

BIODIVERSITY OF MEDICINAL PLANTS FROM THE NORTHERN BLACK SEA COASTAL WETLANDS PART 2 - DURANKULAK LAKE PROTECTED AREA

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ABSTRACT

The present study aims to supplement the available research data on medicinal plants of the Durankulak Lake area. Survey results established a significant variety of medicinal plants: 112 species of higher plants referring to 34 families and 87 genera. The prevailing biological type is the herbaceous perennial type (67 species or 60%). Considering moisture and humidity as a factor, the mesophyte plants (presented by 48 species or 43%) occupy dominant position among the medicinal plants. Eurasian geo-elements (20 species or 18%) are predominant, followed by the Euro-Mediterranean (18 species or 16%), sub-Mediterranean (17 species or 15%). Among the medicinal plants there is only one Balkan endemic species. Medicinal plants of conservation significance represent 11.4% or 13 species. The established medicinal plants have more than 30 types of healing actions, one fifth of which is used primarily for the treatment of gastrointestinal diseases. The species in which the aboveground part (herba) is collected for plant substance constitute half of the established medicinal plants. The in-depth analysis benefits the comparison of the biodiversity of medicinal plants in the Durankulak Lake wetland area with other wetlands.

Keywords: *wetlands, medicinal plants, Durankulak Lake*

INTRODUCTION

In recent years, the interest in the flora and vegetation of the wetlands has been increasing, involving assessment of their environmental and conservation significance, along with assessment of their importance in the formation of high-productive communities which are the basis for different food chains and ensure the existence of a variety of organisms - a guarantee of ecosystem sustainability (1).

In this regard, the Northern Black Sea coastal wetlands in Bulgaria represent a research interest. They are an important moulding factor contributing to the existence of a rich and varied flora including a wide variety of medicinal plants which have not yet been fully explored. Information on various aspects of medicinal plants can be found in the research studies of Dimitrov et al. (2000), Filipova et al. (2002), Ivanov et al. (2002), Ivanov and Filipova (2008), and Zahariev et al. (2016) (1-5).

In view of the conservation and rational use of this biological resource our objectives are to supplement the available data on medicinal plants in the Northern Black Sea wetland area of Durankulak Lake by producing a taxonomic analysis and creating a database on their ecological and biological characteristics, floristic elements, conservation significance and conservation status assessment. Along with the above, we aim to collect available data on the healing

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action and usable parts of the established medicinal plants, as well as data on the diseases they are applicable for.

MATERIALS AND METHODS

The surveyed area is situated in the most north-eastern part of Bulgaria, approximately 6 km from the Bulgarian-Romanian border and 15 km north of Shabla, Varna district (6). The wetland area of 350 ha includes the Durankulak Lake coastal firth, adjacent sand dunes, marine aquaria, grasslands, forest-tree and shrub communities and arable land (1).

Field surveys were based on the inventory route technique and conducted during the 2013-2015 vegetation seasons. The floristic analysis was performed after Tolmachev (1974) (7). The species were determined according to "Flora of the Republic of Bulgaria" (8-12), and "Identification Guide to Higher Plants in Bulgaria" (13). The analysis of the floristic elements is according to the classification of Asyov and Petrova, (2006) (14).

The status of medicinal plants is determined on the basis of the Medicinal Plants Act (15) and the National Strategy for Biodiversity Conservation (16).

The conservation status of the species was defined at a national level according to the "Red Data Book of the Republic of Bulgaria" (17), the Biological Diversity Act (18), Order RD-83 of 03.02.2014 (19), and at an international level as defined in Lucas (1983) (20), the IUCN Red List (21), Appendix 1 to the Convention on the Conservation of European Wildlife and Natural Habitats (22), and the Appendices to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (23). Endemism is presented at the level of Balkan and Bulgarian endemics, according to the "Balkan Endemics in the Bulgarian Flora" (24) and the "List of Bulgarian Endemic Plants" (25).

The phytotherapeutic properties of the plants are described as per Petkov (1982) (26), Asenov (1988) (27), and Nikolov (2006) (28); and their applications in traditional medicine according to Petkov (1982) (26).

RESULTS AND DISCUSSION

Results manifest a considerable diversity of medicinal plants in the Durankulak Lake wetlands: out of 305 species of higher plants identified in the flo-

ra of the area, our survey established 112 species as medicinal plants within the meaning of Medicinal Plants Act (15). Of these, 105 (94%) are such under the Medicinal Plants Act (15), and 54 species (48%) - according to the National Strategy for Biodiversity (16). In total, medicinal plants represent 37% of the higher flora of the surveyed area and 15% of the wild growing medicinal plants in Bulgaria.

The established medicinal plants refer taxonomically to 34 families and 87 genera. With the largest number of species is the Asteraceae - 24 species or 21%; Lamiaceae - 16 species or 16%; Rosaceae - 10 species or 9%; and Fabaceae - 9 species or 8%, the totals making for 52% of the established species. It is noteworthy that the Asteraceae, Lamiaceae, Rosaceae, and Fabaceae families are among the most species-rich families typical for the flora of the area. On the other hand, the Poaceae, Apiaceae, Cyperaceae and Caryophyllaceae (1) families are represented by only 1 species of medicinal plant. Families with the most genera of medicinal plants are: Asteraceae (17), Lamiaceae (11), Rosaceae (8), Fabaceae (6) and Ranunculaceae (4); the Asteraceae and Lamiaceae being among the richest in genera families of the flora of the area. Genera with the highest number of medicinal plants are *Artemisia* (4), *Mentha* (3), *Teucrium* (3), *Potentilla* (3), *Galium* (3).

The prevailing biology type is the herbaceous perennial type (67 species or 60%), followed by annual grass plants (21 species or 19%), shrubs (11 species or 10%) and biennials (6 species or 5%). Annuals to biennials are 4 (4%), while biennial to perennial, typical tree species and shrubs to trees are represented by only 1 species each (1%). Analysis demonstrates that the distribution of the biological types established for the area follows that of the flora for the area. (1).

Considering moisture and humidity as a factor, dominating are the mesophyte plants (48 species or 43%), followed by the xerophytes (44 species or 39%) and hygrophytes (19 species or 17%). Hydrophytes, however, although dominating the lake's vegetation, are represented by only 1 species of medicinal plant or 1%. Medicinal plants have similar ecological structure to the one of the entire flora of the area. It is noteworthy the significant presence of ruderal and xerophyte species in the flora of the area (1), as well as among the medicinal plants.

Primary analysis of the floristic elements suggests prevalence of Eurasian geo-elements (20 species or 18%). Second to them are the Euro-Mediterranean (18 species or 16%), followed by sub-Mediterranean (17 species or 15%), and cosmopolitan (13 species or 12%). The species with different types of Mediterranean distribution account in total for 40 species, representing 36% of the total number of species. There are 48 species with different types of European distribution which represents 43% of the total number of species. Almost the same distribution (with predominantly Eurasian, Mediterranean and cosmopolitan geo-elements) is manifested by the analysis of the floristic elements of the Durankulak Lake area flora (1). The presence of a large number of cosmopolitans among the medicinal species (12%), similar to that of the flora of the area, is mainly due to the fact that the survey covers a wetland area dominated by marsh plants the majority of which are cosmopolitans.

There is only one Balkan endemic plant among the medicinal plants of the studied wetland area: *Achillea clypeolata* S. et S.

Medicinal plants of conservation significance in the area are 13 species (11.4%), which depending on the degree of threat to the biological diversity are referred to different conservation categories and status. They account for almost one third of the 32 conservation significant species of the flora of the survey area (1).

In European Red List (21) for endangered species are included four species from the survey area under the category of near-threatened: *Alisma plan-*

tago-aquatica L., *Bidens tripartita* L., *Pulicaria vulgaris* Gaerth and *Butomus umbellatus* L. In Bulgarian Red Data Book for endangered species are included *Eryngium maritimum* L. and *Taraxacum bessarabicum* (Horn.) Hand.-Mazz. According to Bulgarian Biological Diversity Act, Appendix 3, Article 37, protected plants are *Eryngium maritimum* L. and *Artemisia lerchiana* Web. (18). As per Bulgarian Biological Diversity Act, Appendix 4, Article 41, conservation measures and regulated use is required only for *Heli-syssum arenarium* (L.) Moench (18). There are three species prohibited for collection from their natural habitats: *Helichrysum arenarium* (L.) Moench, *Althea officinalis* L. and *Adonis vernalis* L. The above is according to Order № RD-83 of 03.02.2014 of the Minister for the Environment and Water issued on the basis of the Medicinal Plants Act, Article 10 (19). There is one medicinal plant under special protection and use regulations - *Galium odoratum* (L.) Scop, for which maximum quantities for collection from its natural habitat are annually set. The above restriction is set by Order № RD-83 of 03.02.2014 of the Minister for the Environment and Water issued on the basis of the Medicinal Plants Act, Article 10 (19).

Based on available research data for the healing activity and plant substances, we grouped the medicinal plants of the studied Durankulak Lake area according to the diseases they are applicable for (Table 1).

Analysis indicates that 23 species, representing one fifth of the featured medicinal plants are used

Table 1. Groups of diseases, healing action and plant substance

Species	Healing action	Plant substance
Plants used for treatment of cardiovascular diseases		
<i>Adonis vernalis</i> L.	cardiovascular, diuretic, sedative	Herba Adonidis
<i>Crataegus monogyna</i> Jacq.	cardiovascular, decreasing blood pressure, sedative	Folium, flos et fructus Crataegi
<i>Digitalis lanata</i> Ehrh.	cardiovascular	Folium Digitalis lanatae
<i>Lycopus europaeus</i> L.	antiarrhythmic	Herba Lycopi
<i>Thalictrum minus</i> L.	hypotensive, antitumor action	Herba Talictri
Plants used for treatment of gastrointestinal diseases		
<i>Artemisia absinthium</i> L.	appetite exciting	Herba Absinthii

<i>Agrimonia eupatoria</i> L.	astringent, constipative, stimulates the release of bile, appetite exciting, diuretic, antimicrobial, antiviral action	Herba Agrimoniae
<i>Artemisia vulgaris</i> L.	appetite exciting, sedative, haemostatic action	Herba et radix Artemisiae
<i>Ballota nigra</i> L.	spasmolytic, anti-inflammatory, analgesic	Herba Ballotae
<i>Centaurea cyanus</i> L.	appetite exciting, diuretic, stimulates the release of bile	Flores Centaureae
<i>Centaureum erythraea</i> Raf.	appetite exciting	Herba Centaurii
<i>Cichorium inthybus</i> L.	appetite exciting, diuretic, stimulates the release of bile	Radix Cichorii
<i>Convolvulus arvensis</i> L.	laxative, diuretic, epithelium tonic	Herba Convolvuli
<i>Cuscuta europaea</i> L.	purgative, diuretic, analgesic	Herba Cuscutae
<i>Datura stramonium</i> L.	spasmolytic	Folium Stramonii
<i>Lotus corniculatus</i> L.	analgesic , spasmolytic	Herba et fructus Corniculati
<i>Lythrum salicaria</i> L.	constipative, haemostatic action, antiseptic, spasmolytic	Herba Litrii
<i>Malva sylvestris</i> L.	spasmolytic, expectorant, sedative	Flos et folium Malvae sylvestris
<i>Nigella arvensis</i> L.	carminative, laxative	Semen Nigellae
<i>Potentilla reptans</i> L.	constipative, haemostatic action, anti-inflammatory	Herba Potentillae reptani
<i>Potentilla bornmuelleri</i> Borb.	astringent, haemostatic action, anti-inflammatory	Herba Potentillae
<i>Prunus spinosa</i> L.	astringent, laxative, diuretic	Flos et fructus Pruni spinosae
<i>Pulicaria vulgaris</i> Gaertn.	laxative, insecticide	Herba et radix Pulicariae
<i>Rhamnus catharticus</i> L.	laxative, anti-inflammatory	Cortex, folium et fructus Rhamni cathartici
<i>Rubus caesius</i> L.	astringent, anti-inflammatory	Radix, folium et flos Rubi fruticosi
<i>Teucrium chamaedrys</i> L.	anti-inflammatory, analgesic, astringent, constipative	Herba Teucree
<i>Teucrium polium</i> L.	constipative, analgesic	Herba Teucree
<i>Teucrium scordium</i> L.	anti-inflammatory, analgesic, astringent, constipative	Herba Teucree
Plants used for treatment of liver and biliary tract		
<i>Marrubium peregrinum</i> L.	stimulates the release of bile, spasmolytic	Herba Marrubii
<i>Mentha aquatica</i> L.	spasmolytic, antiseptic	Folium Menthae aquaticae
<i>Mentha pulegium</i> L.	stimulates the production of bile, spasmolytic, antiseptic	Folium Menthae pulegiumae
<i>Mentha spicata</i> L.	stimulates the production of bile, spasmolytic, antiseptic	Folium Menthae spicatae
<i>Solanum nigrum</i> L.	spasmolytic, sedative, analgesic	Herba Solani nigri
<i>Taraxacum bessarabicum</i> (Horn.) Hand.-Mazz.	stimulates the release of bile, diuretic	Herba et radix Taraxaci

<i>Taraxacum officinale</i> Veb.	stimulates the release of bile, diuretic	Herba et radix Taraxaci
Plants used for treatment of respiratory diseases		
<i>Althea officinalis</i> L.	expectorant, anti-inflammatory	Radix Althaeae
<i>Carthamus lanatus</i> L.	anti-inflammatory	Flos et radix Carthamus
<i>Iris pseudacorus</i> L.	expectorant, anti-inflammatory, analgesic	Radix Iridis
<i>Iris pumila</i> L.	anti-inflammatory	Radix Iridis
<i>Paliurus spina-cristi</i> Mill.	expectorant, anti-inflammatory, spasmolytic	Fructus Paliuri
<i>Papaver rhoeas</i> L.	expectorant	Flos Rhoeados
<i>Sideritis montana</i> L.	expectorant	Herba Sideritis csardicae
<i>Trifolium pratense</i> L.	expectorant, diuretic, anti-inflammatory	Flos Trifolii pratensis
<i>Verbascum tapsiforme</i> Schrad.	expectorant, anti-inflammatory	Flos Verbasci
<i>Veronica prostrata</i> L.	expectorant, antiseptic, anti-inflammatory, expectorant, diuretic	Herba Veroniciae
Plants used for treatment of kidney and urinary tract diseases		
<i>Alisma plantago-aquatica</i> L.	diuretic	Rhizoma Plantaginis aquaticae
<i>Arctium lappa</i> L.	diuretic, anti-ulcer	Radix Arctii lappae
<i>Carduus acanthoides</i> L.	diuretic, strengthens the secretion of the digestive tract	Herba Carduus acanthii
<i>Cynodon dactylon</i> L.	diuretic, laxative	Rhizoma Gramminis italici
<i>Eryngium campestre</i> L.	diuretic, spasmolytic	Radix Eringii
<i>Eryngium maritimum</i> L.	diuretic, spasmolytic	Radix Eringii
<i>Galium odoratum</i> (L.) Scop.	diuretic, stimulation of sweat, anti-inflammatory, spasmolytic	Herba Asperule
<i>Galium palustre</i> L.	diuretic, astringent, anti-inflammatory,	Herba Galii palustri
<i>Galium verum</i> L.	diuretic, laxative, analgesic	Herba Galii veri
<i>Ononis pusilla</i> L.	diuretic, anti-inflammatory	Radix Ononidis
<i>Ononis spinosa</i> L.	diuretic, anti-inflammatory	Radix Ononidis
<i>Polygonum aviculare</i> (L.) L.	diuretic, astringent, haemostatic action	Herba Polygoni avicularis
<i>Rosa canina</i> L.	diuretic, against scurvy, strengthens the immune system	Fructus Rosae
<i>Sambucus ebulus</i> L.	diuretic, antiseptic, expectorant	Radix, fructus et flos Ebuli
Plants used for treatment of rheumatic and colds diseases		
<i>Filipendula vulgaris</i> Moench.	anti-rheumatic, diuretic	Herba Ulmariae
<i>Lemna minor</i> L.	antipyretic, anti-inflammatory, analgesic, stimulating bile release	Herba Lemnae
<i>Salix alba</i> L.	antipyretic, anti-rheumatic	Cortex Salicis

<i>Salvia aethiopsis</i> L.	anti-inflammatory	Folium Salviae
<i>Salvia pratensis</i> L.	anti-inflammatory	Folium Salviae
<i>Sambucus nigra</i> L.	stimulation of sweat, diuretic	Flos et fructus Sambuci
<i>Solanum dulcamara</i> L.	stimulation of sweat, anti-inflammatory, diuretic, laxative	Herba dulcamarae
<i>Verbena officinalis</i> L.	stimulation of sweat, antipyretic, sedative, strengthening the body	Herba Verbenae
<i>Xanthium spinosum</i> L.	anti-rheumatic, anti-inflammatory	Herba et fructus Xanthii spinosi
<i>Xanthium strumarium</i> L.	anti-rheumatic, anti-inflammatory	Herba et fructus Xanthii strumarii
Plants used for treatment of metabolic and endocrine diseases		
<i>Galega officinalis</i> L.	hypoglycaemic, diuretic	Herba Galegae
<i>Helichrysum arenarium</i> (L.) Moench.	stimulates metabolism, hypoglycaemic, appetite exciting	Herba et flos Helichrysii arenarii
<i>Lactuca serriola</i> L.	stimulates metabolism	Herba Lactucae
Plants used for treatment of parasitic diseases		
<i>Artemisia lerchiana</i> Web.	anthelmintic	Herba Absinthii
<i>Artemisia maritima</i> L.	anthelmintic	Flos Artemisiae
<i>Xeranthemum annuum</i> L.	antiviral action, antibacterial, antimycotic, strengthens the immune system	Herba Xerantemi
Plants that affect central nervous system		
<i>Conium maculatum</i> L.	analgesic	Fructus et herba Conii
<i>Consolida regalis</i> S. F. Gray	anthelmintic, laxative	Herba et semen Consolidae
<i>Heliotropium europaeum</i> L.	spasmolytic	Rizoma et herba Heliotropii europeii
<i>Leonurus cardiaca</i> L.	sedative, lowers blood pressure, antiarrhythmic	Herba Leonuri
<i>Melilotus alba</i> Med.	sedative	Herba Meliloti
<i>Melilotus officinalis</i> (L.) Pall.	sedative	Herba Meliloti
<i>Scutellaria altissima</i> L.	spasmolytic, astringent, diuretic	Herba Scitelarii
Plants with predominantly haemostatic action		
<i>Achillea clypeolata</i> S. et S	haemostatic action, anti-inflammatory	Herba Millefolii
<i>Achillea millefolium</i> L.	haemostatic action, anti-inflammatory	Herba Millefolii
<i>Bidens tripartita</i> L.	astringent, diuretic, stimulation of sweat	Herba Bidentis
<i>Echium italicum</i> L.	haemostatic action, expectorant, against epilepsy	Radix et folium Echii italici
<i>Persicaria hydropiper</i> (L.) Opiz.	haemostatic action	Herba Polygoni hydropiperis
<i>Plumbago europaea</i> L.	anti-inflammatory, astringent	Radix et herba Plumbaginis

<i>Potentilla argentea</i> L.	astringent, haemostatic action, anti-inflammatory	Rhizoma Potentillae argenteae
<i>Sanguisorba minor</i> Scop.	haemostatic action, astringent, constipative, anti-inflammatory	Rhizona et radix Sanguisorbe
<i>Urtica dioica</i> L.	haemostatic action, diuretic	Folium Urticae
Plants used primarily for wound healing		
<i>Hypericum perforatum</i> L.	anti-inflammatory, astringent, anti-ulcer, haemostatic action, sedative	Herba Hyperici
<i>Plantago lanceolata</i> L.	anti-inflammatory, laxative, anti-ulcer	Folium et herba Plantaginis lanceolatae
<i>Plantago major</i> L.	anti-inflammatory, laxative, anti-ulcer	Folium et herba Plantaginis majoris
<i>Stachys recta</i> L.	regenerative	Herba Stahis recti
Plants used in skin diseases		
<i>Euphorbia amygdaloides</i> L.	keratolytic	Succus Euphorbiae
<i>Euphorbia cyparissias</i> L.	keratolytic	Succus Euphorbiae
Plants with other types of actions		
<i>Anthemis tinctoria</i> L.	hair bleaching	Fructus, folium et cortex Anthemi tinctorii
<i>Butomus umbellatus</i> L.	nutrient	Rizoma Butomi
<i>Chenopodium album</i> L.	nutrient	Herba Chenopodii
<i>Chenopodium hybridum</i> L.	nutrient	Herba Chenopodii
<i>Echinops sphaerocephalus</i> L.	strengthening the body	Fructus Ehinopsis
<i>Lathyrus tuberosus</i> L.	fodder	Herba Lathyri
<i>Salicornia europaea</i> L.	nutrient	Herba Salicornae
<i>Trifolium repens</i> L.	fodder	Herba Trifolii

mainly for treatment of gastrointestinal diseases. The remaining groups of diseases are treated by half that number of species: for the treatment of kidney diseases and urinary tract diseases - 13 species; for treatment of respiratory diseases - 10 species; as haemostatic agents - 9 species; for rheumatic and common cold diseases - 8 species; for diseases of the liver and biliary tract - 7 species, for treatment of the central nervous system - 7 species.

The medicinal plants established for the area have a wide variety of more than 30 types of healing action. Most of the medicinal plants of the studied area have diuretic (12 species) and anti-inflamato-

ry (8 species) activity. Together they account for one fifth of the analysed medicinal plants. The remaining types of treatment activity are associated with 6 and less than 6 species.

Different vegetative and generative parts of the established medicinal plants are used as plant substances. The species in which the aboveground part (herba) of the plant is collected for plant substance dominate above all and constitute half of the established for the area medicinal plants. From a quarter of the species can be collected different plant parts.

CONCLUSION

The in-depth analysis benefits the comparison of the biodiversity of medicinal plants in the Durankulak Lake wetland area with other wetlands which is an integral part of the study of the biodiversity of medicinal plants in Bulgaria. On the basis of the results obtained future research on resources can be performed in view of conservation and rational use of resources, along with promotion of the benefits and significance of wetland areas in the life of local population.

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