

MAPPING GEOGRAPHICAL DISTRIBUTION OF ROMANIAN ORCHIDS AND THEIR BIOLOGICAL ACTIVE SUBSTANCES

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Abstract

The present review aims to map the various species of orchids in Romania, in search of reported biological active substances. Several authors have reported that the main biological active compounds of this botanical group are tannins, volatile oils and phenanthrene quinones, which are not water soluble. The review will pay a special attention to autochthonous Orchidaceae species. In Romania most of these plants were identified in the Iron Gates Natural Park and surroundings. The data analysis will also cover the polyphenolic profile of the underground parts of Orchidaceae group to evaluate their antioxidant and antimicrobial potential, as well as to identify some other biochemical reported compounds as source for new biotechnological applications.

Key words: Orchidaceae, biologically active compounds.

INTRODUCTION

The *Orchidaceae* family, despite all beliefs, is one of the most widespread families of plants in the world. Total number of species counts almost 26,567 species worldwide (World Checklist of Selected Plant Families, Kew WCSP, 2011). These species are mainly known as ornamental ones, but numerous orchids are known for their healing properties, also as a reliable food source, fragrance and flavor usage. Due to the wide spreading, the orchids have many uses in many different cultures. In Southern Africa, the orchid tubers are used for a meatless type of sausage called “chikanda”, representing a cheap source of food. The high consumption of orchid tubers affected very much the orchid population, because of the wide consumption of this kind of food, especially in Zambia, bringing the species almost to extinction in that area. A Turkish kind flour, called “salep”, is made using mainly *Orchis mascula* or *Orchis militaris* plants, but also related species can be used. Salep, with small recipe change, is encountered also in Greece (“salapi”), United Kingdom (“saloop”) and Middle Eastern countries (Arabian “sahlab”). It is well known as a predecessor of coffee because of his rejuvenating properties. Salep has also powerful aphrodisiac effects, a

treatment for the gastrointestinal tract, diarrhea and bilious affections. The main component of orchid flour is glucomannan, a polysaccharide, comprising of mannose and glucose (Kaya & Tekin, 2001). The plant that vanilla is made from is also an orchid: *Vanilla planifolia*. This species contains a substance, vanillin, that is the main responsible for the famous flavor. Two other orchids are known that contain vanillin, *V. pompona* and *V. tahitensis*, but the quality of the flavoring substances is very low and they are not effective from industrial usage. In Bhutan, orchids are used to make a kind of dip or sauce from *Cymbidium hookerianum* called Olatshe. Another Bhutanese delicacy made from *Cymbidium* is Olachoto.

In the USA, *Dendrobium* genus is used as an edible food decoration, but the orchid species used is a hybrid one, not found in nature. *Dendrobium* is also used for making deferent kinds of sauces or dips in Singapore, Thailand and Japan. Australian aborigines use *Dendrobium kingianum* as food, mainly the stems (pseudo-stems). We encounter orchids usage even in Hawaii as salads, *Dendrobium salaccense* is used as a condiment in Malaysia. In Nepal and China *Dendrobium* orchids are used for tea. In China, there is even an Orchid Wine produced, and it is very popular. Faham tea is made in Mauritius and Isle de Reunion.

Although used for their remarkable beauty, Orchids can be found in cosmetic products and play a role in herbal medicines. In other countries, they are used for their therapeutically properties. Most of them have been listed in folk medicine. In the cosmetic industry, the plants from *Orchidaceae* family are valued for anti-ageing potential and skin moisturizing agent.

In Romania, Orchids are mainly use for their ornamental beauty, although there are almost 58 species identified in our country. Almost all the studies concerning the Romanian Orchids, aimed to identify the species, the treats and a proper conservation, if needed.

The aim of this review is to update and to present a comprehensive analysis of traditional and folklore uses, pharmacological reports and phyto-constituents isolated from the *Orchidaceae* family, found on Romanian soil.

MATERIALS AND METHODS

The information on *Orchidaceae* family from Romania was gathered from worldwide accepted scientific databases via an electronic search (Google Scholar, Web of Science, ScienceDirect, ACS Publications, PubMed, Wiley Online Library, SciFinder, CNKI). Information was also obtained from The Plant List, Chinese pharmacopoeia, Chinese herbal classics books, PhD and MSc dissertations, unpublished materials, and local conference papers on toxicology. Plant taxonomy was confirmed to the database "The Plant List" (www.theplantlist.org).

RESULTS AND DISCUSSIONS

As we can see from Table 1, Orchids reports in Romania are more numerous in the National Park Nera Gorges-Beuşniţa, Iron Gate National Park and Pietra Craiului National Park, and, unfortunately, few of them are Red listed species.

Many of the epiphytic Orchids are used as traditional medicine. Chemical components and pharmacology have been studied in recent 15 years. Medicinal orchids, in general, are not subject to detailed pharmacological studies. Extracts and metabolites of these plants, particularly those from flowers and leaves, possess useful pharmacological activities. Particular attention has been given to diuretic, antirheumatic, anti-inflammatory, anticarcinogenic, hypoglycemic activities, antimicrobial, anticonvulsive, relaxation, neuroprotective, and antivirus, activities.

A comprehensive account of chemical constituents and biological activities is presented and a critical appraisal of the ethnopharmacological issues is included in view of the many recent findings of importance of these orchids. A large number of orchids have been empirically used for treatment of different diseases, thus, several studies have been undertaken to provide scientific proof to justify the medicinal use of various plants in treatment of diseases. The orchids extracts have been used for their diuretic, relaxation, anti-rheumatic, hypoglycemic activities, anti-inflammatory, antimicrobial and antivirus, anticarcinogenic, anticonvulsive, neuroprotective properties.

A wide range of orchids' **chemical compounds** are presented in Table 2, including alkaloids, bibenzyl derivatives, flavonoids, phenanthrenes and terpenoids which have been isolated recently from orchid species. Phytochemicals are substances produced by every plant for various reasons as: reproduction, defense, rejecting other plants or animals etc. In orchid's case, there are few studies made about these substances, and for some of them we do not know at all their biological function.

We can group the phytochemicals encountered in orchids as: flavonoids, alkaloids, anthocyanins, carotenoids and sterols.

Table 1. Orchids from Romania: Localization

Ref. No.	Area	Species	References
1.	Babadag-Codru Forest - Tulcea County	<i>Orchis simia</i>	
2.	Bicaz Gorges - Hăghimaş National Park	<i>Cephalanthera damasonium</i>	(Romanescu G. et al, 2013)
3.	Bucegi Mountains	<i>Chamorchis alpina</i>	(Biţă-Nicolae, 2011)
4.	Bucegi Mountains - Prahova and Braşov County	<i>Epipogium aphyllum</i>	Fotografal de orhidee din Bucegi (Galerie FOTO). "Clubul Rotary Valea Prahovei" Association. Retrieved from https://www.rotarybvp.ro/fotografal-de-orhidee-din-bucegi-galerie-foto/
5.	Bucegi Mountains, Călimani Mountains - Pietrosu, Red Lake, Retezat Mountains, Giumulău Mountains	<i>Coeloglossum viride</i>	(Irimia, 2011)
6.	Buzău County	<i>Ophrys scolopax</i> ssp. <i>cornuta</i> var. <i>banatica</i>	(Atanasiu, 2014)
7.	Buzăului Mountains	<i>Nigritella nigra</i> , <i>Nigritella rubra</i>	Margoi, D. (2015, June 20). Montaniarzi: Sangele voinicului, orhideea salbatica din Carpati. Retrieved December 22, 2018, from http://www.montaniarzi.ro/sangele-voinicului-orhideea-salbatica-din-carpati/
8.	Ciucului Mountains, Bucegi Mountains	<i>Nigritella nigra</i> , <i>Nigritella rubra</i>	Puşcarciuc, M. (2012, June 17). Munte&Flori: <i>Nigritella nigra</i> (2013, January 11). Retrieved from http://www.muntesiflori.ro/nigritella-nigra-foto/
9.	Defileul Dunării/Porţile de Fier	<i>Anacamptis pyramidalis</i>	Photo-hunting: La vânătoare de orhidee sălbatice prin Banat. S.C. Tymes Globetrotter S.R.L. Retrieved from http://www.tymestours.ro/RO/XX-orhidee-banat-excursii/01-orhidee-banat-excursii.htm
10.	Dobrogea	<i>Liparis loeselii</i>	(Sârbu et al., 2006)
11.	Glodeasa Forest - Prahova County	<i>Herminium monorchis</i>	
12.	Grohotiş and Hăşmas Mountains - Prahova County	<i>Orchis ustulata</i>	Munte&Flori: <i>Orchis ustulata</i> . Retrieved from http://www.muntesiflori.ro/orchis-ustulata-foto/
13.	Hăghimas National Park - Neamţ County	<i>Orchis coriophora</i> , <i>Orchis morio</i> ssp. <i>alba</i> , <i>Orchis morio</i> ssp. <i>picta</i> , <i>Orchis tridentata</i> , <i>Traunsteinera globosa</i>	(Romanescu G. et al, 2013)
14.	Iron Gates Nature Park	<i>Orchis mascula</i> , <i>Orchis militaris</i> , <i>Orchis pallens</i> , <i>Orchis papilionacea</i> , <i>Orchis purpurea</i> , <i>Platanthera chloranth</i> , <i>Pseudorchis albida</i> , <i>Spiranthes spiralis</i>	(Milanovici, 2014)
15.	Jibou City Area - Sălaj County	<i>Orchis purpurea</i>	(Szatmari, 2016), page 34
16.	Măcinului Mountains-Dobrogea County	<i>Orchis purpurea</i>	Zana Florilor. Flori din Padure: Orhidee alba in Muntii Macinului (<i>Orchis purpurea</i> sau <i>gemanarita</i>). (2017, September 5). Retrieved from http://zanafloilor.eu/flori-padure-orhidee-salbatice-muntii-macinului-orchis-purpurea-sau-gemanarita/
17.	Mădăraş Mountain - Harghita County	<i>Dactylorhiza fuchsia</i>	Munte&Flori: Orhideele genului <i>Dactylorhiza</i> . Retrieved from http://www.muntesiflori.ro/genul-dactylorhiza/
18.	Meseş Mountains - Sălaj County	<i>Platanthera bifolia</i>	(Szatmari, 2016, page 35)
19.	Mic Mountain – Caraş-Severin County,	<i>Dactylorhiza fuchsia</i>	Milanovici, S. (2016, November 2). The orchid flora of the Muntele Mic (Caraş-Severin County, Romania). <i>Journal of Biological Sciences</i> . Retrieved December 22, 2018 from http://journal.pmf.ni.ac.rs/bionys/index.php/bionys/article/view/185
20.	National Park Nera Gorges – Caraş-Severin County	<i>Epipactis microphylla</i> , <i>Himantoglossum hircinum</i> , <i>Limodorum abortivum</i> , <i>Liparis loeselii</i> , <i>Listera ovata</i> , <i>Neottia nidus-avis</i> , <i>Ophrys apifera</i> , <i>Ophrys scolopax</i> ssp. <i>cornuta</i> var. <i>banatica</i> , <i>Orchis coriophora</i> , <i>Orchis mascula</i> , <i>Orchis morio</i> ssp. <i>alba</i> , <i>Orchis morio</i> ssp. <i>morio</i> , <i>Orchis morio</i> ssp. <i>picta</i> , <i>Orchis pallens</i> , <i>Orchis papilionacea</i> , <i>Orchis simia</i> , <i>Orchis tridentata</i> , <i>Platanthera bifolia</i>	(Bătea, 2014)

Ref. No.	Area	Species	References
21.	Only mentioned - no exact area defined	<i>Epipactis palustris</i> , <i>Orchis x gemarii</i> (hibrid)	(Gubandru-Tomescu, 2018)
22.	Ortelec Hills - Zalău City	<i>Orchis militaris</i>	(Szatmari, 2016, page 35)
23.	Piatra Craiului National Park - Braşov/Argeş County	<i>Anacamptis pyramidalis</i> , <i>Cephalanthera rubra</i> , <i>Chamorchis alpina</i> , <i>Corallorhiza trifida</i> , <i>Dactylorhiza cordigera</i> , <i>Dactylorhiza cordigera</i> ssp. <i>siculorum</i> , <i>Dactylorhiza incarnata</i> , <i>Dactylorhiza maculata</i> , <i>Dactylorhiza majalis</i> , <i>Dactylorhiza saccifera</i> , <i>Epipactis atrorubens</i> , <i>Epipactis helleborine</i> , <i>Epipactis microphylla</i> , <i>Gymnadenia conopsea</i> , <i>Gymnadenia odoratissima</i> , <i>Gymnoleucorchis x strampfii</i> (hibrid), <i>Herminium monorchis</i> , <i>Himantoglossum hircinum</i> , <i>Leuchorchis albidia</i> , <i>Limodorum abortivum</i> , <i>Liparis loeselii</i> , <i>Listera cordata</i> , <i>Listera ovata</i> , <i>Neottia nidus-avis</i> , <i>Nigritella nigra</i> , <i>Nigritella rubra</i> , <i>Ophrys apifera</i> , <i>Ophrys scolopax</i> ssp. <i>cornuta</i> var. <i>banatica</i> , <i>Ophrys sphegodes</i> , <i>Orchis coriophora</i> , <i>Orchis mascula</i> , <i>Orchis militaris</i> , <i>Orchis morio</i> ssp. <i>alba</i> , <i>Orchis morio</i> ssp. <i>morio</i> , <i>Orchis morio</i> ssp. <i>picta</i> , <i>Orchis pallens</i> , <i>Orchis papilionacea</i> , <i>Orchis purpurea</i> , <i>Orchis tridentata</i> , <i>Orchis ustulata</i> , <i>Platanthera bifolia</i> , <i>Platanthera chlorantha</i> , <i>Pseudorchis albidia</i> , <i>Traunsteinera globosa</i>	(Gubandru-Tomescu, 2018)
24.	Piatra Mare Mountains - Braşov County	<i>Epipactis helleborine</i> , <i>Epipactis palustris</i>	(Ardelean et al., 2018)
25.	Piatra Mare Mountains - Braşov County	<i>Orchis mascula</i>	(Ardelean et al., 2018)
26.	Plopiş Mountains-Bihor/Sălaj County	<i>Ophrys apifera</i> , <i>Ophrys sphegodes</i>	(Szatmari, 2016)
27.	Postăvaru Mountains - Braşov County	<i>Cephalanthera damasonium</i>	Romfilatelia: Frumusetea florilor rare pe timbre: Orhidee sălbatice din România. Retrieved from http://www.romfilatelia.ro/ro/frumusetea-florilor-rare-pe-timbre-orhidee-salbatice-din-romania/
28.	Postăvaru Mountains - Prahova County	<i>Platanthera bifolia</i>	(Ardelean et al., 2018)
29.	Rarău-Giumalău Mountains - Suceava County	<i>Goodyera repens</i>	(Oprea & Sirbu, 2012)
30.	Retezat Mountains - Hunedoara County	<i>Herminium monorchis</i>	(Benedek & Dragulescu, 2006)
31.	Rosia Montana Area - Alba County	<i>Listera ovata</i>	(Roman & Cristea)
32.	Sibiu County	<i>Orchis militaris</i>	
33.	Solovan Hill - Maramureş County	<i>Dactylorhiza sambuccina</i>	(Goja, 2014)
34.	Stânişoara Mountains-Neamt/Suceava County	<i>Listera cordata</i> , <i>Listera ovata</i> , <i>Neottia nidus-avis</i> , <i>Orchis coriophora</i> , <i>Orchis laxiflora</i> ssp. <i>elegans</i> , <i>Orchis laxiflora</i> ssp. <i>palustris</i> , <i>Orchis militaris</i> , <i>Orchis morio</i> ssp. <i>alba</i> , <i>Orchis morio</i> ssp. <i>morio</i> , <i>Orchis morio</i> ssp. <i>picta</i> , <i>Orchis purpurea</i> , <i>Orchis tridentata</i> , <i>Orchis ustulata</i> , <i>Platanthera bifolia</i> , <i>Traunsteinera globosa</i>	(Oprea & Sirbu, 2012)
35.	Strâmtura - Maramureş County, Hâşmaş Mountains - Maramureş County, Cucului Mountains - Harghita County	<i>Cypripedium calceolus</i>	Schlesinger, A. (2012, 27 May). Munte&Flori: <i>Cypripedium calceolus</i> . Retrieved from http://www.muntesiflori.ro/cypripedium-calceolus-foto/
36.	Tazlăului Subcarpathians, Măcinului Mountains	<i>Cephalanthera longifolia</i>	Zana Florilor. Flori din Padure: Orhidee alba in Muntii Macinului (<i>Cephalanthera longifolia</i>). (2017, August 5). Retrieved from http://zanaflorilor.eu/flori-padure-orhidee-alba-muntii-macinului-cephalanthera-longifolia/
37.	Sugău Cave - Harghita County	<i>Corallorhiza trifida</i>	(Flaviu-Crisan et al., 2014)
38.	Tarcăului Mountains, Vrancei Mountains	<i>Cephalanthera longifolia</i>	Photo-hunting: La vânătoare de orhidee sălbatice prin Banat. S.C. Tymes Globetrotter S.R.L. Retrieved from http://www.tymestours.ro/RO/X/X-orhidee-banat-excursii/01-orhidee-banat-excursii.htm
39.	The National Park Nera Gorges-Beuşniţa	<i>Dactylorhiza maculata</i> , <i>Dactylorhiza majalis</i> , <i>Dactylorhiza saccifera</i>	(Bătea, 2014)

Ref. No.	Area	Species	References
40.	Trotușului Mountains - Bacău County	<i>Dactylorhiza incarnata</i>	Marelena și Radu Pușcariuc - Orhidee din Munții Trotușului, floră - https://sites.google.com/site/romanianatura56/home/c-arpatii-rasariteni/trotusului/orhidee-din-muntii-trotusului-flora
41.	Turda Gorge - Cluj County	<i>Platanthera bifolia</i>	Nagy, Z. (2014, July 29). Lesser Butterfly-orchid (<i>Platanthera bifolia</i>) in the forests around Turda Gorge, Romania. Retrieved December 22, 2018, from https://www.naturepl.com/stock-photo-lesser-butterfly-orchid-platanthera-bifolia-in-the-forests-around-image01469679.html
42.	Umbrărești Village - Galați County	<i>Cephalanthera rubra</i>	

The most important of them is the alkaloid, a type of substance containing carbon, hydrogen and nitrogen atoms (with additional atoms of oxygen and sulfur). Quinine is an alkaloid found in different orchid species and has a pharmacological importance in antimalarial medicines. The most studied substances from Orchids, from a pharmacologically point of view, are: alkaloids, phenanthrenes, terpenoids, bibenzyl derivatives, and flavonoids. They can be found in whole plant, but also in leaves, flowers and roots.

Other secondary metabolites

Organic compounds that are either specific to the plant family or xenobiotic can be transformed in tissue culture. Many orchid species produce secondary metabolites which are either isoprenoid compounds, including sterols (Hills et al., 1968; Wan et al., 1971), or derivatives of shikimic acid. Tissue cultures of *Cymbidium* 'Saint Pierre', *Dendrobium phalaenopsis*, *Epidendrum ochraceum* maintained *in vitro* on media used for other orchids transformed some isoprenoids

(Kukuczanka & Wojciechowska, 1983; Kukuczanka, 1985; Mironowicz et al., 1987), primarily the hydrolysis of (±)-menthyl acetate to menthol (75-85%), the hydrolyzation of phenol acetates, aromatic-aliphatic alcohols and acetates of racemic aromatic-aliphatic alcohols (Mironowicz et al., 1993). Phenanthrene derivatives have been found to be potent phytoalexins, while others act as endogenous plant growth regulators (Gorham, 1980; Majumder et al., 2001). Convallarioides nudol, eranthridin, sitosterol, erianol were isolated from *Eria convallarioides* (Majumder & Kar, 1989). Sitosterol, betulinic acid and some perfumery constituents were isolated from *Luisia indivisa* (Majumder & Lahiri, 1989). Flavone C-glycosides and flavonols were the most common constituents found in 53 and 37%, respectively of 142 species (75 genera) leaves (Williams, 1979). Bulbophyllanthrone: a cytotoxic phenanthraquinone from *Earina autumnalis* (Hinkley & Lorimer, 1999). The addition of

Table 2. Active compounds

Species	Bioactive compound	References
<i>Anacamptis pyramidalis</i>	Phenanthrene quinone: Marchantine A=Orchinol Mucin content and Orchinol, and p-hydroxybenzyl alcohol	(Reinhold et al., 1980) (Teoh, 2016)
<i>Cephalanthera longifolia</i>	Alkaloids, Quercetin and Kaempferol-O-glycosides	(Teoh, 2016)
<i>Cephalanthera rubra</i> , <i>Cephalanthera damasonium</i>	Loroglossin, alkaloids and quercetin	(Teoh, 2016)
<i>Chamorchis alpina</i>	Phytoalexin Orchinol and p-hydroxybenzyl alcohol	(Pridgeon et al., 2001)
<i>Coeloglossum viride</i>	Phenanthrene quinone	(Reinhold et al., 1980)
<i>Cypripedium calceolus</i>	Fatty acid derivatives, isoprenoids, and phenyl derivatives Alkaloids, saponins, sugars, essential oils, phenolic compound, tannins, anthocyanins, lipids, coumarins, luteolin, arbutin	(Teixeira da Silva, 2013) (Jimenez & Pourhashemi, 2014)
<i>Dactylorhiza fuchsii</i> , <i>Dactylorhiza incarnata</i> , <i>Dactylorhiza maculata</i> , <i>Dactylorhiza majalis</i> , <i>Dactylorhiza saccifera</i> , <i>Dactylorhiza sambuccina</i>	Seven anthocyanins (chrysanthemins, cyanin, seranin, ophrysanin, orchicyanin I/II, serapianin) cyanidin 3-oxalylglycosides	(Teixeira da Silva, 2013) (Soare et al., 2011)

Species	Bioactive compound	References
<i>Epipactis atrorubens</i> - Dumbrăviță roșcată	Metabolite: Ophrysanin	<i>Epipactis atrorubens</i> . PhytoChemical Interactions DB. Retrieved from https://www.genome.jp/db/pcidb/kna_species/12930#metabolite (Bazarini et al., 1992)
<i>Epipactis helleborine</i>	A series of four mannose(Man)-, three <i>N</i> -acetylglucosamine (GlcNAc)n-, ten <i>N</i> -acetylgalactosamine/galactose(GalNAc/Gal)-, one 5-acetylneuraminic acid(α -2,3-Gal/GalNAc)- and one 5-acetylneuraminic acid(α -2,6-Gal/GalNAc)-specific plant agglutinins were evaluated for their antiviral activity in vitro	(Jimenez & Pourhashemi, 2014)
<i>Epipogium aphyllum</i>	Carotenoids: neoksantin, lutein, violaxanthin	(Pridgeon et al., 2003)
<i>Goodyera repens</i>	Loroglossin	(Jimenez & Pourhashemi, 2014)
<i>Gymnadenia conopsea</i>	Alkaloids, rutin, loroglossin, Kaempferol-3-0-rutinozid, gudayerin, izorammetin-3-0-rutinozid	(Pérez Gutiérrez, 2010)
<i>Hermidium monorchis</i> <i>Himantoglossum hircinum</i>	Anthocyanins Gymconopin A, Gymconopin B, Gymconopin D, and 3,3'-Dihydroxy-2,6-bis(4-hydroxybenzyl)-5- methoxybibenzyl, Antiallergic phenanthrenes and stilbenes	(Teoh, 2016) (Carey & Farrell, 2002)
<i>Liparis loeseli</i> <i>Listera ovata</i>	Glucmannans, Hydrophilic carbohydrates of high viscosity are found in tubers Phytoalexin orchinol (2,4-dimethoxy-7-hydroxy-9, 10-dihydrophenanthrene) and <i>p</i> -hydroxybenzylalcohol, 4-methoxy-2,5-dihydroxy-9,10-dihydrophenanthrene (Phytoalexin hircinol), Loroglossin (phenolic glycoside). The chemical composition of the flowers(E)-3-methyl-4-decenoic acid (Z)-4-decenoic acid and lauric acid.	(Teoh, 2016) (Bazarini et al., 1992)
<i>Nigritella nigra</i>	Alkaloids	(Reinhold et al., 1980) (Teixeira da Silva, 2013)
<i>Nigritella rubra</i>	Phenanthrene quinone: Marchantine A Seven anthocyanins (chrysanthemins, cyanin, seranin, ophrysanin, orchicyanin I/II, serapianin) cyanidin 3-oxalylglycosides	(Soare et al., 2011) (Teixeira da Silva, 2013)
<i>Ophrys apifera</i> , <i>Ophrys scolopax</i> ssp. <i>Cornuta</i> var. <i>banatica</i> , <i>Ophrys sphegodes</i> , <i>Orchis coriophora</i> , <i>Orchis laxiflora</i> ssp. <i>elegans</i> , <i>Orchis laxiflora</i> ssp. <i>palustris</i> <i>Orchis mascula</i> , <i>Orchis militaris</i> , <i>Orchis morio</i> ssp. <i>alba</i> , <i>Orchis morio</i> ssp. <i>morio</i> , <i>Orchis morio</i> ssp. <i>picta</i>	Seven anthocyanins (chrysanthemins, cyanin, seranin, ophrysanin, orchicyanin I/II, serapianin) cyanidin 3-oxalylglycosides	(Soare et al., 2011) (Teixeira da Silva, 2013)
<i>Orchis pallens</i> , <i>Orchis papilionacea</i> , <i>Orchis purpurea</i> , <i>Orchis simia</i> , <i>Orchis tridentata</i> , <i>Orchis ustulata</i> , <i>Orchis x gennarii</i> (hibrid) <i>Platanthera bifolia</i>	Phenanthrene quinone cyanidin 3-oxalylglycosides Seven anthocyanins (chrysanthemins, cyanin, seranin, ophrysanin, orchicyanin I/II, serapianin) cyanidin 3-oxalylglycosides	(Reinhold et al., 1980) (Soare et al., 2011) (Teixeira da Silva, 2013)
<i>Pseudorchis albida</i>	Volatiles from flowers:benzyl benzoate, benzyl salicylate, cinnamyl alcohol, lilac aldehydes, methyl benzoate and methyl salicylate	(Plepys et al., 2002)
<i>Traunsteinera globosa</i>	Lilic aldehyde Phytoalexin orchinol (2,4-dimethoxy-7-hydroxy-9,10-dihydrophenanthrene) and <i>p</i> -hydroxybenzylalcohol. Flavonoid glycones content of the leaves of <i>P. albida</i> revealed the presence of quercetin and kaempferol The scent was rich in terpenoid compounds, and most of the dominant compounds (e.g. 4-oxoisophorone, β -myrcene, limonene, β -phellandrene, and verbenone) are frequently found in various orchid species	(Baxter et al., 1998) (Jersáková et al., 2011)
	Ophrysanin	KNAPSAcK Metabolite C00006794. PhytoChemical Interactions DB. Retrieved from https://www.genome.jp/db/pcidb/kna_cpds/6794#species

glyphosate (as RoundUp®) resulted in the production of orchinol, a phenolic compound, in *Orchis morio* liquid culture (Beyrle et al., 1995). Dihydrophenanthrenes and bibenzyl synthase are produced in the rhizomes of orchids after wounding, their induced

formation depending on wounding and the extent of fungal infection (Gehlert & Kindl, 1991).

Species that has no active substances studied or known: *Corallorhiza trifida*, *Epipactis microphylla*, *Epipactis palustris*, *Gymnadenia*

odoratissima, *Gymnoleucorchis x strampffii* (hibrid), *Leuchorchis albida*, *Limodorum abortivum*, *Limodorum abortivum* *Listera cordata*, *Neottia nidus-avis*, *Platanthera chlorantha*, *Spiranthes spiralis*.

As we can see in Table 3, there are many medicinal uses for orchids, but not all species encountered in Romania have one. Species without a medicinal use known or studied are: *Cephalanthera rubra*, *Cephalanthera damasonium*, *Chamorchis alpina*, *Corallorhiza trifida*, *Dactylorhiza cordigera*, *Dactylorhiza cordigera* subsp. *sicolorum*, *Dactylorhiza*

fuchsii, *Dactylorhiza majalis*, *Dactylorhiza saccifera*, *Dactylorhiza sambuccina*, *Epipactis atrorubens*, *Epipactis microphylla*, *Epipactis palustris*, *Gymnadenia odoratissima*, *Gymnoleucorchis x strampffii* (hibrid), *Leuchorchis albida*, *Limodorum abortivum*, *Listera cordata*, *Neottia nidus-avis*, *Nigritella nigra*, *Nigritella rubra*, *Orchis pallens*, *Orchis papilionacea*, *Orchis purpurea*, *Orchis tridentata*, *Orchis x gennarii* (hibrid), *Platanthera chlorantha*, *Pseudorchis albida*, *Traunsteinera globosa*.

Table 3. Medicinal uses

Species	Medicinal uses	References
<i>Anacamptis pyramidalis</i>	Demulcent	Rich., L. (N/A). <i>Anacamptis pyramidalis</i> Pyramidal Orchid PFAF Plant Database. Retrieved December 23, 2018 from https://pfaf.org/user/Plant.aspx?LatinName=Anacamptis+pyramidalis
	Skin whitener, neuroprotective	(Teoh, 2016)
<i>Cephalanthera longifolia</i>	Appetizer, tonic, it heals wound	(Pant, 2013)
<i>Coeloglossum viride</i>	Memory impairment in mice	(Zhang et al., 2005)
<i>Cypripedium calceolus</i> - Papucul doamei	Antispasmodic, anxiety, astringent, cramps, delirium tremens, diaphoretic (promotes sweating), diarrhea, enhancing recovery from surgery or illness, hypnotic, hysteria, insomnia, menorrhagia (heavy menstrual bleeding), mood (elevate), muscle spasms, nervousness, pain, pruritus (severe itching), sedative, stimulant, stress, styptic (stops bleeding), tension (emotional), tooth pain.	(Liu D., Ju J.H., Zou Z.J., et al., 2005)
<i>Dactylorhiza incarnata</i>	Demulcent, nutritive	Soó, L. (N/A). <i>Dactylorhiza incarnata</i> Marsh Orchid PFAF Plant Database. Retrieved December 23, 2018 from https://pfaf.org/user/Plant.aspx?LatinName=Dactylorhiza+incarnata
<i>Dactylorhiza maculata</i> - Poroinic	Impotence treatment, genital vasodilatation	(Bivolaru, 2001)
<i>Epipactis helleborine</i>	Relief of moderate an severe pain - oxycodone	
	Highly inhibitory to human immunodeficiency virus type 1 (HIV-1) and type 2 (HIV-2), and showed a marked anti-human cytomegalovirus, respiratory syncytial virus and influenza A virus activity	(Bazarini et al., 1992)
<i>Epipogium aphyllum</i>	Restorative, pain reliever, tonic	(Jimenez & Pourhashemi, 2014)
<i>Goodyera repens</i>	Improve the appetite and treatment of colds, kidney and bladder problems	<i>Goodyera repens</i> Creeping Lady's Tresses, Lesser rattlesnake plantain PFAF Plant Database. Retrieved from https://pfaf.org/user/Plant.aspx?LatinName=Goodyera+repens
	Roots and leaves were used medicinally, by native Americans of British Columbia to treat cancers, ulcers, lupus, colds, burns, rheumatism	(Pridgeon et al., 2003)
	Emollient, detoxification, to improve appetite, as a remedy for snake bites, diseases of the stomach, bladder	(Jimenez & Pourhashemi, 2014)
<i>Gymnadenia conopsea</i>	Demulcent; Nutritive.	<i>Gymnadenia conopsea</i> Fragrant Orchid PFAF Plant Database. Retrieved from https://pfaf.org/user/Plant.aspx?LatinName=Gymnadenia+conopsea
	Tubers are used as aphrodisiac. Alcohol extract of rhizomes of <i>Gymnadenia conopsea</i> showed effect on the collagen synthesis in rat lungs exposed to silica under the influence on antioxidase activities. The extract can ameliorate silica-induced pulmonary fibrosis by increasing activities of antioxidase and alleviating damage of lipid peroxidation to the lungs. Methanol extract from the tubers of <i>Gymnadenia conopsea</i> showed an antiallergic effect on ear passive cutaneous anaphylaxis reactions in mice. Inhibit antigen-induced degranulation.	(Pérez Gutiérrez, 2010)

Species	Medicinal uses	References
<i>Herminium monorchis</i>	Treat kidneys and stomach, and also used for nervous breakdown, insomnia, confusion, anorexia.	(Teoh, 2016)
<i>Himantoglossum hircinum</i>	The antifungal activity of orchinol and hircinol against <i>Candida lipolytica</i>	(Carey & Farrell, 2002)
<i>Liparis loeselli</i>	Activity against bacteria and fungi suggesting that there may be a basis for their usage to treat superficial infections. Pyrrolizidine alkaloids possess anti-oxidant activity	(Teoh, 2016)
<i>Listera ovata</i>	Skin inhibitory to human immunodeficiency virus type 1 (HIV-1) and type 2 (HIV-2) in MT-4, and showed a marked anti-human cytomegalovirus (CMV), respiratory syncytial virus (RSV) and influenza A virus activity in HEL, HeLa and MDCK cells, respectively Tubers were used as a tincture for Stomach disease. Externally skin tone	The use of Orchid for medicinal purposes. Retrieved from http://www.orchids-world.com/evergreen/med.pdf (Bazarini Et al., 1992) (Pérez Gutiérrez, 2010)
<i>Ophrys apifera</i>	Aphrodisiac	(Pant, 2013)
<i>Ophrys scolopax</i> ssp. <i>cornuta</i> var. <i>banatica</i>	Demulcent; Nutritive.	<i>Ophrys scolopax</i> . Woodcock Orchid PFAF Plant Database. Retrieved from https://pfaf.org/user/Plant.aspx?LatinName=Ophrys+scolopax
<i>Ophrys sphegodes</i>	Aphrodisiac	Pant, B., 2013. Medicinal orchids and their uses: Tissue culture a potential alternative for conservation, pages 450-453 <i>Orchis coriophora</i> . Bug Orchid PFAF Plant Database. Retrieved from https://pfaf.org/user/Plant.aspx?LatinName=Orchis+coriophora
<i>Orchis coriophora</i>	Antiflatulent; Demulcent	(Singh & Duggal, 2009)
<i>Orchis laxiflora</i> ssp. <i>elegans</i>	Diarrhea, bronchitis and convalescence	(Singh & Duggal, 2009)
<i>Orchis laxiflora</i> ssp. <i>palustris</i>	Diarrhea, bronchitis and convalescence	(Singh & Duggal, 2009)
<i>Orchis mascula</i>	Aphrodisiac	(Pant, 2013)
<i>Orchis militaris</i>	Demulcent	<i>Orchis militaris</i> . Military Orchid PFAF Plant Database. Retrieved from https://pfaf.org/USER/Plant.aspx?LatinName=Orchis+militaris
<i>Orchis morio</i> ssp. <i>alba</i> , <i>Orchis morio</i> ssp. <i>morio</i> , <i>Orchis morio</i> ssp. <i>picta</i>	Gastroenteritis, antispasmodic	<i>Orchis morio</i> Herb Uses, Cures, Side effects, Nutrients. Herbpthy.com. Retrieved from https://herbpathy.com/Uses-and-Benefits-of-Orchis-Morio-Cid3278
<i>Orchis simia</i>	Aphrodisiac	(Pant, 2013)
<i>Orchis ustulata</i>	Antiflatulent	<i>Orchis ustulata</i> . Dark-Winged Orchid PFAF Plant Database. Retrieved from https://pfaf.org/user/Plant.aspx?LatinName=Orchis+ustulata
<i>Platanthera bifolia</i>	Demulcent	<i>Platanthera bifolia</i> . Butterfly Orchid PFAF Plant Database. Retrieved from https://pfaf.org/user/Plant.aspx?LatinName=Platanthera+bifolia
<i>Spiranthes spiralis</i>	Relieve the symptoms of burns.	<i>Spiranthes autumnalis</i> - <i>Spiranthes spiralis</i> root liquid. (2009, January 5). U.S. National Library of Medicine. Retrieved from https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=01ec3e41-fa6d-4f10-87d8-d1032662cfa3

CONCLUSIONS

The Orchidaceae family represented in Romania by 58 species, have not only an ornamental value, but also an ethnopharmacology importance which was overlooked. In different countries various Orchids species were used in the herbal medicine for their therapeutic activities.

Extracts and metabolites of Orchids plants have ethnopharmacological properties, that should be included in future studies. So far, these plants have been used empirically for the

treatment of different diseases, for pain relief, for problems concerning skin, the reproduction organs, and respiratory system.

Clinical trials with phytochemicals from orchids from Romania, are lacking, so therefore medical recommendation are not to be taken into consideration, at the moment. However, it is hoped, that newer explorations of these botanical species, will be ongoing to design pharmaceutical products, since Orchids should be seen as a therapeutic plant, not only as an ornamental one, by the public and the medical community.

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