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CHEMICAL COMPOSITION OF ESSENTIAL OIL OF *ARTEMISIA SCOPARIA* (ASTERACEAE) FROM ROMANIA

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Abstract

This paper presents the composition of the essential oil extracted from Artemisia scoparia in different phenophases. The essential oil has been extracted by hydro distillation and analysed by gas chromatography coupled with mass spectrometry (GC-MS). The obtained results emphasized the presence of some major chemical compounds in the maturity period, such as beta pinene (2.92%), methyl eugenol (18.63%), capillene (33.33%), spathulenol (8.45%) and ent-spathulenol (14.84%), while during the flowering phase beta-pinene (9.30%), limonene (2.58%), gamma-terpinene (3.05 %), capillene (66.20%). During the growing season, beta-pinene (9.74%), limonene (3.52%), gamma-terpinene (3.93%) and capillene (71.22%) were determined. In the three phenophases the main common chemicals were β-pinene and capillene.

Key words: *Artemisia, essential oil, capillene, phenophase.*

INTRODUCTION

Artemisia scoparia belongs to the genus *Artemisia*, family Asteraceae (Boakye et al., 2017).

This genus contains almost 500 species spread all over the world (Bora & Sharma, 2011). The varied composition of volatile oils in *Artemisia* species presents different therapeutical effects like: antimalarial, antitumor, antihepatitis, antioxidant, antipyretic, antispasmodic (Tan et al., 1998), anti-infertility or anti-nervous disorders (Joshi, 2013). It is also used in agriculture and food industries, with an antifungal, antiparasitic, anticancer (Bayala et al., 2014), antimicrobial and insecticidal effects (Pandey & Singh, 2017), as gastronomic herbs (Hayat et al., 2009), or cosmetics like perfumes, soaps and detergents (Boakye et al., 2017). The strong and aromatic scent of some species of *Artemisia* genus is due mainly to high concentrations of volatile terpenes, constituents of their essential oils, especially in leaves and flowers (Abad et al., 2012).

A. scoparia is considered a medicinal plant, being found in countries such as: Iran, India, Saudi Arabia, China, Korea, Japan, Pakistan, and Central Europe. It has been used to treat inflammation, fever, jaundice (Ding et al., 2021), hepatitis, and to cure ear aches (Boakye et al., 2017). *A. scoparia* oil has bioherbicidal properties, as it causes severe phytotoxicity and interferes with the growth and physiological processes of some weed species (Kaur et al., 2010). It has a strong scent, and its flowering period is July-October (Boakye et al., 2017). The major chemical compounds which are found in *A. scoparia* were β-myrcene, γ-terpinene, neral and cis-p-mentha-2-en-1- ol, β-caryophyllene, p-cymene and p- cymene-8-ol (Kapoor et al., 2004), γ-terpinene, eugenol, eugenyl valerate, limonene, p-cymene, eugenyl isovalerate and eugenyl butyrate (Ali et al., 2000), myrcene as the major constituent followed by (+)-limonene, (Z)-beta-ocimene, gamma-terpinene and acenaphthene (Singh et al., 2009), camphor, 1,8-cineole, and beta-caryophyllene (Cha et al., 2005).

The objective of this study was to analyze the composition of volatile oil in different phenophase of *A. scoparia* species.

MATERIALS AND METHODS

The plants of *A. scoparia* come from the spontaneous flora of Romania (Mahmudia - Tulcea County). The biological material was analyzed fresh in various phenophases. The extraction and analysis of the volatile oil were done within the Faculty of Horticulture, Bucharest. Fresh herbal parts of the collected plants were subjected to hydro distillation for 3h using a Singer-Nickerson equipment to produce oil. The separation and identification of components has been carried out using an Agilent gas chromatograph, equipped with quadruple mass spectrometer detector. A capillary column DB-5 452 (25 m length x 0.25 mm i.d. and 0.25 µm film thickness) and helium as carrier gas were used (Bădulescu et al., 2010). The initial oven temperature was 60°C, then rising to 280°C at a rate of 4°C/min. The NIST spectra bank was used for to identify the essential compounds, which were verified with the Kovats indices.

RESULTS AND DISCUSSIONS

Following the analyse performed on the volatile oil extracted from *A. scoparia*, it was found that the number of identified substances was 18 during the growth period, 16 during the flowering period and 14 during the maturity period. During the growth period, there was noted as the majority of chemical compounds have been represented by β-pinene (9.74%), limonene (3.52%), trans-β-ocimene (2.74%), γ-terpinene (3.93%) and capillene (71.22%) (Figure 1).

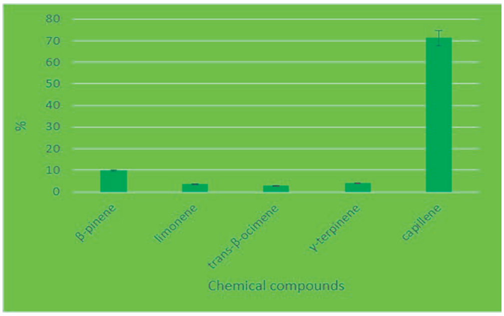

Figure 1. Major chemical compounds in the volatile oil of *Artemisia scoparia* in the growth phenophase

The minor chemical compounds found in *A. scoparia*'s oil during the growth period were α-pinene, myrcene, α-terpinene, p-cymene, cis-β-ocimene, terpinen-4-ol, phenyl cyclohexadiene, lavandulol, pentadienyl benzene, β-caryophyllene, β-cubebene, β-himachalene and spathulenol (Figure 2). From the category of minority chemical compounds analysed in the growth phase, six compounds are not found in the other two phenophases (α-terpinen, p-cymene, terpinen-4-ol, phenyl cyclohexadiene, lavandulol, and pentadienyl benzene).

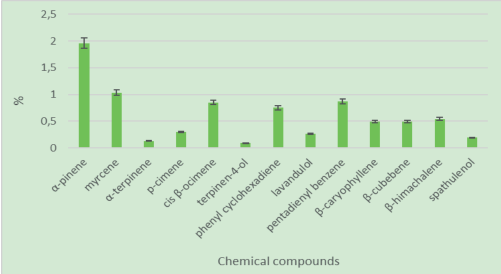

Figure 2. Minor chemical compounds in the volatile oil of *Artemisia scoparia* in the growth phenophase

During the flowering period, the majority chemical compounds were β-pinene (9.30%), limonene (2.58%), trans-β-ocimene (3.17%), γ-terpinene (3.05%), methyl-eugenol (5.49%) and capillene (66.20%) (Figure 3). The major compound named capillene was also found in a chemotype of *Artemisia dracunculus* L. (Tarragon), collected at flowering stage from naturally growing population of Shansha (Himachal Pradesh), North-West Himalaya, India (Chauhan et al., 2010), as well as in a chemotype of *A. scoparia* (full-blooming stage) from Serbia (Ickovski et al., 2020). The minor chemical compounds in the same period were α-pinene, myrcene, cis-β-ocimene, eugenol, cyclohexadiene-1-ol benzene, β-caryophyllene, β-himachalene, spathulenol, β-eudesmol and isoeugenol acetate (Figure 4). Also, among the minor chemical compounds identified in the flowering phenophase, 4 of them (eugenol, β-eudesmol, cyclohexadiene-1-ol benzene and isoeugenol acetate) were not found in the growth and maturation phenophases.

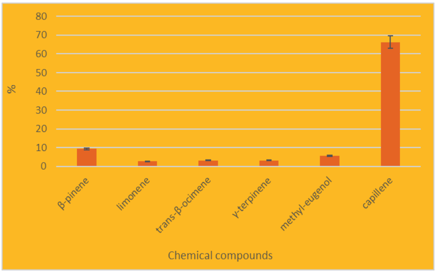

Figure 3. Major chemical compounds in the volatile oil of *Artemisia scoparia* in the flowering phenophase

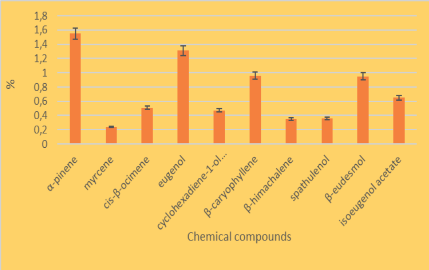

Figure 4. Minor chemical compounds in the volatile oil of *Artemisia scoparia* in the flowering phenophase

Following the analysis of volatile oil in *A. scoparia* plants (during the flowering period) in Iran, the main chemical compounds that were found there were 1-phenyl-penta-2,4-diyne, β-pinene, limonene and (E)-β-ocimen (Safaei-Ghomi et al., 2005). Another study showed that β-ocimene and β-pinene at the vegetative stage, and β-pinene and 1-phenyl-penta 2,4-diyne at the budding and flowering stages were the most abundant constituents (Ranjbar et al., 2020). According to Danesch et al. (2010), the main chemical compounds (during flowering stages) were methyl eugenol, caryophyllene oxide, spathulenol and sabinene. During the maturity period, the following chemical compounds were highlighted β-pinene (2.92%), eucalyptol (2.04%), artemisia ketone (3.61%), camphor (2.36%), methyl eugenol (18.63%), β-caryophyllene (5.11%), capillene (33.33%), spathulenol (8.45%), and ent-spathulenol (14.84%) (Figure 5).

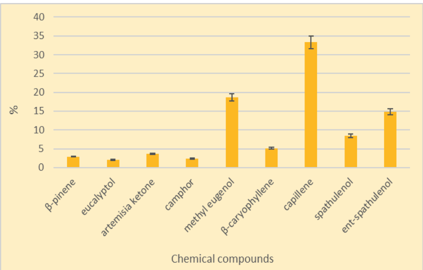

Figure 5. Major chemical compounds in the volatile oil of *Artemisia scoparia* in the maturity phenophase

The major chemical compound ent-spathulenol was only found during the maturity period, whereas some minor chemical compounds were considered the following: α-pinene, cimen, chrysanthenone, β-cubebene, caryophyllene oxide (Figure 6). In the maturity phenophase, from the category of the minor chemical compounds, the following substances were not found in the growth and flowering phenophases: cimen, artemisia ketone, chrysantenone, camphor and caryophyllene oxide.

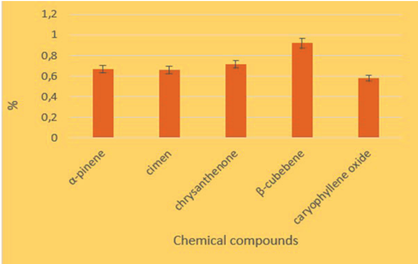

Figure 6. Minor chemical compounds in the volatile oil of *Artemisia scoparia* in the maturity phenophase

The chemical compound methyl-eugenol was present only in the flowering and maturity phenophase, registering a higher value in the maturity phenophase (18.63%), compared to the flowering stage (5.49%). Methyl eugenol has antimicrobial and antifungal activity (Joshi, 2013).

The chemical compound β-caryophyllene showed a higher value in the maturity phenophase (5.11%) compared to the other two phases, growth and flowering (0.49 and 0.96% respecttively) of the same compound. β-caryophyllene has been used for therapeutic agent in traditional medicine and has antimicrobial activity (Yoo & Jwa, 2018). The major chemical compounds common to the three phenophases were β-pinene and capillene. In the three phenophases, for capillene there were registered high values: 71.22% (growth phenophase), 66.20% (flowering phenophase) and 33.33% (maturity phenophase). The chemical compounds limonene, trans-β-ocimene and γ-terpinene, which were found in great quantities in the growth and flowering phenophases were not found in the maturity phenophase. Also, the chemical compounds, eucalyptol, artemisia ketone, camphor and spathulenol present in greater amounts during the maturation period, were not found in the other two phenophases (growth and flowering).

The analysis of leaf and root oils of *Artemisia capillaris* Thunb. syn. *Artemisia scoparia* Waldst. & Kit. (Asteraceae family) showed the dominant presence of phenyl alkynes (61.2%, 85.5%), viz. capillene 60.2% and 82.9%, respectively (Joshi et al., 2010). In the case of the chemical compound β-pinene, higher values were obtained in the growth phenophase (9.74%), respectively flowering (9.30%) compared to the maturing phenophase (2.92%). β-pinene has an antibacterial role (Rivas da Silva et al., 2012), antiproliferative activity against the cancer cells (Li et al., 2009), showing antidepressant-like and sedative-like activity (Guzmán-Gutiérrez et al., 2012). The analysis of the volatile oil extracted from plants in the Tajikistan region indicates the presence of the main chemical compounds: diacetylenes 1-phenyl-2,4-pentadiyne, capillene, β-pinene, methyl eugenol, α-pinene, myrcene, limonene, and (E) -β-ocimene (Sharopov & Setzer, 2011). The major constituents of the oil of *A. scoparia*, collected in Khorasan province, from Iran, were: β-pinene, carvacrol, limonene, cis-ocimene, methyl eugenol, and trans-ocimene (Khayyat & Karimi, 2004). The main identified constituents of the oil obtained from the vegetative stage were as follows: α-thujone, β-thujone, camphor and 1,8-cineole, while for the oils of floral budding and flowering stages, the major ones were α-thujone and β-thujone respectively (Mirjalili et al., 2007). The research conducted by Kaur et al. in 2010 showed that the main chemical compounds from the leaves of *A. scoparia* plants growing in wastelands around Chandigarh were: p-cymene, myrcene and (+) - limonene, respectively.

The essential oil of *A. scoparia* (full-blooming stage) from Serbia was rich in capillene (63.8%), β-pinene (26.1%), (Z)-β ocimene (23.8%) and limonene 10.7%) as the major compounds according to Ickovski et al. (2020). The major components of the essential oil from Turkey determined by Demirci et al. (2005) were capillene (53.0%), β-pinene (20.8%), β-caryophyllene (16.4%), (Z)-β ocimene (16.4%), mircene (12.8 %) and limonene (11.0%). Our results are similar to those obtained by Ickovski et al. (2020) and Demirci et al. (2005), capillene being the main chemical compounds.

CONCLUSIONS

The species of the genus *Artemisia* are plants with a wide use due to the variation of the content in chemical compounds. The main chemical compound was capillene which can be useful in various industries as well as in chemotaxonomic determination. The composition of the volatile oil according to the obtained results and the existing data in the specialised writings, varies depending on the phenophase, the parts of the plant and the ecotype.

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