Macedonian Pharmaceutical Bulletin, 72 (Suppl 1) 413 - 414 (2026)
Online ISSN: 1857-8969
DOI: 10.33320/maced.pharm.bull.2026.72.03.199
Short communication

Comparative analysis of volatile compounds in flowers and leaves of *Sambucus nigra*

Bujar Qazimi[1*], Ivana Cvetkovikj Karanfilova[2], Marija Karapandzova[2], Gjoshe Stefkov[2], Hyrije Koraqi[1], Shpend Dragusha[1], Belma Nallbani[1],Valon Ejupi[1]

[1]*Faculty of Pharmacy, UBT-Higher Education Institution, Lagjia Kalabria, 10000 Pristina, R. Kosovo*
[2]*Institute of Pharmacognosy, Faculty of Pharmacy, Ss. Cyril and Methodius University, Majka Tereza 47, 1000 Skopje, R. N. Macedonia*

Introduction

Sambucus nigra L., commonly known as black elderberry, is a medicinal plant widely distributed throughout Europe and traditionally used in folk medicine for the treatment of respiratory disorders, fever, inflammation, and infections. Due to its rich phytochemical composition, this species has attracted increasing scientific attention in the fields of pharmacognosy, phytochemistry, and pharmaceutical sciences (Młynarczyk et al., 2018). The chemical composition of *S. nigra* varies depending on the plant organ, geographical origin, environmental conditions, and harvesting period. Elderflowers are particularly rich in flavonoids such as rutin, quercetin, and kaempferol derivatives, as well as chlorogenic and caffeic acids, which are considered major contributors to their antioxidant activity. In addition, the flowers contain volatile compounds and organic acids that are important for both medicinal and nutritional applications (Charlebois et al., 2010). Recent phytochemical investigations have demonstrated that the leaves and flowers of *S. nigra* possess high concentrations of phenolic compounds with strong free radical scavenging activity (Qazimi et al., 2023). Furthermore, mineral analyses have shown that *S. nigra* contains essential macro- and microelements such as potassium, calcium, magnesium, iron, and zinc, which are important for human nutrition and therapeutic applications (Qazimi et al., 2024).

The aroma compounds present in the flowers and leaves of *Sambucus nigra* play an important role in attracting pollinators, protecting the plant, and determining its commercial value. Volatile compounds such as linalool, rose oxide, and hotrienol contribute to the characteristic floral fragrance, while green leaf volatiles provide fresh and herbaceous notes important for ecological interactions (Jørgensen et al., 2000). This study aimed to determine and characterize the volatile aromatic compounds present in the flowers and leaves of *Sambucus nigra*. using Headspace - GC/FID/MS method.

Material and methods

Plant material

Flowers and leaves of *S. nigra* L. was collected from six different localities in Kosovo during the full flowering stage of the plant. After collection, the plant material was carefully cleaned and dried at ambient temperature in order to preserve the chemical composition and volatile constituents. The

*bqazimi2003@yahoo.com

dried samples were subsequently stored in appropriate conditions until further analysis.

Analyses of aroma compounds:

GC and GC-MS analyses: 0.3 g of dried flowers and leaves of *S. nigra* was put in sealed vials, warmed for 5 minutes and the gas phase (highly volatile compounds) was investigated on Agilent 7890A Gas Chromatography system equipped with flame ionization detector (FID) and Agilent 5975C Mass Quadrupole detector as well as capillary flow technology which enable simultaneous analysis of the sample on both detectors. HP-5ms (30 m x 0.25 mm, film thickness 0.25 μm) capillary column was used. Operating conditions were as follows: oven temperature 60°C, 20°C/min to 280°C; helium as carrier gas at a flow rate of 1 mL/min; injector temperature 260°C and FID temperature 270°C. 1000 μL of gas phase was injected at split ratio 1:1. The mass spectrometry conditions were: ionization voltage 70 eV, ion source temperature 230°C, transfer line temperature 280°C and mass range from 50-500 Da. The MS was operated in scan mode. GC runtime 43.22 min.

Headspace method: Incubation temperature 80˚C; incubation time 5 min; syringe temperature 85˚C; agitator speed 500 rpm.

Identification of components*:* Identification of the components was made by comparing the mass spectra of components with those from NIST, Wiley and Adams mass libraries, by AMDIS (Automated Mass Spectral Deconvolution and Identification System) and by comparing literature and estimated Kovat's (retention) indices that were determined using a mixture of a homologous series of normal alkanes from C_9 to C_{25} in *n*-hexane, under the same conditions. The percentage ratio of the components was computed by the normalization method of the GC/FID peak areas and average values were taken.

Results and discussion

A total of 18 volatile compounds were identified in the flowers of *S. nigra*, representing 71.17–98.50% of the total volatile fraction. The results indicate a chemical profile dominated by monoterpenes, particularly oxygenated monoterpenes.

Menthol was the predominant compound in all analyzed samples, accounting for 31.22–67.11% of the total volatile composition. Myrcene was the second most abundant constituent (7.99–21.46%), followed by 2-H-pyran-3-ol (2.81–11.16%), benzaldehyde (2.68–9.12%), and limonene (1.17–4.71%). The volatile profile of *Sambucus nigra* leaves was characterized by fewer volatile compounds than in the flowers, with only eight compounds identified, accounting for 78.80–99.01% of the total volatile fraction. Similar to the flowers, menthol (50.14–76.49%) and benzaldehyde (9.66–41.16%) were the dominant compounds, indicating their important role in the aroma of both plant organs. A notable difference was the presence of 1,3,5-octatriene (1.99–9.38%), detected exclusively in the leaves, and may represent a tissue-specific volatile constituent of *S. nigra.*

Conclusion

The results demonstrated that the volatile profile of *Sambucus nigra* is dominated by oxygenated monoterpenes, with menthol as the major constituent in both flowers and leaves. Flowers exhibited greater volatile diversity, while the exclusive presence of 1,3,5-octatriene in leaves suggests tissue-specific metabolic characteristics and contributes to the distinct aroma profile of this plant organ.

References

Młynarczyk K. et al., 2018. Bioactive propertes of Sambucus nigra L. as a functional ingredient for food and pharmaceutical industry. J Funct Foods 40, 377-390. 10.1016/j.jff.2017.11.025

Charlebois D. et al., 2010, Elderberry: botany, horticulture, potential. Hort Rev. 37, 213-280. 10.1002/9780470543672.ch4

Qazimi B. et al., 2023, Phenolic compound composition of Sambucus nigra L. wild-growing plants from Kosovo. Turk J Pharm Sci. 20(6), 380-389. 10.4274/tjps.galenos.2023.60562

Qazimi, B. et al., 2024, Characterization of mineral composition of leaves and flowers of wild-growing *Sambucus nigra*. Acta Pharm. 74(1), 165-176 10.2478/acph-2024-0007

Jørgensen, U. et al., 2000, Olfactory and quantitative analysis of aroma compounds in elder flower (*Sambucus nigra* L.) drink processed from five cultivars. J. Agric. Food Chem. 48(6), 2376–2383.