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RUBRICHE

- Exhibition and conference
- Post event report
- News dal mercato

ABSTRACTS SIROE 2023

Le relazioni presentate
al Congresso Nazionale

FITOTERAPIA

Fitoterapia e integrazione
sportiva (parte 2)

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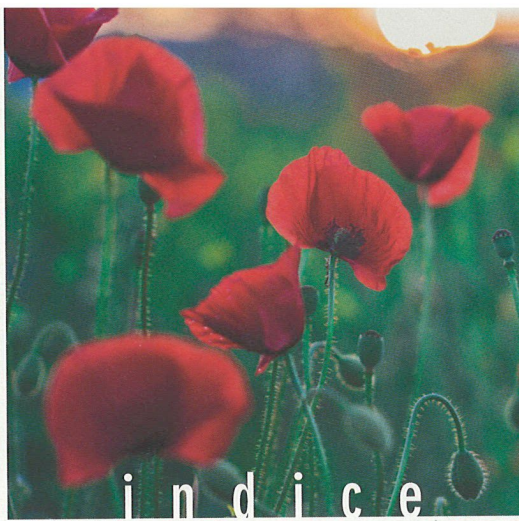


Foto di Lukasz Prajzner

Papaver rhoeas

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Classi di composti	<i>T. praecox</i> (rel. area %)	<i>T. pulegioides</i> (rel. area %)	<i>T. vulgaris</i> (rel. area %)
Monoterpeni	22,55 ^b	25,15 ^b	41,69 ^a
Monoterpeni ossigenati	28,96 ^c	66,21 ^a	54,89 ^b
di cui: Composti fenolici	11,17 ^c	30,10 ^b	47,63 ^a
Sesquiterpeni	24,80 ^a	5,38 ^b	1,82 ^c
Sesquiterpeni ossigenati	26,55 ^a	0,75 ^b	0,69 ^b
Altri composti	1,59 ^b	2,75 ^a	0,98 ^c

Il confronto tra le tre popolazioni di *T. praecox* evidenzia la presenza di due biotipi differenti, tuttavia non è presente un composto chimico predominante tale da permettere l'individuazione del chemiotipo. Nel caso del *T. pulegioides*, invece, si individuano due popolazioni a chemiotipo timolo ed una a chemiotipo alfa-terpinyl acetato (45,8%) (Fig. 1). Per quanto riguarda le popolazioni di *T. vulgaris* il composto predominante, in concentrazioni superiori al 45%, risulta essere per entrambe il timolo, indice del chemiotipo presente.

Discussione e Conclusioni. La composizione degli oli essenziali è fortemente influenzata da fattori genetici, colturali, di lavorazione e di estrazione. Questo si è evidenziato soprattutto per *T. pulegioides* confermando quanto già riportato in letteratura per questa specie (2) ed evidenziando una popolazione a chemiotipo alfa-terpinyl acetato, per la prima volta in Italia; considerato l'impiego di tale composto in differenti ambiti, fra cui quello medico per lo studio delle terapie contro la malattia di Alzheimer, tale popolazione merita ulteriori approfondimenti. Nel caso di *T. praecox* invece non è stato possibile fare una identificazione su base chimica, come in altri habitat montani europei (3). Infine, nel caso di *T. vulgaris*, i dati ottenuti confermano la presenza in Valle d'Aosta del solo chemiotipo a timolo (1), con una concentrazione in principio attivo notevolmente superiore a quella di timo raccolto in altre regioni italiane (4). In futuro si prevede di osservare il comportamento delle diverse accessioni, propagate in vivaio e coltivate a parità di condizioni ambientali e colturali.

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Parole chiave. *Thymus vulgaris*, *Thymus praecox*, *Thymus pulegioides*, Olio essenziale, Valle d'Aosta

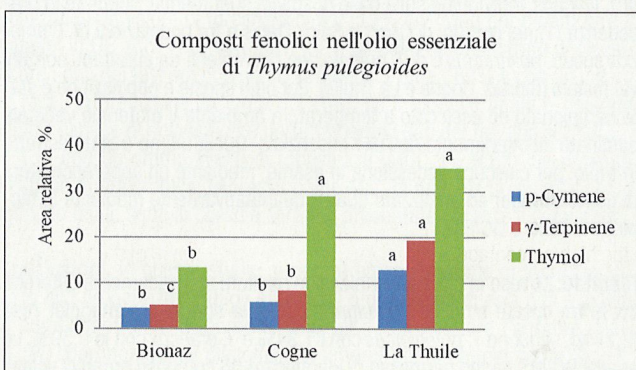


Figura 1. Concentrazione media del timolo e dei suoi precursori biosintetici nell'olio essenziale di *Thymus pulegioides* proveniente da 3 comuni valdostani: Bionaz, Cogne e La Thuile. Per ogni composto, le barre contrassegnate da lettere diverse mostrano valori che differiscono significativamente tra loro al test HSD di Tukey ($p < 0,05$).

Tabella 1. Concentrazione media delle classi di VOCs (composti organici volatili) nell'olio essenziale nelle tre specie del genere *Thymus* esaminate. In ogni riga, valori contrassegnati da lettere diverse differiscono significativamente tra loro al test HSD di Tukey ($p < 0,05$).

PRELIMINARY CHEMICAL PROFILE AND ANTIOXIDATIVE ACTIVITY OF FIVE *PINUS* SPECIES FROM BOSNIA AND HERZEGOVINA

A. Žugič¹, V. Tadić¹, S. Mirković², I. Nešić³

¹Institute of Medicinal Plants Research "Dr. Josif Pančić", Belgrade, Serbia

²PHI Hospital "Sveti Vračevi", Bijeljina, Bosnia and Herzegovina

³Faculty of Medicine, University of Niš, Niš, Serbia
e.mail: azugic@mocbilja.rs

Introduction. Different parts of *Pinus* (bark, needle, cone, and resin) have been used in many areas for their high biological and antioxidant activities. However, very little is known about the chemistry and biological activity of pine species growing in Bosnia and Herzegovina and especially scarce are the data regarding green cone extracts. Therefore, the preliminary chemical profile and antioxidant activity of methanol extracts of needles and green cones of different *Pinus* sp. are reported.

Materials and Methods. The needles and green cones of five pine species (*Pinus heldreichii* Christ., *P. mugo* Turra., *P. nigra* J.F., *P. sylvestris* L. and *P. pinaster* Aiton) were collected in July and August 2016 from the area of mountain Čvrsnica (Bosnia and Herzegovina). The powdered plant materials were extracted with methanol by using a Soxhlet extractor, and total phenolic content was determined according to Folin-Ciocalteu reagent method, while flavonoid and tannin content was calculated using the method described in the European Pharmacopoeia. The antioxidant activity of the extracts was assessed using 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay and Ferric Reducing Antioxidant Potential (FRAP) assay.

Results and Discussion. Results of the preliminary chemical profile investigation of the investigated extracts revealed *P. nigra* and *P. pinaster* green cones to be the most abundant in total phenolic and flavonoid content. In the investigation of tannins content, *P. pinaster* green cones extract was singled out as the sample with the highest percentage of these secondary metabolites (Fig. 1). The antioxidant activity of all extracts determined by DPPH radical scavenging ability ranged from 0.173 to 1.209 μg DPPH/mL. The highest antioxidant activity was found in the extract of *P. pinaster* (green cones), and the lowest in *P. nigra*, needles (PNI). Following the same pattern, the FRAP value was the highest in *Pinus pinaster* (green

The plant and part used	IC ₅₀ DPPH (mg DPPH/mL)	FRAP (mmol Fe ²⁺ /g dry material)
<i>P. nigra</i> , green cones (PNC)	0.436	6.63
<i>P. nigra</i> , needles (PNI)	1.029	8.94
<i>P. sylvestris</i> , green cones (PSC)	0.623	6.20
<i>P. sylvestris</i> , needles (PSN)	0.774	7.63
<i>P. heldreichii</i> , green cones (PHC)	0.620	5.57
<i>P. heldreichii</i> , needles (PHN)	0.900	4.43
<i>P. mugo</i> , green cones (PMC)	0.433	6.65
<i>P. mugo</i> , needles (PMN)	0.432	13.22
<i>P. pinaster</i> , green cones (PPC)	0.173	18.26
<i>P. pinaster</i> , needles (PPN)	0.616	9.04

DPPH = 1,1-diphenyl-2-picrylhydrazyl assay

FRAP= Ferric Reducing Antioxidant Potential assay

Table 1. The antioxidant activity of the investigated samples: *Pinus* extracts (*P. nigra*, green cones (PNC) and needles (PNI); *P. sylvestris*, green cones (PSC) and needles (PSN); *P. heldreichii*, green cones (PHC) and needles (PHN); *P. mugo*, green cones (PMC) and needles (PMN); *P. pinaster*, green cones (PPC) and needles (PPN).

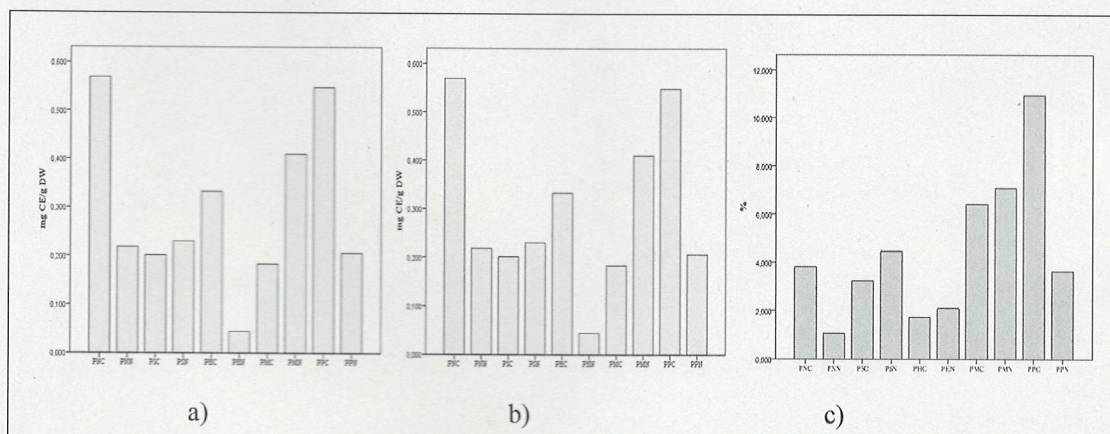


Figure 1. Content of a) total phenolics, b) flavonoids and c) tannins of ten *Pinus* extracts (P. nigra, green cones (PNC) and needles (PNI); P. sylvestris, green cones (PSC) and needles (PSN); P. heldreichii, green cones (PHC) and needles (PHN); P. mugo, green cones (PMC) and needles (PMN); P. pinaster, green cones (PPC) and needles (PPN)).

cones) (18.26 mmol Fe²⁺/g) and the lowest in *P. heldreichii*, needles (PHN) (4.43 mmol Fe²⁺/g) (Tab. 1).

Conclusions. This is the first report on the antioxidant properties and polyphenol content of the needle and cone extracts of *Pinus* species from Bosnia and Herzegovina. The highest antioxidant activity according to both assays was detected in methanol extract of the green cones of *Pinus pinaster*, being proportional to the high content of total phenol and flavonoids, and in particular, tannins, found in this extract.

This study indicated that extract is the potential source of new, natural, pharmacologically active compounds that may find potential applications in the medicine, pharmaceutical, cosmetic, and food industry.

Keywords. *Pinus* species, DPPH, FRAP, Total phenols, Total flavonoids, Total tannins

Acknowledgments: Authors are thankful for financial support, The Ministry of Science, Technological Development, and Innovation projects number EUREKA EI 17236 and EI 13632.

ANTIMICROBIAL ACTIVITY OF ESSENTIAL OILS OF FIVE *PINUS* SPECIES FROM BOSNIA AND HERZEGOVINA

A. Žugič¹, V. Tadić¹, M. Milenković², S. Mirković³, I. Nešić⁴

¹Institute of Medicinal Plants Research "Dr. Josif Pančić", Belgrade, Serbia

²Faculty of Pharmacy, University of Belgrade, Belgrade, Serbia

³PHI Hospital "Sveti Vračevi", Bijeljina, Bosnia and Herzegovina

⁴Faculty of Medicine, University of Niš, Niš, Serbia
e.mail: azugic@mocbilja.rs

Introduction. Essential oils (EOs) of *Pinus* sp. have been proven to possess antimicrobial properties against bacteria and fungi and could serve as a source of antimicrobial agents. The aim of the present study was to investigate the *in vitro* antibacterial activities of the EOs isolated from the fresh needles and cones of *Pinus* spp., as related to their chemical composition.

Material and Methods. The needles and green cones of five pine species (*Pinus heldreichii* Christ., *P. mugo* Turra., *P. nigra* J.F., *P. sylvestris* L. and *P. pinaster* Aiton) were collected in July and August 2016 from the area of mountain Čvrtnica (Bosnia and Herzegovina). The fresh needles and cones of each species were cut into small pieces and separately subjected to hydrodistillation using a Clevenger-type apparatus for 2 hours. The obtained EO was extracted with diethyl ether and dried over anhydrous sodium sulfate. Quantitative and qualitative data of EOs were obtained by gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS). The minimum inhibitory concentration (MIC) was determined by the micro-broth dilution method.

Results and Discussion. The chemical composition of the tested EOs showed a high percentage of α -pinene in *P. nigra* needles (54.42%), *P. pinaster* cones (47.47%), *P. nigra* cones (40%), *P. sylvestris* needles (39.82%), *P.*

MIC (μ g/mL)	PMN	PMC	PNN	PNC	PSN	PSC	PPN	PPC	PHN	PHC
<i>Staphylococcus aureus</i> ATCC 6538	1000	>1000	>1000	>1000	800	100	150	150	800	400
<i>Enterococcus faecalis</i> ATCC 29212	1000	1000	800	1000	600	100	150	100	100	100
<i>Kocuria rhizophila</i> ATCC 9341	500	500	600	800	800	1000	400	800	600	400
<i>Bacillus subtilis</i> ATCC 6633	1000	>1000	>1000	>1000	>1000	>1000	400	400	1000	600
<i>Escherichia coli</i> ATCC 8739	>300	>300	>300	100	>300	150	200	150	>300	>300
<i>Klebsiella pneumoniae</i> NCIMB 9111	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
<i>Salmonella Typhimurium</i> ATCC 14028	>300	>300	>300	>300	>300	>300	>300	200	>300	>300
<i>Pseudomonas aeruginosa</i> ATCC 9027	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
<i>Achromobacter baumannii</i> ATCC 19606	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000
<i>Candida albicans</i> ATCC 10231	>300	>300	>300	>300	>300	150	100	100	100	150

Table 1. Minimal Inhibitory Concentrations (MICs) of *Pinus* sp. essential oils (P. mugo, green cones (PMC) and needles (PMN); P. nigra, green cones (PNC) and needles (PNI); P. sylvestris, green cones (PSC) and needles (PSN); P. pinaster, green cones (PPC) and needles (PPN); P. heldreichii, green cones (PHC) and needles (PHN)).

syvestris cones (37.86%), *P. heldreichii* cones (23.98%), *P. pinaster* needles (17.02%), *P. mugo* needles (11.18%) and *P. heldreichii* needles (11.13%) EOs. (*E*-Caryophyllene was found in high percentage in *P. pinaster* needles, *P. mugo* cones, *P. nigra* cones, *P. pinaster* cones, *P. sylvestris* cones EOs (24.69 %, 21.27%, 14%, 11.7% and 9.13%, respectively). Limonene was found mainly in EOs of *P. heldreichii* cones and needles (60.92 % and 36.79%). As one of the main compounds, (11E,13Z)- λ -abdien-8-ol only appeared in the EO of *P. nigra* cones. Germacren, as a main compound of *P. heldreichii* needles (30.22%), also appeared in the EO of *P. nigra* needles (16.34%) and *P. mugo* cones (16.30%). The major components of *P. pinaster* needles, *P. pinaster* cones, and *P. sylvestris* cones EOs were myrcen (24.65%, 14.61% and 13.8%, respectively). *P. mugo* cones and needles EOs contained predominantly δ -3-carene (23.36% and 19.95%). Tested EOs, isolated from *Pinus* species, have shown to possess inhibitory action against tested isolates in the range of 100–1000 μ g/mL (MICs) (Tab. 1). Among the tested oils, the one isolated from cones and needles of *P. pinaster* exhibited the highest antimicrobial action.

Conclusions. Based on the present results, it could be hypothesized that the antibacterial activity and the synergistic effect of *Pinus* EOs and gentamicin relate to the high percentage of monoterpene and sesquiterpene hydrocarbons. The results point to high potential and completely justified pharmacological utilization of the pine EO because of the wide antimicrobial spectrum of some investigated *Pinus* species' EOs.

Keywords. *Pinus* species, Essential oils, Antimicrobial, Chemical analysis

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