CHEMIJA. 2020. Vol. 31. No. 4. P. 269–277
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Review: Marsh rosemary (*Rhododendron tomentosum* Harmaja (ex *Ledum palustre* Linn) growing in Lithuania) essential oils and their properties

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The paper reviews already (in the past fifteen years) published data from research articles on essential oils (EOs) and their biological properties (such as antioxidant, antifungal, anti-inflammatory and toxic activity) of marsh rosemary (*Rhododendron tomentosum* (Stokes) Harmaja (ex *Ledum palustre* Linnaeus, Ericaceae Juss.) growing wild in Lithuania.

Rh. tomentosum is a perennial woody shrub (up to 1 m in height) with evergreen leaves and small white or white-pink sticky flowers grouped in racemes. The plant emits a strong specific smell that affects the central nervous system, and may cause nausea, headache or aggressive behaviour to some people. Only one species of the plant (ex *L. palustre* var. *palustre*) grows in Lithuania, mainly forming colonies in limited areas over all the territory.

Marsh rosemary are widely used in folk medicine and homeopathy for treatment of various sickness, externally and internally as well. Most applications of *Rh. tomentosum* and pharmacological properties have been validated by scientific researches. In Lithuania, the plant is used for healing rheumatism, different pains, insect bites, eczema and other skin problems, infections, bronchitis, asthma, cold, tuberculosis, to block bleeding, etc.

Rhododendron tomentosum H. (ex *Ledum palustre* L.) plants, the essential oils (EOs) of which are already investigated, were collected mostly in the Eastern part of the country (Rokiškis, Utena, Vilnius and Šalčininkai districts). Monoterpene hydrocarbons, p-cymene, myrcene and limonene, bicyclic monoterpenoid ascaridole and oxygenated sesquiterpenes, ledol, palustrol and cyclocolorenone isomers, were found to be principal compounds in the investigated EOs. Some oils contained appreciable quantities of heterocyclic compound lepalol. Most of the oils could be attributed to the ledol+palustrol or ledol+palustrol+ascaridole chemotype.

Antifungal activity of *Rh. tomentosum* EOs was evaluated by several different techniques: against *Penicillium cyclopium* Westling, *Trichoderma harzianum* Rifai and *Candida parapsilosis* using an agar diffusion method; and amperometricaly, using *Saccharomyces cerevisiae* yeast-modified electrodes.

Anti-inflammatory activity of Lithuanian marsh rosemary EOs has been revealed by subcutaneous carrageenan injection-induced hind paw oedema tests.

However, antioxidant activity (tests using ABTS$^{\cdot+}$, DPPH$^{\cdot}$ and TROLOX) and toxic properties (against brine shrimp (*Artemia sera*) larvae) of *Rh. tomentosum* EOs were summarized.

Keywords: *Rhododendron tomentosum* H., Ericaceae, essential oil composition, ledol, palustrol, ascaridole, cyclocolorenones, antifungal activity, antioxidant tests, antimicrobial properties, toxicity *in vivo*

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INTRODUCTION

Rhododendron tomentosum (Stokes) H. Harmaja (formerly mostly known as *Ledum palustre* Linnaeus, Ericaceae Juss.) is a perennial woody shrub (up to 1 m in height) with evergreen leaves and small white or white-pink sticky flowers grouped in racemes. The flowering period is from April to August, depending on the geographical area. The plant is called commonly as a marsh rosemary, marsh tea or marsh Labrador tea. Its names suggest (including the Lithuanian name Pelkinis gailis) that for the plant it is most appropriate to grow in marshy and swampy areas. The preferred growing habitats are peaty and acidic soils, with various sun illuminations. Wild populations of marsh rosemary are found in Northern and Central Europe, Northern Asia (China, Korea and Japan) and N. America. Only one species of the plant (ex *L. palustre* var. *palustre*) grows in Lithuania [1], mainly forming colonies in limited areas over all the territory: in marshes, pinewoods, and in the forests on the Baltic seashore.

Preparations of marsh rosemary are widely used in folk medicine and homeopathy for treatment of various sickness, externally and internally as well. A long list of traditional uses has been presented in a review article of Popescu and Kopp (2013) [2].

In Lithuanian folk medicine, decoctions, alcoholic extracts or crushed raw material of the plant are used for healing rheumatism, podagra, gout, different pains, to block bleeding, insect bites, eczema and other skin problems, infections, bronchitis, pertussis, asthma, cold, cough, tuberculosis, enterocolitis, etc. In ancient times, marsh rosemary leaves were used for bear preparation instead of hops.

All parts of marsh rosemary synthesize a high content of poisonous terpenoids and emit a strong characteristic smell, which attracts bees and other pollinating insects. Flavour of the plant possesses repellent properties effective against bedbugs, clothing moths and cockroaches. The strong specific smell affects the central nervous system, and may cause nausea, headache or aggressive behaviour to some people.

The most applications of *Rh. tomentosum* in folk medicine and pharmacological properties have been defined on the basis of the current scientific researches [3, 4].

Many research works have been devoted to investigate various bioactivities, such as antibacterial, anticancer, anti-inflammatory, fungicidal, antioxidant, toxic, etc. properties of marsh rosemary extracts (see Table 1 for details) [5–22]. The expectorant and antitussive effect of marsh rosemary tea depends on the presence of ledol in the essential oils [3]. Extracts of aerial parts of *Rh. tomentosum* and *Archangelica officinalis* exhibited radioprotective properties *in vivo*, using albino mongrel male mice irradiated with γ-irradiation [23, 24]. According to some literature sources, marsh rosemary extracts or emitted volatiles influence herbivores behaviour [25–29]. Repellent activity was evaluated against host-seeking nymphs of *Ixodes ricinus* L. [25] and mosquitoes *Aedes aegypti* L. [26], repellence and antifeedant effects were tested against *Hylobius abietis* L. and *Phyllodecta laticollis* Suffrian [28]. Insect growth regulating and toxic properties were investigated on the metamorphosis stages of *Tenebrio molitor* pupae [27]. However, compounds from marsh rosemary extracts have impact on polypropylene plastic degradation [30].

The paper reviews already (in the past fifteen years) published data from research articles on essential oils (EOs) and their biological properties (such as antioxidant, antifungal, anti-inflammatory and toxic activity) of marsh rosemary (*Rhododendron tomentosum* Harmaja (ex *Ledum palustre* Linn)) growing wild in Lithuania.

CHEMICAL VARIABILITY OF THE ESSENTIAL OILS OF MARSH ROSEMARY (*RHODODENDRON TOMENTOSUM* HARMAJA (*EX LEDUM PALUSTRE* LINN)) OF LITHUANIAN ORIGIN

PLANT MATERIAL

Rhododendron tomentosum H. (ex *Ledum palustre* L.) plant material, the essential oils of which are already investigated [13, 31–34], was collected mostly in the Eastern part of the country (Rokiškis, Utena, Vilnius and Šalčininkai districts), and in one study [16] a sampling site was not indicated (Fig. 1). Biological identification of most of the herbal samples and storage of voucher specimens has been performed in the Herbarium of the Institute of Botany, Nature Research Centre (BILAS), Lithuania. One Lithuanian *Rh. tomentosum* herbal voucher was deposited in the Herbarium of the Faculty of Pharmacy, Monastir, Tunisia [16].

Fig. 1. Geographical distribution of sampling sites (in Lithuania) of *Rhododendron tomentosum* H. plants, whose EOs are already investigated

Table 1. **Already scientifically improved biological properties of *Rh. tomentosum* Harmaja (ex *Ledum palustre* L.) extracts, essential oils or emitted volatiles**

Biological activity, method applied	Literature source
Anticancer *in vitro*, using mouse leukemia cells L1210	[5]
Anticancer *in vitro*, using human lympho-blastoid Raji cells	[6]
Analgesic, using model of acetic acid-induced writhing response in mice	[7]
Antibacterial *in vitro*, by broth dilution method, against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*	[8]
Antidiabetic *in vitro*, using C2C12 murine skeletal myoblasts and the 3T3-L1 murine preadipocyte cell lines	[9]
Antidiabetic *in vitro*, using Caco-2/15 cells; western blot analysis *in vivo*. Rats, oral glucose tolerance test	[10]
Antifungal, against *Aspergillus niger*, *Candida albicans*, *Microsporum canis*, *Trichophyton rubrum* and *Trichophyton mentagrophytes*	[11]
Antifungal *in vitro*, by microbroth dilution method, against *Cryptococcus neoformans*, *Saccharomyces cerevisiae*, *Aspergillus niger* and *Candida albicans*	[12]
Antifungal, using agar disc diffusion assay, against *Candida parapsilosis*	[13]
Antifungal, using mediated amperometry *at Saccharomyces cerevisiae*-modified electrodes	[13]
Antifungicidal, by agar-diffusion method, against *Trichoderma harzianum* and *Penicillium cyclopium*	[14, 15]
Anti-inflammatory, by model of lambda-carrageenan-induced paw edema in mice	[7]
Anti-inflammatory *in vivo*, using tests of carrageenan-induced edema in rats	[8]
Anti-inflammatory, using tests of subcutaneous carrageenan injection-induced hind paw oedema in rats	[16]
Anti-inflammatory *in vitro*, by prostaglandin biosynthesis assay; PAF-induced exocytosis	[17]
Antimicrobial *in vitro*, against *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Clostridium perfringens*, *Bacillus cereus*, *Enterobacter aerogenes*, *Klebsiella pneumoniae*, *Candida albicans*, *Mycobacterium smegmatis*, *Acinetobacter lwoffii* and *Candida krusei*	[18]

Table 1. **(Continued)**

Biological activity, method applied	Literature source
Antimicrobial *in vitro*, against pandemic strain *Vibrio parahaemolyticus*	[19]
Antioxidant activity *in vitro*, by DPPH˙ assay, ascorbic acid was used as the reference antioxidant	[10]
Antioxidant, using radical scavenging ABTS˙+, DPPH˙ and TROLOX equivalent assay	[13]
Antioxidant *in vitro*, by DPPH˙ assay, Fe^{3+} -EDTA-H_2O_2 deoxyribose assay, nonenzymatic lipid peroxidation of rat liver homogenate	[18]
Anti-proliferative and proapoptotic activity *in vitro*, the influence of EOs on blood lymphocytes' proliferation and apoptosis rates of synovia-derived cells was determined by flow cytometry method	[20]
Antithrombin	[5]
Antithrombin *in vitro*, using thrombin solution from bovine plasma	[6]
Hepato-protective *in vivo*, in rats and mice, CCl4 intoxication	[21]
Toxicity *in vivo*, tested on mice	[22]
Toxicity *in vivo*, tested on brine shrimp (*Artemia sera*) larvae	[13]

Variuos parts of the plant – all aerial parts or separated shoots, inflorescences and seeds – have been chosen for the oils preparation. Plant material was dried at room temperature (20–25°C); different plant organs were separated before drying.

ESSENTIAL OIL PREPARATION

Hydrodistillation (HD) was performed in a circulatory Clevenger-type apparatus, according to the procedure described in the European Pharmacopoeia. In order to obtain sufficient amounts of wild rosemary EOs, HD time of 2 h was chosen [13, 31–34], and the procedure time of 4 h up to exhaustion of all oils present in the matrix [16]. Previously, it was proved that the extension of distillation time from 2 to 4 h has increased *Rh. tomentosum* oil yield without significant changes in the composition of the oils [35]. Obtained EO is as yellow-grey, greasy mass with a sweet characteristic odour.

Supercritical CO_2 extraction (SFE) of *Rh. tomentosum* herbal material was performed in a laboratory apparatus, working at 90 bar and 40°C in the extraction vessel, at 90 bar and 10°C in the first separator and at 20 bar and 15°C in the second one [16]. The extraction procedure was carried out in a semi batch mode: batch charging of vegetable material and continuous flow of solvents.

The content of EO from Lithuania marsh rosemary aerial parts varied from 0.45 to 2.01% (v/w, on a dry weight basis). The lowest contents 0.45 and 0.59% of the oils were obtained for aged (mature) shoots gathered in Rokiškis District [31], and from young shoots collected in April in Samanis forest marshes (Utena District), respectively [13, 32]. The largest quantity (2.0%) of the EO was obtained after 4 h of a hydro-distillation procedure [16]. The yields of *Rh. tomentosum* EOs varied significantly (almost 3-fold) depending on the plant vegetation stage. The oil yields changed during plant growing stages: maximum values 1.73 and 1.76% (v/w) were determined in June and July (at the end of flowering), respectively. Thereafter, the yields decreased to 1.36% (v/w) in October, at the full seeding stage [13, 32]. The quantity of 0.9% (v/w) of the EO was isolation from seeds [34]. Significant differences (from 2.8- to 4.5-fold) were found between the minimum and the maximum yields of the investigated essential oils [13, 16, 31–34].

Variability in the content of EOs could be explained also by growing conditions, temperature, sun illumination intensity and duration of isolation procedure as well.

MAIN COMPOSITION OF *RHODODENDRON TOMENTOSUM* HARMAJA (*EX LEDUM PALUSTRE* LINN) ESSENTIAL OILS

Constituents with 2,6-dimethyloctane, menthane and aromadendrane skeletons are major and characteristic compounds for the EOs of marsh rosemary of the Lithuanian origin (Fig. 2).

Monoterpene hydrocarbons: p-cymene, myrcene and limonene, bicyclic monoterpenoid ascaridole and oxygenated sesquiterpenes: ledol, palustrol, and cyclocolorenones were determined as principal compounds in the investigated Lithuanian *Rh. tomentosum* EOs (Table 2). The structure

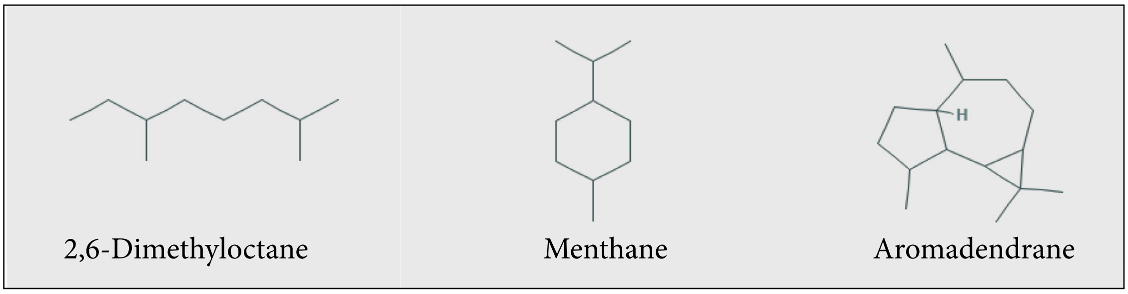

Fig. 2. Main carbon skeletons of *Rhododendron tomentosum* H. (Lithuanian origin) essential oil constituents

Table 2. **Main constituents (%) of *Rh. tomentosum* Harmaja (Lithuanian origin, ex *Ledum palustre* L.) essential oils from already published data**

Location, Reference	No. in BILAS	Plant organ, EO content, %	Ledol	Palustrol	iso-Ascaridole	p-Cymene	Myrcene	Limonene	Cyclocolorenones
Juodupė, Rokiškis d. [31]	not indicated	Young and aged shoots, 0.45–2.01	23.9–30.8	35.2–42.8	0.1	tr.–0.3	5.7–8.6	not indicated	5.0–9.3
Šilėnai, Vilnius d. [31]	not indicated	Young and aged shoots, 0.55–1.52	23.63–0.5	31.4–36.7	0.2–0.3	0.1	1.2–6.1	3.7–11.0	4.0–5.3
Samanis forest, Utena d. [32]	68889	All aerial parts from April to October collected at the same day of month	21.0–32.3	26.2–37.9	tr.–14.2	0.2–5.0	0.4–11.4	below detection limits	2.7–6.5
Šulnys Lake, Šalčininkai d. [33]	68886–68888	All aerial parts during flowering, not indicated	5.2–23.4	1.2–31.8	16.7–20.5	6.2–20.3	0.1–1.0	0–0.9	0.1–2.0
Samanis forest, Utena d. [13]	68889	All aerial parts, collected every month from April to October, 0.59–1.76	18.0 ± 2.9–29.0 ± 5.0	24.6 ± 2.6–33.5 ± 4.4	0.1 ± 0.1–14.0 ± 2.4	0.2 ± 0.2–4.8 ± 0.2	0.4 ± 0.1–10.1 ± 1.3	not indicated	2.7 ± 0.5–6.2 ± 0.3
Rūdninkai, Šalčininkai d. [34]	68890	Seeds, 0.9 shoots, 1.5	In seed EO: 27.0, in shoot EO: 36.5	In seed EO: 38.3, in shoot EO: 21.0	0.7–5.0	1.7–2.2	0.4–1.9	below detection limits	2.1–3.5
Not indicated [16]	168, Herbarium in the Faculty of Pharmacy, Monastir, Tunisia	Aerial parts, by SFE – 1.5, by – 2.0	23.3–26.7	41.0–43.4	4.5–15.1*	0.9–1.3**	0.5–0.9	tr.–0.7	3.0–4.8

d., district; HD, hydrodistillation; SFE, supercritical CO_2 extraction.

* According to the authors [16], identified compound is ascaridole.

** According to the authors [16], identified constituent is o-cymene.

of main constituents is presented in Fig. 3. Most of the oils could be attributed to the ledol+palustrol or ledol+palustrol+ascaridole chemotype. It should be mentioned that the ledol+palustrol chemotype is common for the EOs of *Rh. tomentosum* plants of the European and Asian origin. Ascaridole (organic peroxide) has been identified as a predominant compound in the marsh rosemary growing in some countries, such as Finland and Sweden [26, 35]. Monoterpene myrcene has been determined among main constituents or even the first major one in *Rh. tomentosum* EOs from other world countries (Sweden, Finland, Estonia, Russia (Tomsk region) and China) [25, 35–37, 39]. Marsh rosemary oils with the predominant compound p-cymene were evaluated also in some countries (Finland, Northest China, etc.) [35, 38, 39]. Monoterpene limonene is quite rare as the major constituent in the EOs of *Rh. tomentosum*.

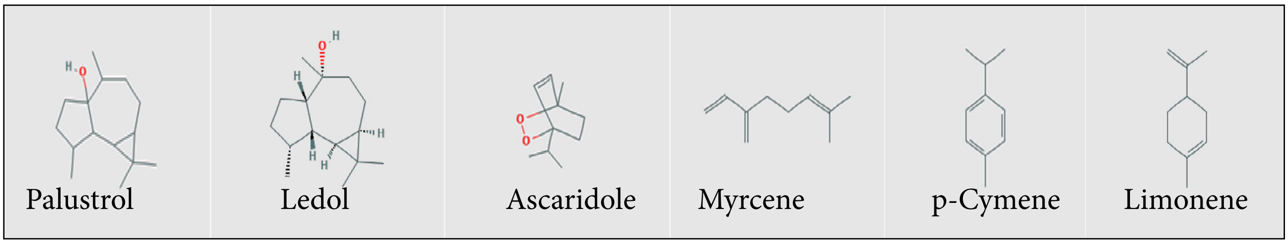

Fig. 3. Structures of the main constituents (taken from National Library of Medicine, National Center for Biotechnology Information, https://pubchem.ncbi.nlm.nih.gov) present in *Rh. tomentosum* Eos (coloured online)

Limonene, p-cymene and myrcene were determined in appreciable quantities in the oils of the plants collected in the Southern regions of Tomsk, Transbaikalia and Amur Province, and also from the Southern part of the Island of Sakhalin [40]. Cyclocolorenone derivatives were identified as the dominating constituents in marsh rosemary plants of the Russian origin (Leningrad Region) [41]. Some investigated *Rh. tomentosum* EOs of the Lithuianian origin were characterized by appreciable amounts of the specific constituents, furyl containing compounds, such as lepaline (3-(4-methyl)-1,4-pentadienyl) furan), lepalone (5-(3-furyl)-2-methyl-1-penten-3-one), lepalol (5-(3-furyl)-2-methyl-1-penten-3-ol) and 2-methyl-5-(3-furyl)-3-penten-2-ol [13, 32, 34]. Quantities of the heterocyclic compound lepalol reached up to 7.9 ± 0.3% of the total oil content in some studies [13, 32].

BIOLOGICAL PROPERTIES OF MARSH ROSEMARY (*RHODODENDRON TOMENTOSUM* HARMAJA (*EX LEDUM PALUSTRE* LINN), LITHUANIAN ORIGIN)

ANTIFUNGAL ACTIVITY

Antifungal activity of *Rh. tomentosum* EOs was evaluated by several different techniques: against *Penicillium cyclopium* Westling, *Trichoderma harzianum* Rifai, using an agar diffusion method [14, 15]; against pathogenic yeast *Candida parapsilosis* in agar disc diffusion assay [13]; and amperometrically, using *Saccharomyces cerevisiae* yeast-modified electrodes [13].

Rh. tomentosum EOs activity against *Trichoderma harzianum* and *Penicillium cyclopium*

A strong antifungal activity of *Rh. tomentosum* EOs was evaluated against *Trichoderma harzianum* Rifai and also *Penicillium cyclopium*. Growth of the mitosporic fungus *T. harzianum* was inhibited by all investigated *Rh. tomentosum* essential oils, obtained from the plants (from Utena District) of various vegetative stages and different organs (shoots and flowers) [14, 15]. The EOs suppressed totally the development of this fungus after seven days.

A little weaker (comparing with *T. harzanum*) antifungal activity was observed against *P. cyclopium* using flower marsh rosemary oils. The oil influenced fungus growth only during the first three days, while its influence decreased after seven days. Only two shoot oils (gathered in July and August, Fig. 4.3, 4.4) containing, despite principal compounds ledol and palustrol, appreciable amounts of iso-ascaridole (14.0 ± 2.4 and 12.7 ± 2.0%,) and p-cymene (4.0 ± 0.4 and 4.8 ± 0.2%) completely suppressed growth of *P. cyclopium.*

The study has confirmed that *Rh. tomentosum* EOs can find practical application as a growth inhibitor of some micromycetes [14].

Antifungal activity of *Rh. tomentosum* EOs against *Candida parapsilosis*

An agar disc diffusion assay against the pathogenic yeast *Candida parapsilosis* (CBS 883C) was evaluated; and the data from this experiment revealed the potential antifungal activity of marsh rosemary EOs [13]. The filter paper discs were impregnated with 10 μL of diluted EO and nystatin (an agent used to treat *Candida* infections) as a positive control reagent. The inoculated Petri plates were incubated at 30°C for 48 h, the inhibition zone around an EO-impregnated paper disc was found to be three-fold larger compared to that around a commercial nystatin-impregnated paper disc. However, the density of the *C. parapsilosis* lawn in a plate containing EO was lower than in the plate with nystatin, indicating the suppressing effect of EO vapours on the pathogenic fungi growth [13].

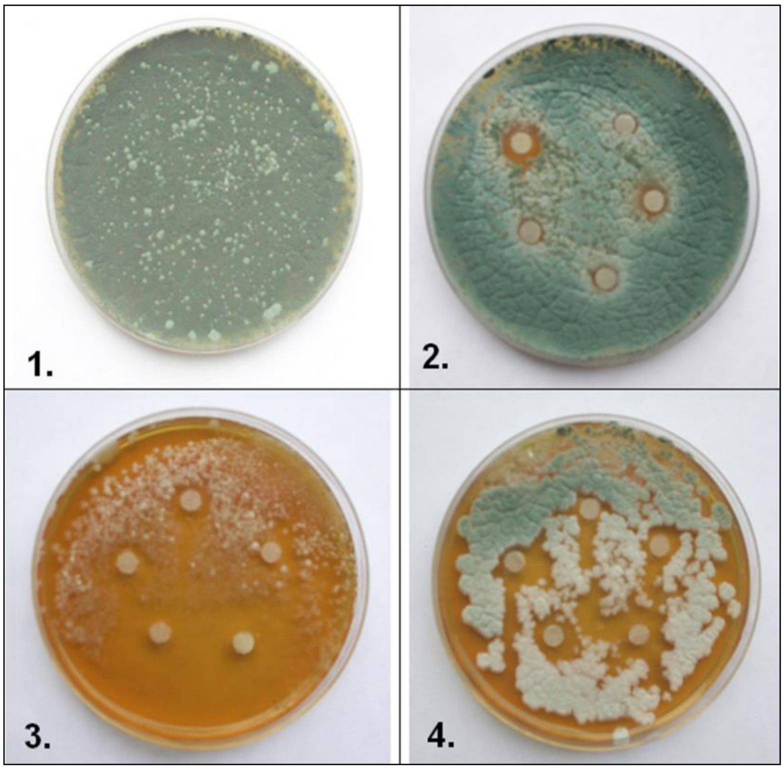

Fig. 4. Petri plates with *Penicillium cyclopium* transferred on agar medium; and five spots of *Rh. tomentosum* EOs (plates 2, 3, 4) after 7 days [14, 15]. The pictures have been taken from a poster presentation [15] (coloured online)

Antifungal activity: *Rh. tomentosum* EOs impact on yeast *(Saccharomyces cerevisiae)* membranes

Antifungal activity of EOs was investigated by mediated amperometry at yeast *Saccharomyces cerevisiae*-modified electrodes [13]. The effect of the essential oil on yeast membrane permeability was monitored by comparing the current responses to lactic acid at yeast-modified electrodes treated with vapours of EO with those obtained at electrodes without such treatment. Employing the responses of yeast-modified electrodes to L-lactic acid, the effect of vapours of *Rh. tomentosum* EO on the permeability of yeast *S. cerevisiae* cell walls was tested [13]. The data from the above study showed that the subjection of yeast cells to vapours of EO resulted in the 3 to 4-fold increase of electrode responses due to the disruption of yeast cell membranes.

ANTIOXIDANT ACTIVITY OF *RH. TOMENTOSUM* EOS

The ABTS$^{\cdot+}$ (2,2'-amino-bis(ethylbenzothiazoline-6-sulfonic acid) diammonium salt) and DPPH$^{\cdot}$ (2,2-diphenyl-1-picrylhydrazyl) assays are commonly used to evaluate the ability of present antioxidants in the matrix to scavenge free radicals.

A variation of antioxidant activities was evaluated among *Rh. tomentosum* EOs samples from Samanis marsh (Utena District) depending on the plant vegetation stage [13]. The highest antioxidant activity was exhibited by young shoot EO (herbal material collected in June). It was concluded in the research that the older the plant, the lower the ability of EO is to scavenge free radicals (for shoot oils of the plants collected in September and October) [13].

ANTI-INFLAMMATORY ACTIVITY OF *RH. TOMENTOSUM* EOS BY SUBCUTANEOUS CARRAGEENAN INJECTION-INDUCED HIND PAW OEDEMA TESTS

The anti-inflammatory activity of two plant extracts – fraction obtained by supercritical fluid extraction (SFE) and EO extracted by hydrodistillation (HD) from the aerial parts of *Rh. Tomentosum* – has been reporteded [16]. The extracts containing as the main compound palustrol

(41.0–43.4%), ledol (23.3–26.7%) and ascaridole (4.5–15.1%) showed an anti-inflammatory activity. The tests were evaluated by the subcutaneous carrageenan injection-induced hind paw oedema. The treated animals received essential oil (SFE and HD), the reference group received ketoprofen or piroxicam and the control group received NaCl 0.9% [16].

The results of the above study showed that the EOs enhanced a significant inhibition of oedema 50–73% for HD oil and 52–80% for SFE oil. These results were similar to those obtained with piroxicam (70%) and ketoprofen (55%). *Rh. tomentosum* essential oils extracted both by HD and SFE showed a significant anti-inflammatory activity as compared with non-steroidal anti-inflammatory drugs [16].

TESTS OF TOXIC ACTIVITY OF *RH. TOMENTOSUM* EOS *IN VIVO*

A toxicity test of the eight EOs (isolated from shoots and inflorescences; plant material collected in Samanis marsh (Utena District)) showed that the lethality LC_{50} and LC_{95} of brine shrimp (*Artemia sera*) larvae was 11.23–20.50 and 34.00–76.07 (μg/mL), respectively [13]. In general, the data from the above study revealed that all *Rh. tomentosum* EOs were notably toxic. Among them, EO obtained from shoots gathered in September (during the seed ripening stage) and containing appreciable amounts of palustrol (26.0 ± 2.5%), ledol (21.5 ± 4.0%) and ascaridole (7.0 ± 2.4%) appeared the most toxic. In contrary, inflorescence oil including almost the same quantities of palustrol (30.0 ± 1.6%) and ledol (23.3 ± 2.3%), but 10.1 ± 1.3% of myrcene and insignificant amounts of ascaridole isomers was evaluated as less toxic [13].

Received 14 August 2020
Accepted 21 September 2020

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Asta Judžentienė

PELKINIO GAILIO (*RHODODENDRON TOMENTOSUM* HARMAJA (EX *LEDUM PALUSTRE* LINN)), AUGANČIO LIETUVOJE, ETERINIAI ALIEJAI IR JŲ SAVYBĖS

Santrauka

Straipsnis apibendrina Lietuvoje augančio pelkinio gailio (*Rhododendron tomentosum* Harmaja (ex *Ledum palustre* Linn)) eterinių aliejų sudėties ir jų biologiškai aktyvių savybių (antioksidacinių, antifungicidinių, priešuždegiminių ir toksiškumo) tyrimus, per pastaruosius 15 metų publikuotus mokslinėje spaudoje.

Pelkinis gailis (*Rhododendron tomentosum* Harmaja, anksčiau vadintas *Ledum palustre* Linn) yra visžalis, daugiametis krūmas, žydintis baltais ar rausvai baltais lipniais žiedais, kurie suformuoja žiedynus. Šis augalas (ex *L. palustre* var. *palustre*) auga ir Lietuvoje, dažniausiai kolonijomis (aukšta)pelkėse, durpynuose, spygliuočių miškuose, smėlinguose pajūrio pušynuose. Gailis turi aštrų specifinį kvapą, kuris veikia centrinę nervų sistemą, gali sukelti vėmimą, galvos skausmus ar agresyvią elgseną. Pelkinio gailio preparatai yra plačiai naudojami liaudies medicinoje ir homeopatijoje; daugelis jo gydomųjų savybių yra moksliškai patvirtintos. Šis augalas naudojamas žaizdų, egzemos ir kitų odos ligų gydymui, nuo įkandimų, veikia raminamai, mažina reumato sukeltus skausmus, slopina uždegimus, spazmus, gydo peršalimo ligas, bronchitą, astmą, tuberkuliozę, stabdo kraujavimą ir kt.

Apibendrinti pelkinio gailio, augančio Lietuvoje (Rokiškio, Utenos, Vilniaus ir Šalčininkų rajonuose ir vienoje nenurodytoje augavietėje), jau ištirtų eterinių aliejų duomenys: cheminė sudėtis bei biologinis aktyvumas. Aliejuose pagrindiniais junginiais nustatyti šie monoterpenai: p-cimenas, mircenas ir limonenas, biciklinis monoterpenoidas askaridolis ir oksiduoti seskviterpenai: ledolis, palustrolis bei ciklokolorenonai. Kai kuriuose aliejuose rasta nemažai heterociklinio junginio lepalolio. Didžioji dalis ištirtų lietuviškų gailių eterinių aliejų gali būti priskirti ledolis + palustrolis ar ledolis + palustrolis + askaridolis chemotipams.

Pateikti duomenys susiję su lietuviško pelkino gailio *Rh. tomentosum* antifungicidiniu aktyvumu prieš *Trichoderma harzianum, Penicillium cyclopium* ir *Candida parapsilosis,* panaudojant agaro diskų difuzijos metodą, taip pat amperometriškai, naudojant *Saccharomyces cerevisiae* mielėmis modifikuotus elektrodus.

Priešuždegiminės lietuviško pelkinio gailio eterinio aliejaus savybės buvo ištirtos su laboratorinėmis žiurkėmis, stebint jų užpakalinių kojų patinimą (edemą), sukeltą atlikus karagenino injekciją į paodį.

Pateikti publikuoti duomenys apie gailio eterinių aliejų antioksidacines savybes, nustatytas su $ABTS^{\cdot+}$, $DPPH^{\cdot}$ ir TROLOX reagentais, o toksinis aktyvumas – su krevečių lervomis (*Artemia sera*).