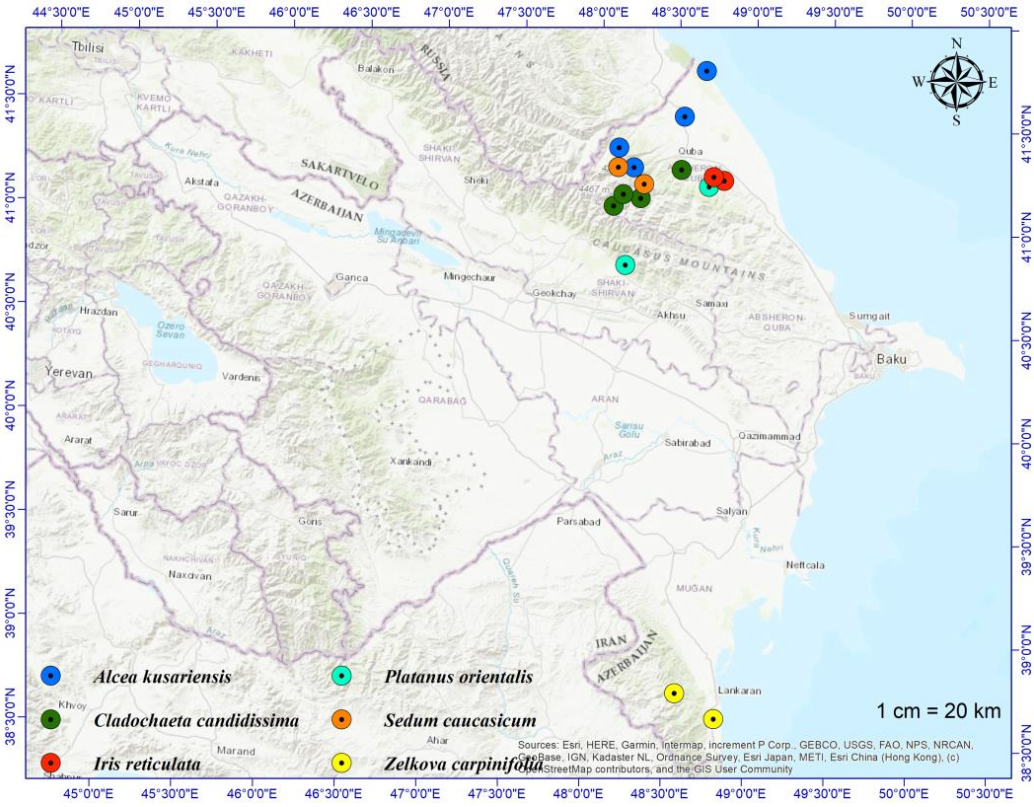

Figure 1. The map of routes of investigated areas

kusariensis some shrubs, such as *Paliurus spina-christi* Mill. (1-2 points), *Rhus coriaria* L. (abundance of plants 2 points) and *Rubus sanctus* Schreb. (2-3 points) can be found. Herbaceous plants are represented by *Glycyrrhiza glabra* L. (3-4 points), *Cichorium intybus* L. (3 points) and *Polygonum aviculare* L. (2-3 points). Species *Euphorbia boissieriana* (Woronow) Prokh., *Foeniculum vulgare* Mill., *Melilotus officinalis* (L.) Lam., *Teucrium hircanicum* L., *Senecio grandidentatus* Ledeb. (*Jacobaea erucifolia* subsp. *arenaria* (Soó) B. Nord. et Greuter) received 1-2 points and were recorded as the most abundant ones.

In Khachmaz district *A. kusariensis* was found on the seacoast where species such as *Convolvulus persicus* L., *Melilotus caspius* Gruner (*M. polonicus* (L.) Pall.), *Argusia sibirica* (L.) Dandy, *Cakile euxina* Pobed. and *Equisetum ramosissimum* Desf. were dominant. By the roadsides, *A. kusariensis* coexists with *Tribulus terrestris* L. (1-2 points), *Capparis spinosa* L. (2 points), *Chondrilla juncea* L. (1-2 points), *Heliotropium europaeum* L. (1-2 points), *Eryngium campestre* L. (1-2 points) and *Rubus caesius* L. (2-3 points).

Cladochaeta candidissima (M. Bieb.) DC. (Compositae Giseke) is an endemic plant of the Caucasus, also a rare species (Fig. 2B). Perennial shiny rod-root plant (4) 15-40 cm tall. The leaves are fleshy, the baskets are reverse-conical, collected in a dense shield, the flowers are yellow. It blooms in June-August, bears fruit in July-September. Distributed in all districts of the Greater Caucasus, in Gobustan and Samur-Davachi lowland. It grows on pebbles of rivers from the lowland to the subalpine belt [Flora of Azerbaijan, 1961].

The aerial and underground parts of *C. candisissima* are collected on pebbles of the Alikchay river in the vicinity of the villages of Alikchay (1649 m above sea level), Bostankesh (1899 m above sea level) and Khynalig (1976 m above sea level), as well as on pebbles of the Garachay river in the vicinity of the village of Alyj (671 m above sea level) (Fig. 1).

On the pebbles of the Alikchay river, the plant population is very poor and only 3 species *Cirsium argillosum* Kharadze, *Plantago major* L. and *Anthemis rudolphiana* Adams (*Archanthemis marschalliana* subs. *sosnovskyana* Lo Presti ex Oberpr were noted. The pebbles of the Garachay river hosted *Cladochaeta candidissima* neighbored by *Amaranthus retroflexus* L. (4-5 points), *Equisetum arvense* L. (2-4 points), *Sambucus ebulus* L. (2-3 points), *Geranium lucidum* L. (3 points), and with an abundance mark of 1-2 points *Ailanthus altissima* (Mill.) Swingle, *Tamarix*

ramosissima Ledeb., *Xanthium spinosum* L., *Mentha longifolia* (L.) L., *Polygonum persicaria* L. (*Persicaria maculosa* Gray), *Artemisia absinthium* L., *Tussilago farfara* L., were found there as well. In addition, few virginil species of *Alnus incana* (L.) Moench were present.

Sedum caucasicum (Grossh.) Boriss. (*Hylotelephium maximum* subsp. *ruprechtii* (Jalas) Dostál) (Crassulaceae DC.) is an endemic plant of Caucasus (Fig. 2C). A perennial naked plant with a thick rhizome and often-thickened fusiform roots. The stem is usually purple in color, (25) 30-50 (70) cm tall. The leaves are large, oval-ovate, stalk-bearing, 3-4 cm wide. The petals are whitish or pale-raised. It blooms in July-August, bears fruit in August-September. Distributed in the regions of the Guba part of the Greater Caucasus, Northern Lesser Caucasus, Central Lesser Caucasus and mountain part of Nakhchivan from the lower to the upper mountain belt [Flora of Azerbaijan, 1953].

The aerial and underground parts of *S. caucasicum* are collected on the rocky slopes of the forest near the village of Gyryzdakhna (1392 m above sea level) of the Guba district and on the mountain slopes of Mount Shahdag (1755 m above sea level) of the Gusar district (Fig. 1).

In the forest, the edificatory are *Fagus orientalis* Lipsky and *Tilia caucasica* Rupr. (*T. begoniifolia* Steven). In the woody-shrub tier *Carpinus caucasica* Grossh (*C. betulus* L.) (3-4 points), *Acer campestre* L. (3 points), *A. velutinum* Boiss. (2 points), *A. platanoides* L. (2 points), *Taxus baccata* L. (1-2), *Rubus idaeus* subsp. *idaeus* L. (3 points), *Mespilus germanica* L. (*Crataegus germanica* (L.) Kuntze) (2 points) were found.

On the rocks and stems of *S. caucasicum* was neighbored by the species with an abundance mark of 2-3 points, *Asplenium trichomanes* L., *Phyllitis scolopendrium* (L.) Newman, *Papaver oreophyllum* Rupr., *Pyretrum leptophyllum* M. Bieb. (*Tanacetum leptophyllum* (M. Bieb.) Sch. Bip.), *Polygonathum glaberrimum* K. Koch, *P. verticillatum* (L.) All., *Erigeron venustus* Botsch. (*E. caucasicus* subsp. *venustus* (Botsch.) Grierson), *Carlina vulgaris* L., *Petasites albus* (L.) Gaertn., *Lavatera thuringiaca* L.

On the humid grassy slopes of Shahdag mountain, *S. caucasicum* grows on rocks, where it is part of the plant groups represented by such species as *Allium kuntianum* Vved., *Rubus saxatilis* L., *Campanula trautvetteri* Fed. (*C. glomerata* L.), *Erigeron caucasicus* Steven, *Sedum oppositifolium* Sims (*S. spurium* M. Bieb.), *Saxifraga cartilaginea* Willd. (*S. paniculata* Mill.), *Thalictrum foetidum* L.

Iris reticulata M. Bieb. (Iridaceae Juss.) - a rare species (Fig. 2D). The perennial plant is 10-20 (30) cm tall. Leaves are in groups of 2-3, green, thin, tetrahedral. The flowers are single, purple in color. Color in March-April. Distributed in the regions of Guba part of the Greater Caucasus, Gobustan, Samur-Devechi, Caspian and Kur-Araz lowlands, Gobustan, Bozgir plateau, Kur plain and Diabar. It grows from the lowland to the middle mountain belt [Flora of Azerbaijan, 1952], beautiful ornamental plant.

Aerial parts of *I. reticulata* were collected in the forest between the villages of Gedik and Isnov, Guba district (475-486 m above sea level) (Fig. 1).

In this area, *I. reticulata* is found on forest edges, grassy slopes, and among shrubs, represented mainly by the species *Rhus coriaria*, *Cydonia oblonga* Mill., *Cornus mas* L., *Rubus caesius* L., *Rosa canina* L., *Crataegus pentagyna* Willd., and herbaceous species represented by *Orchis picta* Loisel. (*Anacamptis morio* subsp. *picta* (Loisel.) Jacquet et Scappat.), *Vinca herbacea* Waldst. et Kit., *Papaver commutatum* Fisch. et C. A. Mey., *Tulipa biebersteiniana* Shult. et Schult.f.

Platanus orientalis L. (Platanaceae Dumort.) - Eastern plane tree or Oriental Plane. Relict, a rare species (Fig. 2E). Deciduous tree 25-30 m tall. It is found in the regions of the Greater Caucasus of the eastern, Small Caucasus of the southern and Kura-Araks lowlands. It blooms in April-May, bears fruit in September-October [Flora of Azerbaijan, 1953].

The leaves and fruits of *P. orientalis* were collected on a personal plot at the source in the village of Isnov of Guba district (at an altitude of 557 m above sea level), as well as in a forest in the vicinity of the village of Khanagakh of Ismaili district (950 m above sea level) (Fig. 1).

In the forest, the coenosis edifier is *Carpinus caucasica*, and the dominants are *Acer velutinum* and *Tilia platyphyllos* Scop. The woody-shrub tier formed by *Fraxinus excelsior* L., *Robinia pseudoacacia* L., *Corylus colurna* L., *Prunus divaricata* Ledeb., *Cornus mas*, the liana shrubs represented by *Hedera pastichovii* Woronow and *Vitis sylvestris*. The herbaceous tier is dominated by *Sambucus ebulus*, *Dryopteris filix-mas* (L.) Schott, *Geum urbanum* L. and *Eupatorium cannabinum* L.

Zelkova carpinifolia (Pall.) K. Koch (Ulmaceae Mirb.) - Caucasian zelkova is a relict and rare species (Fig. 2F). Deciduous tree (15) 20-25 (35) m tall. It blooms in March, bears fruit in May-September. Distributed in

Table. Antimicrobial activity of the plant extracts used in this study.

№	Species name	Concentration	Microorganisms					
			Candida albicans	*Staphylococcus aureus*	*Escherihia coli*	*Pseudomonas aeruginosa*	*Klebsiella pneumoniae*	*Bacillus anthracoides*
1.	*Alcea kusariensis* (flowers)	1	±	+	+	-	-	-
		2	±	+	+	-	-	-
		3	±	-	+	-	-	-
2.	*Alcea kusariensis* (stem with flowers)	1	±	-	-	-	±	-
		2	±	-	-	-	±	-
		3	-	-	-	-	±	-
3.	*Alcea kusariensis* (leaves)	1	-	-	-	-	-	-
		2	-	-	-	-	-	-
		3	-	-	-	-	-	-
4.	*Alcea kusariensis* (stem)	1	-	-	-	-	+	-
		2	-	-	-	-	+	-
		3	-	-	-	-	+	-
5.	*Alcea kusariensis* (root)	1	±	-	-	-	+	+
		2	-	-	-	-	+	+
		3	-	-	-	-	+	-
6.	*Alcea kusariensis* (seeds)	1	±	±	-	-	±	-
		2	±	±	-	-	±	-
		3	-	-	-	-	-	-
7.	*Cladochaetha candidissima* (whole plant)	1	-	-	-	-	+	+
		2	-	-	-	-	+	-
		3	-	-	-	-	±	-
8.	*Iris reticulata* (aerial parts)	1	-	-	-	-	-	+
		2	-	-	-	-	-	-
		3	-	-	-	-	-	-
9.	*Sedum caucasicum* (flowers)	1	±	-	-	-	-	-
		2	±	-	-	-	-	-
		3	±	-	-	-	-	-
10.	*Sedum caucasicum* (leaves)	1	±	±	-	-	±	±
		2	±	±	-	-	±	±
		3	±	±	-	-	±	-
11.	*Sedum caucasicum* (stem)	1	-	-	-	-	+	-
		2	-	-	-	-	+	-
		3	-	-	-	-	+	-
12.	*Sedum caucasicum* (root)	1	+	+	-	-	±	-
		2	+	+	-	-	±	-
		3	+	+	-	-	±	-
13.	*Platanus orientalis* (leaves)	1	±	±	-	-	±	-
		2	±	±	-	-	±	-
		3	±	±	-	-	±	-
14.	*Platanus orientalis* (fruit)	1	+	+	-	-	±	-
		2	±	+	-	-	±	-
		3	±	+	-	-	±	-
15.	*Zelkova carpinifalia* (leaves)	1	-	-	-	-	±	-
		2	-	-	-	-	±	-
		3	-	-	-	-	±	-

Note: bacteriostatic effect observed: "-" - no effect; "+" - effects the development of microorganism; "±" - does not fully affect the development of the microorganism, but sharply reduces its growth.

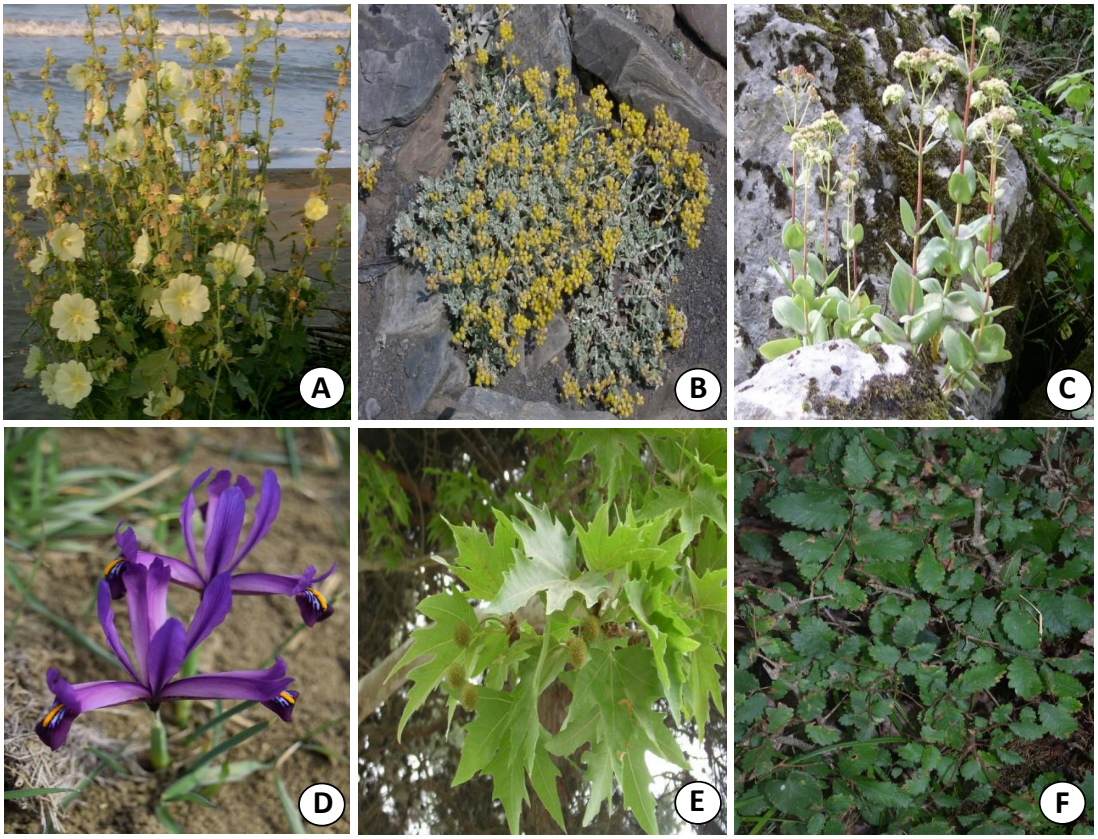

Figure 2. Studied plant species: A. *Alcea kusariensis* (Iljin) Iljin.; B. *Cladochaeta candidissima* (M. Bieb.) DC.; C. *Sedum caucasicum* (Grossh.) Boriss.; D. *Iris reticulata* M. Bieb.; E. *Platanus orientalis* L.; F. *Zelkova carpinifolia* (Pall.) K. Koch.

the regions of the Central Lesser Caucasus and Southern Lesser Caucasus, Lankaran lowlands and mountain part of Lankaran. Can be found in forests from the lowland to the middle mountain belt [Flora of Azerbaijan, 1952].

The leaves of *Z. carpinifolia* are collected in mixed forests of the Hyrkan type in Lankaran (5 m above sea level) and Lerik (358 m above sea level) areas (Fig. 1).

In these woodlands, the coenosis edifiers are *Parrotia persica* C.A. Mey. and *Quercus castaneifolia* C.A. Mey. The species *Pterocarya pterocarpa* (Michx.) Kunth (*P. fraxinifolia* (Lam.) Spach), *Acer velutinum*, *A. laetum*, *Alnus subcordata* C.A. Mey., *Ruscus hyrcanus* Woronow, *Danae racemosa* (L.) Moench, *Mespilus germanica*, *Smilax excelsa* L., *Ligustrum vulgaris* L., *Hedera pastuchovii*, *H. helix* L. are dominants of the woody-shrub tier at various sites. The herbacous tier is represented by *Sambucus ebulus* L., *Polygonum hydropiper* L., *Galium odoratum* (L.) Scop., *Phyllitis scolopendrum*, *Acalypha australis* L., *Erigeron crispus* Pourr. (*E. bonariensis* L.), *Mentha aquatica* L. with the greatest mark of abundance (4-5 points).

The antimicrobial activity varied based on the plant extracts and their dilutions. As it can be observed from table *S. caucasicum* root extract was effective at all dilutions against *Candida albicans* and *Staphylococcus aureus.* The plant extract didn't have any activity against *Escherihia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae* and *Bacillus anthracoides* but reduced the growth of *Klebsiella pneumoniae* with the sterile area of 12 mm for all dilutions. Although the flower extract was not effective against bacteria it had activity within 16 mm against *C. albicans*. The stem extract had weak activity against *K. pneumoniae* within 10 mm of the disc. Extract of the leaves didn't have strong activity against *C. albicans, K. pneumoniae* and *S. aureus* and resulted in sterile areas of 12 mm,12 mm and 9 mm in diameter, respectively.

All extracts of *A. kusariensis* exhibited weak antimicrobial activity. Flower extract had some activity against *S. aureus* and *E. coli*, root extract's weak activity was against *K. pneumoniae* and *B. anthracoides*, and extract of the stem without flowers had weak activity against *K. pneumoniae*. Extracts of flower, seed and stem with flowers negatively influenced the growth of

C. albicans with 18 mm, 14 mm and 13 mm inhibition zones, respectively (Table).

Fruit extract of *P. orientalis* was effective against *S. aureus* with all dilutions, active against *C. albicans* with first concentration. Also, growth of *K. pneumoniae* was reduced at all concentrations. No activity was observed for other microorganisms. Leaves extract showed activity against *C. albicans, S. aureus* and *K. pneumoniae* with 10-15 mm, 10 mm and 9 mm inhibition zones, respectively.

Extract of whole plant of *C. candisissima* had activity against *B. anthracoides* with the first concentration, some activity against *K. pneumoniae* with the first and second concentrations. No activity was observed against other microorganisms.

The extract of leaves of *Z. carpinifalia* exhibited no antimicrobial activity. The growth of *K. pneumoniae* was reduced significantly.

As it is shown in table, extract of *I. reticulata* had no observable activity against all microorganisms, but *B. anthracoides* with the inhibition zone of 15 mm in diameter.

Thus, primary studies of the antimicrobial activity of methanol extracts obtained from rare endemic plants (*Alcea kusariensis, Cladochaeta candidissima, Sedum caucasicum, Iris reticulata, Platanus orientalis, Zelkova carpinifolia*) of the flora of Azerbaijan showed that most of them have moderate activity against various microorganisms (*Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus, Bacillus anthracoides* and *Candida albicans*). For the purpose of advanced study of the antimicrobial properties of the studied species, in the future it is planned to carry out work on the isolation of pure biologically active substances and compounds included in the composition of the corresponding methanol extracts, and to expand the range of strains of microorganisms used.

ACKNOWLEDGMENTS

The research was supported by the Science Development Foundation (project EİF-BGM-4-RFTF-1/2017).

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Azərbaycan florasının bəzi nadir və endem növlərinin antimikrob fəallığı və fitosenotik xüsusiyyətləri

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Məqalədə Azərbaycan florasına aid və əvvəllər öyrənilməmiş 6 nadir və endemik növün (*Alcea kusariensis, Cladochaeta candidissima, Sedum caucasicum, Iris reticulata, Platanus orientalis* və *Zelkova carpinifolia*) metanol ekstraktlarının antimikrob fəallığının tədqiq edilməsinin nəticələri əks olunmuşdur. Test-kultur qismində normal insan mikroflorasının tərkibinə daxil olan və şərti-patogen hesab edilən *Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus, Bacillus anthracoides* və *Candida albicans* ştammları götürülmüşdür. Aparılmış tədqiqatlar nəticəsində müəyyən edilmişdir ki, həm bütöv bitkilərdən, həm də onların müxtəlif orqanlarından alınmış metanol ekstraktlar, həm ayrı-ayrılıqda, həm də bir-biri ilə müxtəlif birləşmədə kifayət qədər fəal antimikrob xüsusiyyət nümayiş etdirirlər. Bununla yanaşı, göstərilən növlərin yayılma yerlərinin fitosenozları öyrənilərək təsvir edilmiş və müvafiq CİS xəritəsi tərtib olunmuşdur.

Açar sözlər: *bioloji fəallıq, flora, dərman bitkiləri, mikroorqanizmlər, bitki ekstraktları, fitosenoz*

Антимикробная активность и фитоценотическая характеристика некоторых редких и эндемичных видов флоры Азербайджана

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В статье приводятся результаты исследования антимикробной активности метанольных экстрактов, полученных из ранее не изученных 6 редких и эндемичных видов (*Alcea kusariensis, Cladochaeta candidissima, Sedum caucasicum, Iris reticulata, Platanus orientalis* и *Zelkova carpinifolia*) флоры Азербайджана. В качестве тест-культур были взяты штаммы *Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus, Bacillus anthracoides* и *Candida albicans*, входящие в состав нормальной микрофлоры человека и считающиеся условно-патогенными. Проведенными исследованиями установлено, что метанольные экстракты, полученные как из целых растений, так и из их различных органов, как по отдельности, так и в различном сочетании друг с другом, обладают достаточно выраженными антимикробными свойствами. Были также изучены и описаны фитоценозы мест произрастания указанных видов, составлена соответствующая ГИС карта.

Ключевые слова: *биологическая активноть, флора, лекарственные растения, микроорганизмы, растительные экстракты, фитоценозы*