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Review

The endemic plants - a valuable resource with vast potential in Bulgaria: A brief overview

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Abstract. *The plant kingdom with its natural products, both terrestrial and marine, has been widely studied. Plant-based products have long been used for the prevention and treatment of various diseases. Many natural compounds are reported to have a number of interesting and significant biological activities, such as antioxidant, anti-inflammatory, antitumor, antibacterial, antiviral, antifungal, antiparasitic, analgesic, antidiabetic, antiatherogenic, antiproliferative, and cardioprotective and neuroprotective activities. In order to find a natural product, researchers often explore the possibilities given by nature. Special attention is paid to bioactive compounds synthesized by endemic plants as a specific resource of limited habitat. This review focuses on a brief overview of endemic plants in Bulgaria, most common in the mountainous regions of the country, with the aim to encourage the knowledge of these resources with vast potential for unique biological compounds and specific characreristics beneficial to humans for various purposes.*

Key words: biological activity, Bulgarian flora, endemic plant, potential

Introduction

Bulgaria covers an area of approximately 111,000 km^2 (about 1% of Europe and 20% of the Balkan Peninsula) (Stoyanov, 1950). A specific feature of the country is that it covers three climatic zones (Central European, continental, Eurasian steppe and the Mediterranean) as well as transitional ones. The diversity in the relief (high mountains, vast plains, narrow valleys, steep sea shores, sand and dune complexes) and the geological history are the reason why the country has rich and specific flora, which includes a large number of endemic and relict species.

Bulgarian vascular plants belong to 130 families, 872 genera, 3550-3750 species (depending on the taxonomic interpretation), 847 subspecies and 2000 varieties. Most of the Bulgarian plants are found in the lowlands, plains and altitudes reaching 700-900 m a.s.l. (xerothermic oak forests; mesophytic and xeromesophytic oak and hornbeam forests). The Stara planina mountain has the richest flora (about 2000 species), followed by the Rhodope mountains, Pirin and Rila mountains (1600-1800 species), the limestone mountains in Western Bulgaria, Osogovo mountain, Strandzha mountain and the lowlands: the Struma valley, the Thracian lowland, the hilly plain of the Tundzha River, the Black Sea coast and Dobrudzha and the Danube Plain (from 800 to 2500 species).

Biological diversity is related to the vertical distribution of species along the altitudinal belts and a variety of forest ecosystems: 2246 species are found below 500 m a.s.l.; 2137 species, from 500 to 1000 m; 780 species, from 1000 to 2500 m; and 114 species, above 2500 m. The largest variety of plants is found on limestone rocks. Most plant species found in Bulgaria belong to the following biological groups: perennial, 2264 species; biennial, 353; annual, 515 (Peev et al., 1998).

The vegetation of an area usually includes four groups of floristic elements: (a) edificators, the main builders of plant communities (which determine the current state of bioclimatic conditions); (b) dominant species that are widely and evenly distributed in the main communities; (c) cosmopolitans, large ecological amplitude species distributed over a large area; and (d) relict and endemic species that best reflect the history of the vegetation cover, even under conditions of human intervention.

This review focuses on the status of endemic plants in Bulgaria, most common in the mountainous regions of the country, with the aim to encourage the knowledge of this resource with vast potential for biological compounds and specific characteristics beneficial to humans.

Endemic plants

Endemics (from Greek „*endemos*“ - native) are biological species whose territory is limited to a certain geographical area

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- island, part of a continent - country, mountain, body of water, etc. In this regard - according to the type of the place of the occupied territory, the endemics are subdivided into island and continental. The group of European endemics includes species distributed in different regions of the Balkan Peninsula (Balkan endemics), as well as Bulgarian endemics - found in different habitats in Bulgaria (regional endemics) and only in one area (local endemics) (Hristova et al., 2015).

The endemic population is a special genotype that leads to important phenotypic features. Their phytochemical model was studied, and special characteristics of the secondary metabolites of the plants were found (Hashim et al., 2020). Researchers reported the presence of specific secondary metabolites that have never been isolated in nature or have never been isolated in related species or genera (Jassbi, 2006). Endemism and biodiversity are natural heritage that must be protected, especially when due to the fact that most of these species are poorly studied at the taxonomic and metabolic level.

Endemics of Bulgaria

Endemic plants are among the most interesting representatives of any flora. Kuzmanov (1981) reviewed endemics and their distribution in the country. The author reports 330 endemic species (92 Bulgarian and 238 Balkan endemics). However, there have been a number of changes with regard to these species. Some of them have been found in other countries or outside the territory of the Balkan Peninsula, and so far have been considered Bulgarian or Balkan endemics.

In Bulgaria, endemic species are most common in communities of widespread species and are rarely edificators, which is characteristic of the conditions of temperate continental climate (Kozhukharov, 1977). The presence of regional endemic plants that are strictly specific shows that the country is rich in specific ecological niches and has a diverse phytogenetic and phytoclimatic history. A total of 444 endemic species (270 Balkan and 174 Bulgarian endemics) have been found on the territory of Bulgaria - 12.8% of the native flora and 11% of the whole Bulgarian flora. A total of 165 species of plants are protected by the Biodiversity Act (2007) (87 Balkan and 78 Bulgarian endemics), which represent 37.2% of all endemic vascular plant species in the country. A total of 108 Balkan and 68 Bulgarian endemics are protected, which makes a total of 176.

The endemic species in Bulgarian flora are divided in four groups as follows:

1. Balkan endemics: species that can be found only on the Balkan Peninsula but in more than one country. To this group belong *Aesculus hippocastanum* L. (found in all countries of the Balkan Peninsula except Romania), *Acer heldreichii* Orph. ex Boiss. (Bulgaria, North Macedonia, Albania, and Greece), *Alchemilla bulgarica* Rothm. (Serbia and Greece), *Crocus veluchensis* Herb. (widely distributed in the mountains of Bulgaria, North Macedonia, and Northern Greece), *Fritillaria drenovskyi* Deg. et Stoj. (Bulgaria and North Macedonia), *Gentianella bulgarica* (Vel.) Holub (Bulgaria, Albania, and Romania), *Geum bulgaricum* Panc. (Bulgaria, Bosnia and Montengro), *Haberlea rhodopensis* Friv. (Bulgaria and Northeastern Greece), *Lathraea rhodopea* Dingl. (Bulgaria and Greece), *Viola perinensis* W. Becker, etc. Most of the Balkan endemic species are distributed primarily in Bulgaria. They include: *Abies borisii-regis* Mattf., *Aquilegia aurea* Janka, *Astracantha thracica* (Griseb.) Podl., *Silene skorpilii* Vel., *Dianthus microlepis* Boiss., *Festuca valida* (Uechtr.) Penzes, *Pinus peuce* Griseb., *Satureja pilosa* Vel., etc. Some of these species form independent communities.

2. Bulgarian endemics: species that are found only in Bulgaria. In this group are included: *Anthemis orbelica* Panc., *Centranthus kellereri* (Stoj., Stef. et T. Georg.) Stoj. et Stef., *Festuca pirinica* Horv. ex Markgr.-Dannb., *Geum rhodopaeum* Stoj. et Stef., *Jasione bulgarica* Stoj. et Stef., *Minuartia bulgarica* (Vel.) Griseb., *Ranunculus stojanovii* Delip., *Sedum kostovii* Stef., *Seseli rhodopaeum* Vel., *Silene velenovskyana* D. Jord. et P. Pan., *Tragopogon stribrnyi* Hayek, *Tulipa rhodopea* Vel., *T. urumoffii* Hayek, etc.

3. Regional endemics: species that are found only in a certain floristic region within Bulgaria. To this group belong *Anthemis stribrnyi* Velen. (Rhodopes), *Primula deorum* Vel. (Rila), *Rhinanthus javorkae* Soo (Pirin), etc.

4. Local endemics: species that are found in one, two or three adjacent areas of a single subregion. In this group are included: *Arenaria rhodopaea* Delip. (central Rhodopes), *Brassica jordanoffii* O.E. Schultz (in several adjacent dry valleys of northern Pirin), *Silene velcevii* Jord. et Panov (Fore-Balkans), *Viola stojanowii* Becker (Belasitsa, below Tumba Peak), etc.

Endemic plants on the territory of Bulgaria are most often found in the mountains. Stara Planina is the richest in endemic species with more than 90 Bulgarian endemic species, 20 of which are native. Endemics are also found in other Bulgarian mountain parts: the Rhodopes, over 80 species and subspecies (20% of which are found only in the Rhodopes); Pirin, over 70 species and subspecies (30 of which are local or strictly regional Pirin endemics); Rila, about 50 species and subspecies (ten of them are found only in Rila); Vitosha, 25 species and subspecies; Strandzha, 19; Sredna Gora, 12; Belasitsa, 8, and Osogovo, 6. Significantly fewer endemic species and subspecies are found in the lowlands (Peev et al., 1998). Table 1 presents several Bulgarian endemics.

Table 1. List of several endemic plants in Bulgaria*

No	Species name	Family	Distribution in Bulgaria (floristic regions)	Reference
1	*Achillea thracica*	Asteraceae	Thracian lowland (area of the villages of Manole and Belozem and the town of Sadovo, Plovdiv region), Tundzha hilly plain (between the villages of Manolovo and Skobelevo, Kazanlak region), Topolovgrad region; 150-300 m asl	Kuzmanov, 1978, 1984a; Ganchev, 1992; Velenovský, 1891.
2	*Alkanna jordanovii*	Boragi-naceae	Thracian lowland (Besaparski hills), Tundzha hilly plain (Yambol region); up to 200 m asl	Kozhukharov, 1989
3	*Alopecurus riloensis*	Poaceae	In the Vitosha, Rila and Central Stara Planina mountains; 1900-2900 m asl	Stoyanov et al. 1967; Kochev, 1984; Richards and Sell, 1976.
4	*Alopecurus thracicus*	Poaceae	Thracian lowland (along the Maritsa River, between Lyubimets and Svilengrad - locality Kelemeto); about 100 m asl	Vasilev, 1984, 1992; Kozhukharov, 1992; Penev and Kozhukharov, 1968; Walter and Gillet, 1998.
5	*Alyssum orbelicum*	Brassica-ceae	Pirin (North - on the slopes of the circus Banski Suhodol), 2350-2450 m asl	Anchev, 2007; Anchev and Uzunov, 2002; Petrova and Velcev, 2006.
6	*Anchusa davidovii*	Boragi-naceae	Rila (Dry Lake), 1500-2200 m asl	Kozhukharov, 1989; Petrova, 2006.
7	*Anthemis jordanovii*	Astera-ceae	Strandzha (near the village of Stoilovo); 200 m asl	Kuzmanov, 1984a; Ganchev, 2006.
8	*Anthemis rumelica*	Asteraceae	Black Sea coast (Ropotamo river, village of Kondolovo, village of Fazanovo, Burgas region), Northeastern Bulgaria (Madara plateau), Fore-Balkans (village of Krapets, village of Smolyanovtsi), Stara Planina (East - Sinite Kamani Nature Park, Aytoska mountain), Strumska valley (Blagoevgrad), Slavyanka (Strgach mountain), Rhodopes (East - Zlatograd, Kardzhali, Zhelezni vrata, Momchilgrad), Thracian lowland (Haskovo region), Tundzha hilly plain (Kazanlak, Sakar Mountain, Topolovski, Sv. hills, with Omarchevo), Strandzha (village of Dervent, village of Strandzha); 1000 m asl	Fernandes, 1976; Thin, 1980; Kuzmanov, 1984a; Walter and Gillet, 1998; Grozeva et al., 2004; Bondev, 2006.
9	*Aquilegia nigricans*	Ranuncu-laceae	It is distributed in the range from 1000 to 2000 asl. in Stara Planina, Middle and Western Rhodopes, Rila	Dimova, 2017
10	*Arabis ferdinandi-coburgii*	Brassicaceae	Pirin (North - on the slopes of Vihren Peak, the circuses Golyam and Malak Kazan, Banski Suhodol, Bayuvi Dupki, Kamenititsa, Razlozhki Suhodol and the ridge Golyam Sredonos); 2000-2800 m asl	Anchev, 2001, 2007; Asenov, 1970; Andreev, 1984; Vladimirov, 2006
11	*Aubrieta columnae*	Brassicaceae	Slavyanka, Pirin (North - Baba Peak); 1000-1800 m asl	Asenov, 1970; Bozhilova and Tonkov, 1984; Anchev, 2001, 2006, 2007; Anchev and Goranova, 2009.
12	*Betonica bulgarica*	Lamiaceae	Stara Planina (Middle, East), Thracian lowland; 700-1500 m asl	Koeva, 1984, 1989; Grozeva et al., 2004; Hayek, 1929.

13	*Brassica jordanoffii*	Brassicaceae	Pirin (North - above the Banderitsa hut, in the locality Jamdzhievi skali, on the slopes of Kutelo peak, the circuses Golyam and Malak Kazan, Banski Suhodol and Razlozhki Suhodol, around Dry Lake); (1850) 2100-2500 m asl	Yordanov, 1970; Andreev, 1984, 1992; Anchev, 2007.
14	*Bromus parilicus*	Poaceae	Slavyanka (locality Parilski dol), Pirin (south), Rhodopes (Middle - locality Rakovo dere); over 1000 m asl	Petrova et al., 1997
15	*Campanula euxina*	Campanulaceae	Black Sea coast (North - Frangen plateau), Northeastern Bulgaria (in the area of the village of Madara and the Provadia plateau); 100-500 m asl	Anchev and Goranova, 2011; Kovanda and Anchev, 1989; Petrova and Velchev, 2006
16	*Campanula jordanovii*	Campanulaceae	Fore-Balkans (West - Vratsa Mountain), Stara Planina (East), Slavyanka, Pirin (North), Rila, Rhodopes (Middle); (600) 900-1900 m asl	Kovanda and Anchev, 1989; Anchev, 1992; Sopotlieva and Petrova, 2002; Grozeva et al., 2004.
17	*Capsella bursa-pastoris*	Brassicaceae	Black Sea coast (North - Devnya), Thracian lowland (near Karlovo and in the region of Plovdiv, Krichim, Lyubimets)	Valev, 1970; Terziyski, 1984; Anchev, 2001, 2007.
18	*Carduus armatus*	Asteraceae	Grasslands between 1500-2000 m asl in three floristic regions	Petrova and Vladimirov, 2009
19	*Carduus candicans*	Asteraceae	Across the country, 0-1000 m asl	Delipavlov et al., 2003
20	*Centaurea achtarovii*	Asteraceae	Pirin; (1700) 2200-2600 m asl	Bancheva, 2015
21	*Centaurea davidovii*	Asteraceae	Meadows and pastures in the floristic region of Western and Central Balkan Range	Bancheva and Gorgorov, 2010
22	*Chamaecytisus frivaldszkyanus*	Fabaceae	Danube Plain, Fore-Balkans, Stara Planina (Middle, East), Rhodopes (Middle), Thracian Lowland, Tundzha Hilly Plain; up to 1200 m asl	Kuzmanov, 1978
23	*Cirsium stojanovii*	Asteraceae	The Black Sea coast (South - Sveti Vlas), Rhodopes (East - Krumovgrad and Momchilgrad); up to 300 m asl	Kuzmanov, 1984b
24	*Colchicum davidovii*	Liliaceae	Northeastern Bulgaria (Shumen, Targovishte), Stara Planina (East - Sliven); up to 1000 m asl	Kuzmanov and Kozhukharov, 1964; Kovachev, 1984; Bondev, 2006.
25	*Colchicum diampolis*	Liliaceae	Znepol region (near the Dupnitsa-Kyustendil road, at the junction for the village of Golyam Varbovnik), Tundzha hilly plain (locality Ormana, Yambol region; village of Hanovo; between the town of Aytos and the village of Balgarevo; village of Tserkovski; village of Iskra)	Kuzmanov and Kozhukharov, 1964; Cheshmedzhiev, 1984; Bondev, 2006.

26	*Crepis schachtii*	Astera-ceae	Slavyanka; above 1600 m asl	Evstatieva, 1984; Dimitrova, 2002; Sell, 1976.
27	*Cyanus achtarovii*	Asteraceae	Pirin; (1700) 2200-2600 m asl	Ninova, 1984; Bancheva, 1999a,b; Meshinev, 2006; Bancheva and Raimondo, 2003
28	*Elymus varnensis*	Poaceae	Black Sea coast (North - Kavarna, Varna, Aksakovo, South - Poda, Tsarevo)	Kitanov, 1963; Melderis, 1980; Petrova, 1984; Kozhukharov, 1986, 1992.
29	*Erysimum pirinicum*	Brassica-ceae	Central Pirin, on southeastern slopes of mount Orelek, 1800 m asl	Anchev and Polatschek, 1998
30	*Festuca pirinica*	Poaceae	Pirin (Vihren peak, Kamenititsa peak and the Big Cauldron and Small Cauldron circuses)	Red Data Book of the Republic of Bulgaria, 2011
31	*Fritillaria pontica*	Liliaceae	Eastern and Southern Bulgaria; 0-1500 m asl	Dimova, 2017
32	*Galium velenovskyi*	Rubiaceae	Rhodopes (East), Thracian lowland (Svilengrad region); 250-500 m asl	Anchev, 1989; Petrova and Velchev, 2006
33	*Geum rhodopaeum*	Rosaceae	It is found in the following floristic regions: Rhodopes (Western), Sredna Gora (Western), Pirin (Southern) and Western border mountains. 1200-1500 m asl	Delipavlov, 2003
34	*Gypsophila tekirae*	Caryophylla-ceae	Thracian lowland (Besaparski hills); 180-350 m asl	Stefanov, 1929; Valev, 1966; Stanev, 1984.
35	*Hedysarum grandiflorum*	Fabaceae	Danube plain (town of Levski - locality Karamandol and near the villages of Kozar, Belene, Chervena and Delyanovtsi; along the valley of the river Studena between the town of Svishtov and the town of Pavlikeni - the villages of Sovata, Hadjidimitrovo, Alekovo; village of Dragomirovo, village of Novo selo); up to 300 m asl	Ganchev and Kochev, 1963; Kozhukharov, 1976, 1984; Tsonev, 2004.
36	*Hieracium belogradcense*	Astera-ceae	Fore-Balkans (West - Belogradchik); 500–550 m asl	Georgiev and Kitanov, 1939; Stoyanov et al., 1967.
37	*Jasione bulgarica*	Campanula-ceae	It is found in the mountains Middle Stara Planina, Vitosha (around Selimitsa peak), Osogovska, Pirin (Northern and Middle), Rila, Western and Middle Rhodopes, 1700-2700 m asl	Anchev, 2012
38	*Leontodon rilaensis*	Asteraceae	Mountains Rila, Pirin, Middle Stara Planina and Vitosha; 2000-2500 m asl	Asyov et al., 2012

39	*Limonium bulgaricum*	Plumbagina-ceae	Danube plain (along the valley of the Studena river and its tributaries in the area between the town of Svishtov, the town of Pavlikeni and the town of Byala); 200-250 m asl	Anchev, 1982, 1992, 2006; Tsonev, 2004;
40	*Linaria brachyphylla*	Scrophularia-ceae	Belasitsa (Tumba peak); 1500-1700 m asl	Delipavlov and Popova, 1995
41	*Marrubium friwaldskyanum*	Lamia-ceae	Rhodopes (West, Middle), Thracian lowland; 400-1500 m asl	Nikolov, 1992
42	*Medicago rhodopaea*	Fabaceae	Fore-Balkans, Stara Planina (East), Rhodopes (Middle), Thracian Lowland (Besaparski Hills), Tundzha Hilly Plain; up to 500 m asl	Delipavlov et al., 2003
43	*Merendera rhodopaea*	Liliaceae	Middle Rhodopes (above Asenovgrad), the Thracian lowland (Besaparski hills, above the village of Isperihovo, Pazardzhik district)	Red Data Book of the Republic of Bulgaria, 2011
44	*Micromeria frivaldszkyana*	Lamia-ceae	Stara Planina (Middle, East); 900-1800 m asl	Stoyanov et al., 1967
45	*Oxytropis kozuharovii*	Faba-ceae	Pirin (North - Okadenski rid, the yellow rocks); 2550-2700 m asl	Pavlova et al., 1999
46	*Papaver degenii*	Papavera-ceae	Pirin (North); 1915-2850 m asl	Kuzmanov, 1968, 1970; Andreev, 1984, 1989, 1992; Greuter et al., 1989.
47	*Poa jordanovii*	Poaceae	Rhodopes (West - Beglika Reserve); 1600 m asl	Kozhukharov and Stoeva, 1983
48	*Primula deorum*	Primula-ceae	Vitosha region (between Golyam Rezen and Cherni Vrah), Rila; 1900-2800 m asl	Peev, 1982, 1984; Albach and Vladimirov, 2002; Peev, 2006.
49	*Primula frondosa*	Primula-ceae	Stara Planina (Middle); 800-2200 m asl	Peev, 1982, 1984, 2006.
50	*Pyrus bulgarica*	Rosaceae	Eastern Stara Planina (above the resort of Sunny Beach) and Strandzha (between the villages of Veselie and Yasna Polyana), the Western Border Mountains, Belasitsa; 0-200 m asl	Dimova, 2017
51	*Ranunculus stojanovii*	Ranuncu-laceae	Rhodopes (West - the village of Ravnogor, Middle - the village of Latinka); Thracian lowland	Bancheva, 2015
52	*Rheum rhaponticum*	Polygona-ceae	Rila (Northwest and Middle); 1700-2500 m asl	Valev, 1966; Stanev, 1984; Libert and Englund, 1989; Ganchev, 2006.
53	*Rhinanthus javorkae*	Scrophula-riaceae	Pirin (North - Banderishka valley, Malak Kazan circus, between Golyam Kazan and Premkata peaks, below the Vihren and Kutelo peaks); 1700-2500 m asl	Vasilev, 1984; Asenov, 1995; Peev, 2006.

54	*Secale rhodopaeum*	Poaceae	Rhodopes (Middle - Trigrad Gorge; East - Veikata Peak); 900-1300 m asl	Kozhukharov, 1984; Delipavlov, 1962, 2003; Kozhukharov, 2006.
55	*Sedum zollicoferi*	Crassulaceae	Slavyanka (above the village of Paril); up to 1700 m asl	Valev, 1970; Cheshmedzhiev, 1984.
56	*Sempervivum erythraeum*	Crassulaceae	Pirin, Banderica, Rila, Goljam Mramorec, Rila Monastery	Letz, 2009
57	*Seseli rhodopaeum*	Apiaceae	Western and Middle Rhodopes, Northeastern Bulgaria (Dervent Gorge), Eastern Fore-Balkan (Veliko Tarnovo region)	Red Data Book of the Republic of Bulgaria, 2011
58	*Silene velenovskyana*	Caryophyllaceae	Sofia region (Plana), Rila (the last gatherings are from 1919), Pirin, Western and Middle Rhodopes	Red Data Book of the Republic of Bulgaria, 2011
59	*Thymelaea bulgarica*	Thymelaeaceae	Stara Planina (East - Sinite Kamani Nature Park), Znepol region, Slavyanka, Pirin; at 900–1500 m asl	Stoeva, 2004; Cheshmedzhiev, 1997.
60	*Tulipa pirinica*	Liliaceae	Slavyanka (locality Pazlaka near the village of Ilinden), Pirin (south - locality Sari Padina near the village of Koprivlen, locality Lalevo at the foot of Sveta Elena peak); 800-1300 m asl	Delipavlov, 1987; Petrova, 1992.
61	*Tulipa rhodopea*	Liliaceae	Rhodopes (Middle - Asenovgrad region); Slavyanka, the valley of the Mesta and Rhodope rivers (East), probably instead of nearby species, its localities in these areas need confirmation; 500-800 m asl	Kitanov, 1964; Delipavlov, 1984; Velchev, 1992.
62	*Tulipa urumoffii*	Liliaceae	Northeastern Bulgaria, Stara Planina (East), Sofia region, Znepol region, Tundzha hilly plain; 100-1000 m asl	Kitanov, 1964; Delipavlov, 1984; Velchev, 2006.
63	*Verbascum davidoffii*	Scrophulariaceae	Pirin (North - between the valley of the river Banderitsa and Razlog suhodol); 1300 - 2000 m asl	Urumoff, 1920, 1923; Stefanova, 1984; Andreev, 1988; Stefanova-Gateva, 1995.
64	*Verbascum decorum*	Scrophulariaceae	Rhodopes (West - on the rocks of the Chepinska River (Eli Dere), Middle - Dobrostanski rid); 200-600 m asl	Stefanova, 1984; Stefanova-Gateva, 1995.
65	*Verbascum urumoffii*	Scrophulariaceae	Vitosha region, Znepol region; 600-1000 m asl	Stojanov et al., 1934; Stefanova, 1984; Stefanova-Gateva, 1995; Dimitrov, 2002.
66	*Viola rhodopeia*	Violaceae	Rila (eastern slopes of Belmeken peak, springs of Kriva reka, Kurtovo), Western Rhodopes (Beglika, Tashboaz, Dospat region) and Middle Rhodopes (Perelik peak); between 1300 and 2400 m asl	Delipavlov, 1979

*According to Petrova and Velchev (2006), the number of Bulgarian endemics is 174; changes frequently due to the fact that some species are found in other countries, as well as that new species are found; asl - above sea level.

Phytochemical potential

Many studies have shown that the antioxidant properties of plants are mainly due to their phenolic compounds (Forni et al., 2019). Table 2 presents several bioactive compounds found in the aforementioned species.

Table 2. Biologically active substances contained in some Bulgarian endemic plants

No	Plant species	Bioactive compound	Reference
1	*A. thracica*	O-methyl quercetin, O-methyl kaempferol, O, O-dimethyl quercetin, O,O-dimethyl kaempferol	Stojanović et al., 2017
2	*A. jumrukczalica*	β-phenylpyruvic acid TMS, Salicylic acid TMS, Trans-cinnamic acid TMS, Vanilic acid TMS, Gentisic acid TMS, Protocatechuic acid TMS, Syringic acid TMS, p-coumaric acid TMS, Caffeic acid TMS, Sinapic acid TMS, Benzoic acid TMS, m-hydroxybenzoic acid TMS, p-hydroxybenzoic acid TMS, β-resorcylic acid TMS, Mandelic acid TMS, Gallic acid tms, 3, 4, 5-trimethoxymandelic acid tms	Nikolova et al., 2012
3	*A. aitosensis*	isorhamnetin-3-O-robinobioside, isorhamnetin-3-O-(2,6-di-O-αrhamno-pyranosyl-β-galactopyranoside), alangiflavoside	Vasilev et al., 2019
4	*A. rumelica*	1α, 4B-dihydroxy-11Hα-guaia-2, 10(14)-dien-12, 6 α-olide, Centauridin, Santin	Todorova et al., 2011
5	*B. bulgarica*	Rutin, quercetin and hispidulin	Tsanova et al., 2018
6	*C. armatus*	Flavonoids: Apigenin, Hesperidin, Kaempferol, Luteolin, Myricetin, Quercetin, Hyperoside, Rutin Phenolic acids: Gallic acid, 3,4-dyhydroxybenzoic acid, 2-hydroxybenzoic acid, Chlorogenic acid, Vanillic acid, Caffeic acid, Syringic acid, p-Coumaric acid, Sinapic acid, Ferulic acid, Cinnamic acid	Dimitrova-Dyulgerova et al., 2015
7	*C. candicans*	Flavonoids: Apigenin, Hesperidin, Kaempferol, Luteolin, Myricetin, Quercetin, Hyperoside, Rutin Phenolic acids: Gallic acid, 3,4-dyhydroxybenzoic acid, 2-hydroxybenzoic acid, Chlorogenic acid, Vanillic acid, Caffeic acid, Syringic acid, p-Coumaric acid, Sinapic acid, Ferulic acid, Cinnamic acid	Dimitrova-Dyulgerova et al., 2015
8	*C. rhodopaeus*	Flavonoids: Apigenin, Hesperidin, Kaempferol, Luteolin, Myricetin, Quercetin, Hyperoside, Rutin Phenolic acids: Gallic acid, 3,4-dyhydroxybenzoic acid, 2-hydroxybenzoic acid, Chlorogenic acid, Vanillic acid, Caffeic acid, Syringic acid, p-Coumaric acid, Sinapic acid, Ferulic acid, Cinnamic acid	Dimitrova-Dyulgerova et al., 2015
9	*C. thracicus*	Flavonoids: Apigenin, Hesperidin, Kaempferol, Luteolin, Myricetin, Quercetin, Hyperoside, Rutin Phenolic acids: Gallic acid, 3,4-dyhydroxybenzoic acid, 2-hydroxybenzoic acid, Chlorogenic acid, Vanillic acid, Caffeic acid, Syringic acid, p-Coumaric acid, Sinapic acid, Ferulic acid, Cinnamic acid	Dimitrova-Dyulgerova et al., 2015
10	*C. davidovii*	Flower: Apigenin, Luteolin, Scutellarein 6,4'dimethyl ethers, 6-hydroxyluteolin 6-methyl ether, Kaempferol 3-methyl ether Folia: Scutellarein 6-methyl ether, Scutellarein 6,4'dimethyl ethers, Scutellarein 6,7,4'-trimethyl ethers, 6-hydroxyluteolin 6-methyl ether, 6-hydroxyluteolin-6,3'-dimethyl ethers	Nikolova and Bancheva, 2013
11	*J. bulgarica*	Apigenin, Luteolin, Kaempferol	Nikolova et al., 2019
12	*M. frivaldszkyana*	Phenolic acids (Chlorogenic acid, Ferulic acid, Rosmarinic acid, Protocatehuic acid, Vanillic acid, Caffeic acid, Syringic acid, Salicylic acid) Flavonoids ((−)-Epicatechin, Hesperidin, Quercetin, Kaempferol, Apigenin)	Mladenova et al., 2021

13	*P. degenii (seeds)*	Amurensine, O-methylthalisopavine, Allocryptopine, Protopine	Doncheva et al., 2017
14	*V. anisophyllum*	4-Hydroxybenzoic acid, cis-p-Coumaric acid, Vanillic acid, 4'-Hydroxy-3'-methoxyacetophenone, Gentisic acid, Protocatechuic acid, Ferulic acid, Syringic acid, trans-p-Coumaric Acid, 3,5-Di-tert-butyl-4-hydroxybenzoic acid, Ferulic acid, Caffeic acid	Nikolova et al., 2017
15	*V. davidoffii*	trans-Cinnamic acid, 4-Hydroxybenzoic acid, cis-p-Coumaric Acid, Eudesmic acid, Vanillic acid, Isoferulic acid, 4'-Hydroxy-3'-methoxyacetophenone, Gentisic acid, Protocatechuic acid, Benzenepropanoic acid, Dihydroferulic acid, Ferulic acid, Syringic acid, trans-p-Coumaric Acid, 3,5-Di-tert-butyl-4-hydroxybenzoic acid, Ferulic acid, Caffeic acid	Nikolova et al., 2017
16	*V. hodopeia*	Kaempferol, Quercetin 3-O-rutinoside (rutin), Isorhamnetion 3-O-rutinoside, Orientin	Nikolova et al., 2019

Phenolic substances have a number of properties that play an important role in human health. Some of their pharmacological properties are anti-allergic, antiviral, anti-inflammatory, antimicrobial, anti-cancer and others (Middleton et al., 2000; Xouri et al., 2007). Phenolics also have a function of preventing oxidative modification by neutralizing free radicals by extracting oxygen or decomposing them into peroxides through their antioxidant activity (Nijveldt et al., 2001). Phenolic acids, tannins and flavonoids have many biological effects such as anti-cancer, anti-inflammatory and anti-atherosclerotic, which are due to their antioxidant activity (Krishnaiah et al., 2011). Natural antioxidants fight oxidative stress and related pathologies. Endemic plants are also a source of substances that can be used to fight antibiotic resistance as well as against many infections (Haddouchi et al., 2013).

The available data show that a more detailed study and protection of plants in the region and the country is extremely important, as these plants are adapted to a particular area and its geographical features in relation to external species (Qin and Xu, 1998). Compounds of pharmacological significance and phytochemicals isolated from such endemic and native plants used in folk medicine have been of interest for the last few decades (Farnsworth, 1994; Benzi and Ceci, 1997).

The future of endemic plants

Climate change and the composition of the atmosphere affect not only the climate system, but also natural ecosystems (Ni, 2011). Man-made climate change is a key component of global change. It includes various issues such as the intensity and frequency of extreme events, the magnitude and speed of change, the change in average climate and climate variability, long-term and short-term changes, and rapid or abrupt changes (Parmesan et al., 2013). The result of these changes is that the world's ecosystems are affected, mainly through the spread and growth of plants. Elevated CO_2 and NO_2 have been reported to affect plant distribution by controlling plant growth (Reich and Sarah, 2013). Climate change worldwide in recent years has led to major changes in the distribution of plant species (Kosanic et al., 2018). Designing future changes in the distribution of endemic flora is a crucial step towards planning and mitigating the impact of climate change on biodiversity (Araújo and Rahbek, 2006).

Species that spread in a narrow range are considered the most prone to extinction due to changing climatic conditions and competition from alien species. The conservation of endemic species has long been a matter of work, as they are not found anywhere else in the world and if they are lost from their native habitat, they will be lost forever. Conservation of ecosystems and biodiversity in their natural habitats is the most appropriate approach to the conservation of species, including endemic species (Maxted et al, 1997; Engelmann, 2011).

Conclusion

Climate change affects the flora of the world in many ways. With the change in a Balkan region's climate, its inherent plants are threatened with extinction. This gives rise to attempts to preserve these specific plants. Therefore**,** methods for *in vitro* conservation of endemic plants are becoming more common. This would help the world and scientists, who are increasingly interested in biological substances that are found in endemic plants. Assessing the current and future distribution of endemic species in Bulgaria will be crucial for their conservation and sustainable management. In this regard, such review papers summarizing the situation, problems and prospects raise public awareness, set a question of the conservation of potentially endangered species and are therefore of essential benefit to help preserve the specific national flora.

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