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PHYTOCHEMICAL COMPOSITION OF *SALVIA OFFICINALIS* AND *SIDERITIS RAESERI* EXTRACTS ORIGINATING FROM ALBANIA

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Abstract

This study aims to present the phytochemical composition of sage (*Salvia officinalis*) and mountain tea (*Sideritis raeseri*), two medicinal and aromatic plant species, belonging to the Lamiaceae family, widely distributed in the Albanian territory. The plants extracts were obtained by ultrasound-assisted extraction and analyzed by spectrophotometric means for their antioxidant activity using the DPPH and ABTS radical screening assays, total phenolic and flavonoid content (TPC, TFC). The polyphenolic profile of the sample was characterized by Reversed-Phased High-Performance Liquid Chromatography (RP-HPLC). Both of plants extracts didn't show significant differences in the antioxidant screening assays suggesting a similar antioxidant potential. The global characterization revealed that the sage extract contained a higher TPC with an average of 115.73 ± 3.80 mg GAE/g D.W. Meanwhile, the mountain tea extract prevailed in the TFC with an average of 11.60 ± 0.39 mg QE/g D.W. The chromatograms revealed a rich polyphenolic profile for the extracts, with *S. raeseri* having a higher number of detected peaks. In the present research work, both of the medicinal and aromatic plants collected in Albania showed remarkable antioxidant potential, total phenolic and flavonoid content. The rich polyphenolic profile unveiled from the RP-HPLC characterization encourage further research and application of these plants extracts for their nutritional and pharmaceutical properties.

Keywords*: Salvia officinalis, Sideritis raeseri,* phytochemical characterization

Introduction

The *Lamiaceae* plant family is one of the largest, most diverse, and widespread among the dicotyledons, with about 236 genera and 6900 to 7200 species. The plants in this family are known for their highly aromatic scent, attributed to the presence of external glandular structures that produce volatile oil. These oils are used for

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medicinal purposes and have various applications in pharmaceuticals, cosmetics, perfumes, pesticides, and food as flavoring agents (Venkateshappa and Sreenath, 2013). The reports in the literature suggest that plants of the Lamiaceae family possess antioxidant and antimicrobial potential due to their phytochemical composition. However, the properties of these plant extracts can vary depending on factors such as environmental conditions, extraction conditions, and assessment protocols (Kozłowska *et al.*, 2015).

Salvia is the largest genera of the Lamiaceae family with 900 species found worldwide. However, only a few species are used, as the rest are considered unsuitable due to their bad odor or potential harm to human consumption. *Salvia officinalis* L. is a perennial round shrub, native to the Mediterranean region and the Middle East (Altindal and Altindal, 2016; Hazrati *et al.*, 2022). The majority of phytochemical compounds, present in the flower, leaves, and stem of *S. officinalis*, such as alkaloids, carbohydrates, fatty acids, phenolic compounds, glycosidic derivatives, polyacetylenes, steroids, terpenes/terpenoids, waxes have been found and successfully identified (Ghorbani and Esmaeilizadeh, 2017). The sage herbal infusion has been used in traditional medicinal practices as a preparation for mouth or throat inflammation relief, mild gastrointestinal disorders (dyspepsia, flatulence, poor digestion, bloating, and heartburn), and as a relief of menopausal hot flushes, and excessive perspiration (European Medicines Agency, 2016a).

The genus *Sideritis*, part of the Lamiaceae family, includes more than 150 species and several subspecies of shrubs and annual or perennial herbs. These plants are mainly found in the Mediterranean region, the Balkans, the Iberian Peninsula, Macaronesia, Central Europe, and Asia. The taxonomical classification of this botanical genus is complex due to the high number of hybridizations between species (Bertsouklis *et al.*, 2022; Mitropoulou *et al.*, 2020). Many of the *Sideritis* species are endemic to specific regions, adapted to the native growing conditions and their natural habitat. For instance, *Sideritis raeseri* Boiss. & Heldr. is considered a Balkan endemic species found in south Albania, southeastern parts of North Macedonia, and North Greece (Sota *et al.*, 2023). The species with the most commercially interest from this genus are *Sideritis scardica* Griseb., *S. clandestine* (Bory & Chaub.) Hayek, *S. raeseri* Boiss. & Heldr, and *S. syriaca* L. In literature, the common names used to refer the plants of this genera are mountain tea, ironwort, and Shepard's tea (Drinić *et al.*, 2021). The infusions prepared from the flowering aerial parts, of the four main *Siderities* species mention above, have been used in traditional medicine to treat colds, coughs, and relieve of mild gastrointestinal discomfort (European Medicines Agency, 2016b). The biological activities of the *Siderities* species have been attributed to the diverse photochemical compounds including phenolic acids, flavonoids, phenylpropanoids, iridoid glycosides, diterpenes, and essential oils (Šavikin *et al.*, 2021).

Albania is a suitable environment for the growth of sage, as it thrives in dry, cool lands along the Mediterranean foothills, protected by strong winds. The plant prefers stony soils consisting of limestone karst rocks, and can be found at altitudes between 150 to 1200 meters above sea level in the western part of the country. This includes

areas from the Adriatic to the Ionian coast, such as Shkodër, Lezhë, Krujë, Dibër, Tiranë, Elbasan, Skrapar, Përmet, Tepelenë, Leskovik, Gjirokastër, Delvinë, and Sarandë. The first harvest take place between 15 June and 15 July, while the second harvest occurs between 15 September and 15 October. Except for *Salvia officinalis* L., six other *Salvia* species can also be found in Albanian territory, including *S. glutinosa* L., *S. horminum* L., *S. sclarea* L., *S. pratensis* L., *S. verbenaca* L., and *S. verticillata* L. Meanwhile, the mountain tea grows in areas with limestone rocks and near pastures, specifically at altitudes of 900 meters and higher above sea level in the southern region of the country. These areas include Llogara, Lunxhëri, Çajup, Sevaster, Gramoz, Çikë, Përmet, Tepelenë, Nemërçë, Tomor, Çermenikë, and Korçë. The optimal period for harvest is during June and July (Pazari, 2014; Salihila, 2019).

The aim of this paper is to present the phytochemical composition of sage (*S. officinalis*) and mountain tea (*S. raeseri*), which are widely distributed throughout the Albanian territory. Due to their ecological, economic, ethical, pharmaceutical, and cosmetic significance, they are included in the list of country-important medicinal and aromatic plants. Sage, due to its widespread adaptation and growth, is a well-studied plant of high interest that has found application in different fields. On the other hand, mountain tea (*Sideritis* species), which is distributed and used mostly in the Mediterranean and the Balkans region, shows limited application in the pharmaceutical and food industries. A better understanding of the phytochemical composition creates more opportunities for wider utilization of plants' essential oils/extracts for their beneficial properties.

Materials and methods

Plant materials

For this study, sage (*Salvia officinalis*) was collected in Brigje, Shkodër, Albania, in September 2023. The identification of the plant was assisted by Prof. Dr. Lulëzim Shuka from the Department of Biology, Faculty of Natural Sciences, University of Tirana, Albania. After being cleaned of impurities, the collected sample was dried at room temperature. Additionally, mountain tea was purchased from a pharmaceutical store in Tirana, Albania. According to the product label, the dry mountain tea, belonging to the *Sideritis raeseri* species, was collected from Gramoz Mountain in Kolonjë, Albania, a well-known area for the cultivation of this plant (Pazari, 2014).

Reagents

Reagents for the determination of total phenolic content (TPC), total flavonoid content (TFC), antioxidant radical screening reagents [2,2-Diphenyl-1-picrylhydrazyl (DPPH), and 2,2’-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS)], standards for the RP-HPLC identification and quantification were purchased from Sigma-Aldrich (Steinheim, Germany). Methanol, and formic acid of HPLC grade were purchased from Honeywell (Seelze, Germany). Methanol, and ethanol of analytical grade were secured from S.C. Chimreactiv, S.R.L. (Bucharest,

Romania), while the Folin–Ciocâlteu reagent from Remed Prodimpex S.R.L. (Bucharest, Romania).

Ultrasound-assisted extraction

The dried leaves were ground in an electric grinder (Heinner HCG-150SS; Bucharest, Romania), and 5.00 g of sample was extracted in a triple-stage, batch extraction, with 50 mL of ethanol 70 % (*v*/*v*) in a Digital Ultrasonic Bath (Mod. DU-32; ARGOLAB), at 25 °C, 40 kHz ultrasound frequency, for 15 min. The obtained extracts were centrifuged for 15 min at 6500 rpm, 4 °C, and the supernatant was concentrated in a rotary vacuum concentrator (RVC 2-18 CDplus, Martin Christ) equipped with a vacuum pump and cooling trap concentrator (CT02-50, Martin Christ). The concentrated sample was stored at 4 °C until investigation. The extraction yield is calculated based on the weight of the raw sample used for extraction and the weight of the concentrated extract, the result is expressed in percentage (%).

Determination of Antioxidant Activity, Total Phenolic Content (TPC), and Total Flavonoid Content (TFC)

The phytochemical characterization and antioxidant activity were evaluated by colorimetric spectrophotometric means (Biochrom; Libra 22 UV/Visible Spectrophotometer) as descried in previous published work (Mërtiri *et al.*, 2024). The concentrated ethanolic extracts were redissolved in ethanol 70 % (*w*/*v*), and the results are expressed as average values for triplicate measurements ± standard deviation. For the DPPH radical screening assay, the reading absorbance of the protocol was performed at 515 nm, while for the ABTS radical screening assay at 734 nm. The results for the antioxidant activity are expressed in milligrams of Trolox equivalents per gram of dry weight (mg TE/g D.W.). The protocol for the total phenolic content (TPC) consists of the use of Folin-Ciocâlteu reagent and Na_2CO_3 20 % (*w*/*v*), the reading of the absorbance was performed at 765 nm. The results are expressed in milligrams of gallic acid equivalents per gram of dry weight (mg GAE/g D.W.). The determination of total flavonoid content (TFC) was based on the use of $AlCl_3$ 2 % (methanolic solution *w*/*v*), and the absorbance read at 440 nm. The results are expressed in milligrams of quercetin equivalents per gram of dry weight (mg QE/g D.W.).

Reversed-Phase High-Performance Liquid Chromatography characterization

The Reversed-Phase High-Performance Liquid Chromatography (RP-HPLC) analysis for the polyphenolic profile of the concentrated extracts was performed in an Agilent 1200 HPLC System equipped with an autosampler, degasser, quaternary pump system, multi-wavelength detector, and column thermostat (Agilent Technologies). The separation protocol involved the utilization of a binary elution system consisting of methanol 100 % (*v*/*v*) as solvent A, and formic acid 10 % in ultrapure water (*v*/*v*) as solvent B in a Hypersil™ BDS C18 column (150 x 4.6 mm, 5µm) (Thermo Fisher Scientific Inc. A). The separation and the identification of the polyphenolic compounds accorded at a wavelength of 280 nm and 320 nm. Results are expressed as average values for duplicate measurements ± standard deviation, in

micrograms per gram of dry weight (µg/g D.W.), based on calibration curves for each standard compound.

Statistical analysis

The differences between the *S. officinalis* and *S. raeseri* extracts were compared by performing the One-Way ANOVA analysis. The data were checked for the normality distribution (Ryan-Joiner Test) and the equality of the variances (Bartlett's Test), followed by the Tukey test ($p > 0.05$) or the Games-Howell test ($p < 0.05$), and 95 % confidence. The statistical evaluation was performed in Minitab Software Version 19.1 for Windows.

Results and discussion

Extraction yield, and antioxidant activity of the Extracts

Table 1 presents the results of the extraction yield and global characterization by spectrophotometric means obtained from sage and mountain tea. From the application of ultrasound-assisted extraction with ethanol 70 %, sage had a higher extraction yield compared to the mountain tea (30.35 % and 18.46 %, respectively), with a 1.64-time higher amount of final concentrated extract. The extraction yield obtained in this work's extraction conditions is higher compared with other results reported in the literature, such as in the cause of Mokhtari *et al.* (2023), which reported an extraction yield of 19.80 % from the ultrasound-assisted extraction of *S. officinalis*, collected in Iran, using methanol 70 %.

Related to the antioxidant activity, from the statistical evaluation, the plants extracts didn't show significant differences in the antioxidant potential in both screening assays ($p > 0.05$). Sage and mountain tea ethanolic extracts in the DPPH radical screening assay showed an average of 24.48 ±0.99 mg TE/g D.W., and 22.96 ± 0.45 mg TE/g D.W. respectively. Meanwhile the results for ABTS radical screening assay, was obtained an average of 29.38 ± 0.49 mg TE/g D.W. for *S. officinalis*, and 29.43 ± 0.08 mg TE/g D.W. for *S. raeseri*.

Table 1. Extraction yield, antioxidant activity, and global characterization of the Extracts.

Assessment	*S. officinalis*	*S. raeseri*
Extraction yield (%)	30.35	18.46
DPPH (mg TE/g D.W.)	24.48 ± 0.99 [a]	22.96 ± 0.45 [a]
ABTS (mg TE/g D.W.)	29.38 ± 0.49 [a]	29.43 ± 0.08 [a]
TPC (mg GAE/g D.W.)	115.73 ± 3.80 [a]	71.65 ± 7.37 [b]
TFC (mg QE/g D.W.)	9.38 ± 0.32 [b]	11.60 ± 0.39 [a]

The results for the antioxidant activity, and global characterization are expressed as average values for triplicates measurements ± standard deviation; Lowercase letters, in the same row, are used for statistical comparisons between the extracts. Means that do not share a letter are significantly different, based on the Tukey test ($p > 0.05$).

Global characterization of the sage extract

S. officinalis extract exhibited a high TPC, with an average of 115.73 ± 3.80 mg GAE/g D.W. and a TFC of 9.38 ± 0.32 mg QE/g D.W. The results obtained from the spectrophotometric characterization showed higher content of investigated compounds compared with the results reported in some work in the literature. TPC obtained from *S. officinalis* collected in Tunisia varied between 0.399 to 2.337 mg GAE/g dry matter (D.M.), and 0.436 – 0.923 mg QE/g D.M for the TFC (Hamrouni-Sellami *et al.*, 2013). Also lower TPC and TFC, compared with our results, are reported for sage collected in Iran (6.43 mg GAE/g D.W., and 4.11 mg QE/g D.W., respectively) (Mokhtari *et al.*, 2023). However, higher TPC has been reported for collected in Polonia with an average of 175.20 ± 6.30 mg GAE/g extract, and 225.90 ± 8.90 mg GAE/g extract from the maceration with ethanol 70 %, and methanolic 70 %, respectively (Kozłowska *et al.*, 2015). Higher content was reported from Algerian sage extract, with a TPC of 221.08 ± 2.36 mg GAE/g sample, and TFC of 80.54 ± 1.30 mg QE/g sample, from the maceration with ethanol 80 % (Boufadi *et al.*, 2020). An example of the extraction solvent influence in the extraction of the phenolic compound can be observed in the case of Stagos *et al.* (2012). The authors reported a TPC of 184 mg GAE/g D.W. for methanolic, and 91 mg GAE/g D.W. for aqueous extracts obtained from accelerated solvent extraction of sage sample collected in Ioannina, Greece.

Global characterization of the mountain tea extract

S. raeseri extract showed a TPC of 71.65 ± 7.37 mg GAE/g D.W., and a TFC with an average of 11.60 ± 0.39 mg QE/g D.W. Stagos *et al.* (2012) in his work reported a higher TPC, compared with the results obtained in this work, for *Sideritis raeseri* subsp. *raeseri*, collected in Mt. Agrafa (Greece), with a content of 430 and 273 mg GAE/g D.W. for methanolic and aqueous extracts, respectively. Šavikin *et al.* (2021) obtained lower TPC, compared with our results, varying between 19.32 to 47.23 mg GAE/g D.W. from the optimization of ultrasound-assisted extraction of *S. raeseri*. Dimaki *et al.* (2022) also obtained lower TPC, compared with our results, with an average of 12.38 ± 1.23 mg of GAE/g D.W., and TFC of 10.67 ± 1.20 mg QE/g D.W. for *S. raeseri* subsp. *raeseri*.

RP-HPLC characterization of the sage extract

Table 2 presents the identified compounds from the RP-HPLC polyphenolic profile characterization. From the identified compounds, hesperidin had the highest quantity in *S. officinalis* extract with an average of 403.32 ± 0.95 µg/g D.W., followed by epigallocatechin (316.78 ± 0.00 µg/g D.W.). The majority of the identified compounds, in the phenolic acids group such as chlorogenic acid, cinnamic acid, and ferulic acid, as well as flavonoids like apigenin, epicatechin gallate, epigallocatechin, hesperidin, isorhamnetin, luteolin, quercetin and its isomers, were found in both plant extracts. Cinnamic acid, epigallocatechin, hesperidin, and isorhamnetin were the identified compounds present in higher content in sage extract. Caffeine, caffeic acid, ellagic acid, and naringin were compounds identified and detected only in the sage extract.

Table 2. Identified compounds from the RP-HPLC characterization of the Extracts.

Identified compounds	***S. officinalis*** (µg/g D.W.)	***S. raeseri*** (µg/g D.W.)
Alkaloid		
Caffeine	0. 32 ± 0.00 ^{R}	n.d.
Terpenoid		
Cafestol	4.16± 0.00 $^{E, b}$	6044.74 ± 29.05$^{A, a}$
Phenolic acids		
Caffeic acid	0.83 ± 0.00 ^{O}	n.d.
Chlorogenic acid	2.81 ± 1.37 $^{H, b}$	45.90 ± 0.00 $^{E, a}$
Cinnamic acid	2.66 ± 0.09 $^{I, a}$	1.49 ± 0.08 $^{O, b}$
Ellagic acid	1.97 ± 0.00 ^{K}	n.d.
Ferulic acid	0.26 ± 0.02 $^{S, b}$	0.41 ± 0.04 $^{S, a}$
Gallic acid	n.d.	82.30 ± 0.00 ^{B}
p-Coumaric acid	n.d.	0.92 ± 0.00 ^{P}
Syringic acid	n.d.	0.67 ± 0.22 ^{Q}
Flavonoid aglycones		
Apigenin	0.44 ± 0.03 $^{P, b}$	1.84 ± 0.07 $^{M, a}$
Epicatechin	n.d.	2.40 ± 0.00 ^{J}
Epicatechin gallate	5.49 ± 0.00 $^{D, b}$	11.69 ± 0.00 $^{H, a}$
Epigallocatechin	316.78 ± 0.00 $^{B, a}$	78.30 ± 0.00 $^{C, b}$
Hesperidin	403.32 ± 0.95 $^{A, a}$	15.85 ± 4.41 $^{G, b}$
Isorhamnetin	1.07 ± 0.00 $^{M, a}$	0.51 ± 0.02 $^{R, b}$
Kaempferol	0.90 ± 0.02 $^{N, b}$	1.86 ± 0.01 $^{K, a}$
Luteolin	2.06 ± 0.00 $^{J, b}$	21.97 ± 0.21 $^{F, a}$
Naringin	4.14 ± 0.00 ^{F}	n.d.
Quercetin	0.37 ± 0.01 $^{Q, b}$	2.98 ± 0.11 $^{I, a}$
Flavonoid glycosides		
Quercetin 3-*D*-galactoside	6.59 ± 0.19 $^{C, b}$	60.50 ± 0.82 $^{D, a}$
Quercetin 3-glucoside	2.95 ± 0.27 ^{G}	n.d.
Quercetin dihydrate	1.10 ± 0.03 $^{L, a}$	1.74 ± 0.21 $^{N, a}$
Rutin trihydrate (Quercetin-3-rutinoside trihydrate)	n.d.	1.86 ± 0.28 ^{L}

The results are expressed as average values for duplicate measurements ± standard deviation; n.d. — not detected. Uppercase letters in the same column, are used for statistical comparisons between the different compounds in one sample; lowercase letters in the same row, are used for statistical comparisons between the samples. Means that do not share a letter are significantly different based on the Tukey test ($p > 0.05$) or the Games–Howell test ($p < 0.05$).

The chromatogram presented in Figure 1, shows 21 peaks read at 280 nm recorded from *S. officinalis* extract. However, several peaks remained unidentified due to the absence of satisfying correspondence in our research center's RP-HPLC system standards database. The phytochemical compounds identified in our work are in accordance with findings published previously. For instance, in *S. officinalis*, compounds such as caffeic acid, ferulic acid, cinnamic acid, epicatechin, kaempferol, luteolin, apigenin, as well as different isomers of quercetin and catechin were detected in our sage extract as well as works in literature (Mokhtari *et al.*, 2023; Boufadi *et al.*, 2020; Hamrouni-Sellami *et al.*, 2013; Generalić *et al.*, 2012). There are also compounds such as gallic acid, syringic acid, *p*-coumaric acid, and rutin, which were not detected in our experiments. Differences in the content amount from the detected phytochemical compounds in our study compared to those reported in the literature can be observed. For instance, Hamrouni-Sellami *et al.* (2013) reported from the methanolic extract of the *S. officinalis* a content varying between 62.27 ± 0.97 to 11.46 ± 0.50 µg/g D.M. for caffeic acid, 83.95 ± 1.06 to 6.00 ± 0.38 µg/g D.M. for ferulic acid, and 11.63 ± 0.47 – 8.11 ± 0.39 µg/g D.M. for luteolin which are higher compared to our sage extract. Meanwhile for trans-cinnamic acid (26.42 ± 0.92 to 0.22 ± 0.06 µg/g DM) the content is in the range with the content detected in our sage extract.

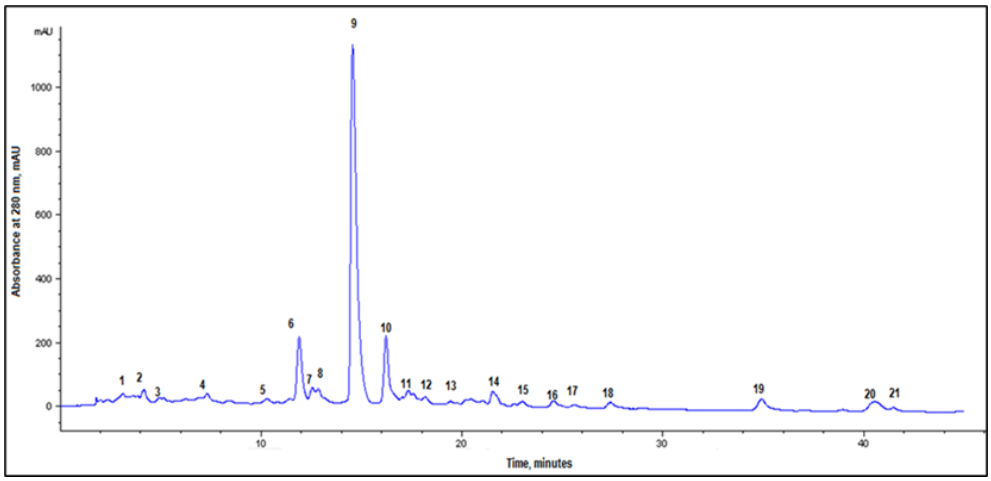

Figure 1. Chromatogram of the polyphenolic compounds profile, at 280 nm, of *S. officinalis* extract: 1 – epigallocatechin, 2 – chlorogenic acid, 3 – caffeine, 4 – ferulic acid, 6 – quercetin 3-*D*-galactoside, 8 – quercetin 3–glucoside, 9 – hesperidin, 10 – cinnamic acid, 13 – quercetin dihydrate, 14 – luteolin, 15 – kaempferol, 17 – apigenin, 18 – isorhamnetin, 5, 7, 11, 12, 19–21 – unidentified compounds.

The synthesis and composition of phytochemical compounds in medicinal and aromatic plants essential oils/extracts are controlled by genetic factors, but they are also influenced by factors including physiological stages, agronomic practices, environmental conditions like temperature, humidity, and light conditions (Hazrati

et al., 2022). In the study conducted by Hasa *et al.* (2021), from the analyses of *S. officinalis* essential oil collected in different geographical locations in Albania, revealed that sage growing southern part of the country belonged to the camphor chemotype, while sage the northern part belonged to the *α*-thujone chemotype. The study also concluded that the harvest period affected the essential oil composition. Sage collected in the south had higher camphor content in June and lower content in September, while the content of *α*-thujone increased. Similarly, sage collected in the north of Albania showed high *α*-thujone content in June and lower content in September, with an increase in camphor content. Hazrati *et al.* (2022) observed significant changes in the composition of *S. officinalis* essential oil based on the time of harvest, with the accumulation and conversion of certain metabolites over 24-hour period.

The variations in the content of phytochemical compounds that we observed in our study, compared to previously published work, can be attributed to various factors mentioned earlier. These factors significantly influence the composition of the phytochemical profile in the extract.

RP-HPLC characterization of the mountain tea extract

In *S. raeseri* extract cafestol was the identified compound with the highest content with an average of 6044.74 ± 29.05 µg/g D.W., followed by gallic acid with 82.30 ± 0.0 µg/g D.W. Compounds like gallic acid, *p*-coumaric acid, syringic acid, and epicatechin were identified and detected only in the mountain tea extract. Cafestol, chlorogenic acid, ferulic acid, apigenin, epicatechin gallate, kaempferol, luteolin, quercetin and quercetin 3-*D*-galactoside were found in higher content in the mountain tea extract compared to the sage extract. Figure 2 shows the chromatogram obtained from the mountain tea extract which exhibits an extensive polyphenolic profile with 34 recorded peaks read at 280 nm from the RT-HPLC detector. Mróz *et al.* (2023) analyzed the phytochemical profile of *Sideritis scardica* and *Sideritis raeseri* extracts by HR-LC-ESI-Orbitrap-MS in negative ion mode. The samples secured from a Greek producer were extracted by conventional solvent extraction (infusion), and assisted solvent extraction (microwave, ultrasound, and high-pressure extraction) using different water and ethanol concentration. The working team identified 102 phytochemicals including flavonoids, phenolic acids, terpenoids, phenylethanoid glycosides and other compounds such as sugar acids, saccharides, carboxylic acids, etc. Flavonoids and their derivates were the predominant phytochemical compounds in the *Sideritis* species. These compounds included mostly glycosides and acetyl glycosides of flavonoids and their methylated forms. The main flavonoid aglycones were hypolaetin, methylhypolaetin, isoscutellarein, methylisoscutellarein, and apigenin. In accordance with this study, the RP-HPLC characterization of *S. raeseri* extract in our work also showed a rich polyphenolic profile with flavonoids (aglycone and glycosides form), and phenolic acids being in a higher number from the identified compounds from the available RP-HPLC standard database of our research center.

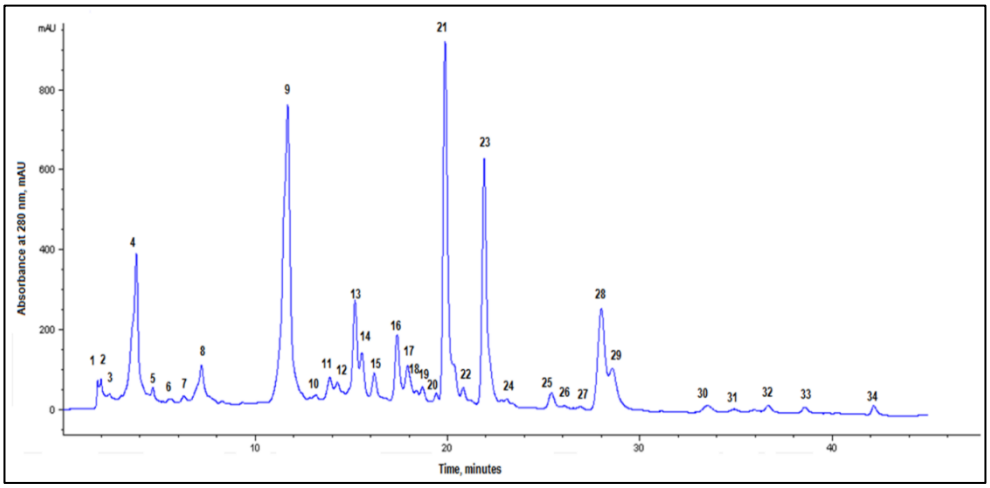

Figure 2. Chromatogram of the polyphenolic compounds profile, at 280 nm, of *S. raeseri* extract: 1 – cafestol, 2 – epigallocatechin, 4 – chlorogenic acid, 6 – syringic acid, 7 – epicatechin gallate, 8 – ferulic acid, 9 – quercetin 3-*D*-galactoside, 10 – rutin trihydrate, 12 – hesperidin, 15 – cinnamic acid, 19 – quercetin, 20 – quercetin dihydrate, 23 – luteolin, 24 – kaempferol, 25 – apigenin, 27 – isorhamnetin, 3, 5, 11, 13, 14, 16–18, 21, 22, 26, 28–34 – unidentified compounds.

Conclusions

The current study investigates the phytochemical composition of sage (*Salvia officinalis*) and mountain tea (*Sideritis raeseri*) from Albania. The spectrophotometric analysis shows that sage extract had a higher total phenolic content (115.73 ± 3.80 mg GAE/g D.W.), while the mountain tea extract had a higher total flavonoid content (11.60 ± 0.39 mg QE/g D.W.). Both plant extracts exhibited similar antioxidant potential in the screening assays. RP-HPLC analysis revealed rich polyphenolic profiles, with various identified and quantified phytochemicals in the plant extracts, such as alkaloids, terpenoids, phenolic acids, and flavonoids. The findings in this research paper emphasize the importance of further investigation and the potential application of these medicinal and aromatic plants as an alternative and sustainable source of natural extracts in various industrial fields.

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