Research Journal of Agricultural Science, 58 (1), 2026; ISSN: 2668-926X;
http://doi.org/10.59463/RJAS.2026.1.19

PHYTOCHEMICAL PROFILE AND ANTIOXIDANT ACTIVITY OF *PLATYCLADUS ORIENTALIS* LEAVES

Doris FLOARES (OARGA)[1], Diana OBISTIOIU (ORCID: 0000-0002-1481-6954) [1], Anca HULEA[1], Iuliana POPESCU[1], Ersilia ALEXA (ORCID: 0000-0003-4641-7365) [2], Isidora RADULOV (ORCID: 0000-0001-7113-9163) [1]

[1]Faculty of Agriculture[1], Faculty of Food Engineering[2], University of Life Sciences "King Mihai I" from Timisoara, Romania

Corresponding author: doris.oarga@usvt.ro

Abstract. *Medicinal plants have long been recognised as valuable sources of bioactive compounds with therapeutic potential, particularly due to their antioxidant properties and their role in mitigating oxidative stress-related diseases. Among these, Platycladus orientalis, a species in the Cupressaceae family, has attracted growing scientific interest for its diverse pharmacological activities, including antioxidant, antimicrobial, and anti-inflammatory effects. Although previous studies have reported the presence of phenolic compounds and flavonoids in this species, detailed quantitative data on individual polyphenol profiles remain limited. This study aimed to evaluate the phytochemical composition and antioxidant activity of ethanolic leaf extracts of Platycladus orientalis. Total polyphenolic content was determined using the Folin–Ciocalteu method, while total flavonoid content was assessed using the $AlCl_3$ colourimetric method. Antioxidant activity was evaluated using the DPPH radical-scavenging assay. Furthermore, high-performance liquid chromatography (HPLC) was employed to identify and quantify individual polyphenolic compounds. The results revealed a significant presence of phenolic and flavonoid compounds, with rutin identified as the most abundant compound, followed by ferulic acid, epicatechin, resveratrol, and caffeic acid. Our findings revealed that the total phenolic content was 4919.42 mg GAE/Kg, the total flavonoid content was 3656.66 mg QE/Kg, and the DPPH radical scavenging activity was 9.09 µM TE/g, indicating a notable antioxidant potential of the extract. Pearson correlation analysis revealed significant relationships between individual polyphenols, total phenolic and flavonoid contents, and antioxidant activity, highlighting the contribution of specific compounds to the overall bioactivity. The findings have important implications for the potential application of this plant in pharmaceutical, nutraceutical, and cosmetic industries. Overall, this research contributes to the growing body of knowledge on Platycladus orientalis by offering a comprehensive evaluation of its antioxidant capacity and phytochemical composition, highlighting its potential as a natural source of bioactive compounds.*

Keywords*: Platycladus orientalis, total polyphenolic content, total flavonoid content, DPPH scavenging activity, individual polyphenolic content*

INTRODUCTION

Medicinal plants have been used since ancient times as important therapeutic resources for maintaining health and treating diseases, mainly due to their content of bioactive compounds (EKOR, 2014). Plant extracts exhibit a broad spectrum of biological activities, including antioxidant, antimicrobial, and anti-inflammatory effects, which contribute to their beneficial impact on human health (JAFARI KHORSAND ET AL., 2022). Oxidative stress, caused by the overproduction of reactive oxygen and nitrogen species, is closely associated with the development of chronic diseases such as cardiovascular disorders and cancer; however, plant-derived phytochemicals can counteract these

effects by neutralising free radicals (YEDJOU ET AL., 2023). Consequently, consuming plant products rich in natural antioxidants may enhance the body's defence systems and reduce the risk of oxidative stress-related diseases. Due to these properties, medicinal plants have attracted considerable interest in the pharmaceutical, biotechnological, and cosmetic industries (MUMIVAND Et Al., 2021).

Platycladus orientalis, commonly known as oriental thuja, is an evergreen coniferous tree or shrub from the *Cupressaceae* family, widely distributed and cultivated across diverse regions and valued for its recognised medicinal properties (SRIVASTAVA Et Al., 2012). The major biologically active constituents of *P. orientalis* leaves are flavonoids, polysaccharides, and tannins. (BURANGE ET AL., 2021).

This plant has been extensively used in traditional medicine to treat a range of conditions, including sore throat, osteoarthritis, psoriasis, amenorrhea, cystitis, bronchial catarrh, and gastrointestinal disorders (IMTIAZ ET AL., 2023). Previous studies on extracts of *Platycladus orientalis* have reported a wide range of pharmacological properties, including antimicrobial, antioxidant, anticancer, and anti-inflammatory activities (KAPANCIK ET AL., 2024).

This study investigates the phytochemical composition and antioxidant potential of *Platycladus orientalis* leaves. We assessed the total polyphenolic and flavonoid contents, performed DPPH radical-scavenging assays, and determined the concentrations of individual polyphenols. To understand how specific phytochemicals contribute to overall bioactivity, Pearson correlation analysis was used to examine relationships among individual phenolic compounds, total phenolic and flavonoid contents, and the extract's antioxidant activity.

MATERIAL AND METHODS

Chemicals

All chemicals used in this study were of analytical grade. Folin–Ciocalteu reagent, trolox, gallic acid, quercetin standards, and 1,1-diphenyl-2-picrylhydrazyl (DPPH) were purchased from Sigma–Aldrich Chemie GmbH (Munich, Germany). Formic acid, acetonitrile, sodium carbonate, sodium nitrite, and aluminium chloride were obtained from Merck KGaA (Darmstadt, Germany). Ethanol was acquired from Chimreactiv SRL (Bucharest, Romania).

Plant material and extraction method

Platycladus orientalis plant material was collected from Alba - Iulia, Alba County, Romania (46°04′17″N 23°34′23″E). Non-representative or damaged parts were removed, retaining only the selected plant material for analysis. The sample was then ground and immediately subjected to extraction.

Extraction was performed using a conventional solvent extraction procedure. Briefly, 1 g of the ground sample was mixed with 10 mL of 70% ethanol and stirred continuously on a hot-plate magnetic stirrer (Velp Scientifica, Usmate, Italy) at room temperature for 24 hours. After extraction, the mixtures were filtered through filter paper, and the resulting extracts were stored at 4 °C until further chemical analysis.

Total phenolic content determination (TPC)

The total phenolic content was determined using the Folin–Ciocalteu method. Briefly, 0.5 mL of the extract was mixed with 1.25 mL of Folin–Ciocalteu reagent and allowed to react at room temperature for 5 minutes. Subsequently, 1 mL of 6% sodium carbonate solution was added, and the mixture was thoroughly homogenised. The reaction mixture was then incubated at room temperature for 2 hours. The absorbance was recorded at 750 nm using a Specord 205 UV–VIS spectrophotometer (Analytik Jena AG, Jena, Germany). All measurements were carried out in triplicate, and the results were expressed as mean ± standard deviation. A calibration curve prepared with gallic acid was used for quantification, and the results were reported as mg gallic acid equivalents per gram of sample (mg GAE/Kg).

Total flavonoid content determination (TFC)

The total flavonoid content was determined by mixing 1 mL of the extract with 0.3 mL of 10% aluminium chloride and 0.3 mL of 5% sodium nitrite. The reaction mixture was kept at room temperature for 6 minutes, after which 2 mL of 1 M sodium hydroxide and 6.4 mL of 70% ethanol were added. The solution was thoroughly mixed and allowed to stand at room temperature for 30 minutes. Subsequently, the absorbance was measured at 415 nm using a Specord 205 UV–VIS spectrophotometer (Analytik Jena AG, Jena, Germany). All measurements were performed in triplicate, and results were expressed as mean ± standard deviation. Quantification was performed using a calibration curve constructed with quercetin as the standard, and the results were expressed as mg quercetin equivalents per gram (mg QE/Kg).

DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity assay

A 0.3 mM ethanolic solution of DPPH was prepared to evaluate the antioxidant activity. For the assay, 1 mL of the extract was mixed with 2.5 mL of the DPPH solution. The mixture was vigorously shaken and then incubated in the dark at room temperature for 30 minutes. Subsequently, the absorbance was recorded at 518 nm using a UV–VIS spectrophotometer (Specord 205; Analytik Jena AG, Jena, Germany). A control solution was prepared by replacing the extract with 70% ethanol. All measurements were carried out in triplicate, and the results were expressed as mean values.

The antioxidant activity was expressed as the percentage of radical scavenging activity (RSA), calculated according to the following equation:

$$\mathrm{RSA}(\%) = \frac{A_c - A_s}{A_c} \times 100$$

where: A_c represents the absorbance of the control, and A_s represents the absorbance of the sample.

In addition, antioxidant capacity was expressed as μM Trolox equivalents per 100 g. This was achieved by constructing a calibration curve with Trolox standards (1.0–25 μg/mL), determining the Trolox-equivalent values of the samples by interpolation from the regression equation, and converting the results to μM using the molar mass of Trolox and the sample solution concentration.

Analysis of individual polyphenols using HPLC

Compound identification was achieved by comparing retention times, UV absorption spectra, and mass spectrometry data with those of reference standards; therefore, the assigned compounds should be considered tentative, given the limitations of LC–MS-based phenolic profiling. Quantitative analysis of individual polyphenols was performed using an HPLC–MS system (Shimadzu 2010 EV, Kyoto, Japan), equipped with an SPD-10A UV detector and a mass spectrometer. Separation was carried out on an EC 150/2 NUCLEODUR C18 Gravity SB column (150 × 2 mm, 5 µm; Macherey-Nagel GmbH & Co. KG, Düren, Germany).

The mobile phase consisted of two solvents: (A) water acidified with formic acid to pH 3 and (B) acetonitrile, also adjusted to pH 3. The gradient elution program was as follows: 0–20 min, 5% B; 20–50 min, 5–40% B; 50–55 min, 40–95% B; and 55–60 min, 95% B. The flow rate was maintained at 0.2 mL/min, and the column temperature was set at 20 °C. Detection was performed at wavelengths of 280 and 320 nm.

Calibration curves were established within the concentration range of 20–50 µg/mL. The method was validated to ensure analytical reliability, and all samples were analysed in triplicate.

Statistical analysis

All experiments were performed in triplicate, and the results are expressed as mean ± standard deviation (SD). Pearson correlation analysis was conducted to assess relationships among the variables using JASP (version 0.19.3.0).

RESULTS AND DISCUSSIONS

TPC and TFC content determination

For the quantification of total polyphenol (TPC) and total flavonoid (TFC) contents, ethanol was used as the extraction solvent due to its low toxicity, compatibility with bioactive compounds, and ability to penetrate plant tissues and release intracellular constituents. Its antimicrobial properties also help minimise contamination during extraction. A 70% ethanol solution was selected because hydroethanolic mixtures of 60–80% offer optimal polarity for extracting a broad range of phenolic compounds, effectively solubilising both flavonoids and phenolic acids (FLOARES ET AL., 2023).

Phenolic compounds are a major class of plant secondary metabolites that are widely distributed across different plant tissues. These compounds are recognised for their strong ability to neutralise free radicals, and their presence is often positively associated with the antioxidant capacity of plant extracts, particularly with total phenolic and flavonoid content (FARNAD ET AL. 2014).

The antioxidant potential of phenolic compounds is primarily linked to their redox characteristics, which enable them to act as electron donors, reducing agents, hydrogen atom donors, and quenchers of reactive oxygen species, including singlet oxygen. Structurally, phenolic compounds can exist as simple molecules containing a single phenolic unit, such as phenolic acids, or as more complex structures with multiple phenolic groups, including flavonoids and anthocyanins (CHARLTON ET AL., 2023).

Table 1 presents the total phenolic content, total flavonoid content and antioxidant capacity determined in *Platycladus orientalis* leaves extract.

Research Journal of Agricultural Science, 58 (1), 2026; ISSN: 2668-926X;
http://doi.org/10.59463/RJAS.2026.1.19

Table 1

Total phenolic content, flavonoid content and antioxidant capacity of *Platycladus orientalis* leaves extract

Total phenolic content (mg GAE/Kg)	Total flavonoid content (mg QE/Kg)	DPPH scavenging activity (μM TE/g)
4919.42 ± 9.96	3656.66 ± 14.59	9.09 ± 0.05

The results are presented as mean ± standard deviation (SD) of three independent measurements (n = 3).

The results demonstrated that the extract contains a considerable amount of phenolic and flavonoid compounds, which are known to contribute significantly to antioxidant activity. Previous studies by Imtiaz et al. compared the total phenolic and flavonoid contents and antioxidant activities of extracts and fractions from nine medicinal plants, including *Platycladus orientalis*. Their findings indicated that the chloroform and ethyl acetate fractions of *Platycladus orientalis* exhibited the highest levels of phenolic and flavonoid compounds among the tested samples (IMTIAZ et al. 2025).

DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity assay

Antioxidants are substances that can neutralise free radicals by interacting with them, thereby reducing their ability to damage cells. Their presence helps prevent oxidative damage, which has been linked to the development of cancer and various other diseases. Antioxidants function in different cellular locations and participate in diverse biochemical processes within the body. Some act as a primary defence by inhibiting the formation of free radicals, while others eliminate them before they can cause harm or help repair cellular damage after it occurs. Many plants are rich in phytochemicals that exhibit antioxidant properties (CHAUDHARY ET AL., 2023).

The findings of the present study (Table 1) are in good agreement with those reported in previous studies. Mostafa et al. investigated the biological effects of several plant extracts, including *Platycladus orientalis*, in relation to their potential metabolomic-based applications against the West Nile virus vector, *Culex pipiens*. Their results showed that the extract of *Platycladus orientalis* exhibited notable antioxidant activity, with an IC_{50} value of 15.25 μg/mL (MOSTAFA ET AL., 2024).

Analysis of individual polyphenols using HPLC

The phytochemical characterisation of the ethanolic extract of *Platycladus orientalis* leaves (Table 2), performed by HPLC, revealed a complex profile of individual phenolic acids and flavonoids, with pronounced quantitative differences.

Table 2

The individual profile of polyphenols detected using the HPLC method

Individual polyphenol compound	Class	*m/z*	Ret. time(min.)	Concentration μg/mL
Caffeic	Phenolic acids	179	5.05	2.8 ± 0.1
Epicatechin	Flavonoids	289	31.86	31.01 ± 1.02

p - Coumaric	Phenolic acids	163	28.04	0.12 ± 0.03
Ferulic	Phenolic acids	193	5.71	57.7 ± 1.35
Rutin	Flavonoids	609	34.10	74.37 ± 2.45
Rosmarinic	Phenolic acids	359	28.06	1.06 ± 0.08
Resveratrol	Stilbenes	227	36.46	24.23 ± 0.75
Quercitine	Flavonoids	301	31.93	0.65 ± 0.06
Kaempferol	Flavonoids	285	34.06	0.17 ± 0.01

The results are presented as mean ± standard deviation (SD) of three independent measurements (n = 3).

The results showed a clear predominance of rutin (74.37 µg/mL), followed by ferulic acid (57.7 µg/mL) and epicatechin (31.01 µg/mL), with resveratrol detected in moderate amounts (24.23 µg/mL). Other compounds, including caffeic acid, rosmarinic acid, quercetin, kaempferol, and p-coumaric acid, were present in significantly lower concentrations. The amount of polyphenol compounds decreased in the order of: rutin> ferulic acid > epicatechin >resveratrol > caffeic acid > rosmarinic acid > quercitine > kaempferol > p - coumaric acid.

These findings are in agreement with recent studies that employed HPLC-based metabolite profiling to identify individual phenolic compounds in *Platycladus orientalis* extracts. Previous investigations have consistently confirmed the presence of bioactive flavonoids in *Platycladus orientalis* leaf extracts using chromatographic techniques. A study conducted by Zhang N. N. et al. reported that HPLC analysis of the hot-water extract of *Thuja orientalis* leaves revealed the presence of flavonoids, including kaempferol and isoquercetin (ZHANG ET AL., 2013). Similarly, MOSTAFA R. M. ET AL. evaluated the biological potential of leaf extracts from *Bougainvillaea glabra*, *Delonix regia*, *Lantana camara*, and *Platycladus orientalis* against *Culex pipiens* and various microbial agents, demonstrating significant insecticidal, antimicrobial, and antioxidant activities, highlighting their potential for biotechnological and pharmacological applications. In the same study, HPLC analysis of the acetone extract of *Platycladus orientalis* revealed the presence of phenolic compounds, with rutin identified at a concentration of 0.18680 mg/mL (MOSTAFA ET AL., 2024). Furthermore, Xu C. et al. investigated the protective potential of bioactive compounds derived from *Platycladus orientalis* against UV-induced damage related to androgenetic alopecia, reporting that phytochemical analysis of a 95% ethanolic leaf extract revealed kaempferol (2.41%), rutin (2.35%), and quercetin (1.34%) (XU ET AL., 2024). In a more recent study, Kim J. et al. demonstrated that *Platycladus orientalis* leaf extract promotes hair growth via activation of the non-receptor tyrosine kinase ACK1, and, in addition to biological evaluation, performed a phytochemical characterisation of the aqueous extract, identifying key phenolic compounds using chromatographic techniques. In this case, rutin was detected as the major flavonoid at 38.0 ppm, while kaempferol was present at a significantly lower level of 2.2 ppm (KIM et al., 2024). Such variability has been widely documented, as the phytochemical profiles of plant extracts are influenced by factors including solvent polarity, plant origin, and processing methods.

Research Journal of Agricultural Science, 58 (1), 2026; ISSN: 2668-926X;
http://doi.org/10.59463/RJAS.2026.1.19

Pearson correlation heatmap of phenolic compounds, TPC, TFC, and antioxidant activity

The correlation heatmap revealed significant relationships among individual phenolic compounds, total phenolic and flavonoid contents, and antioxidant activity (DPPH), highlighting the complex interactions among phytochemicals in the extract (Fig.1).

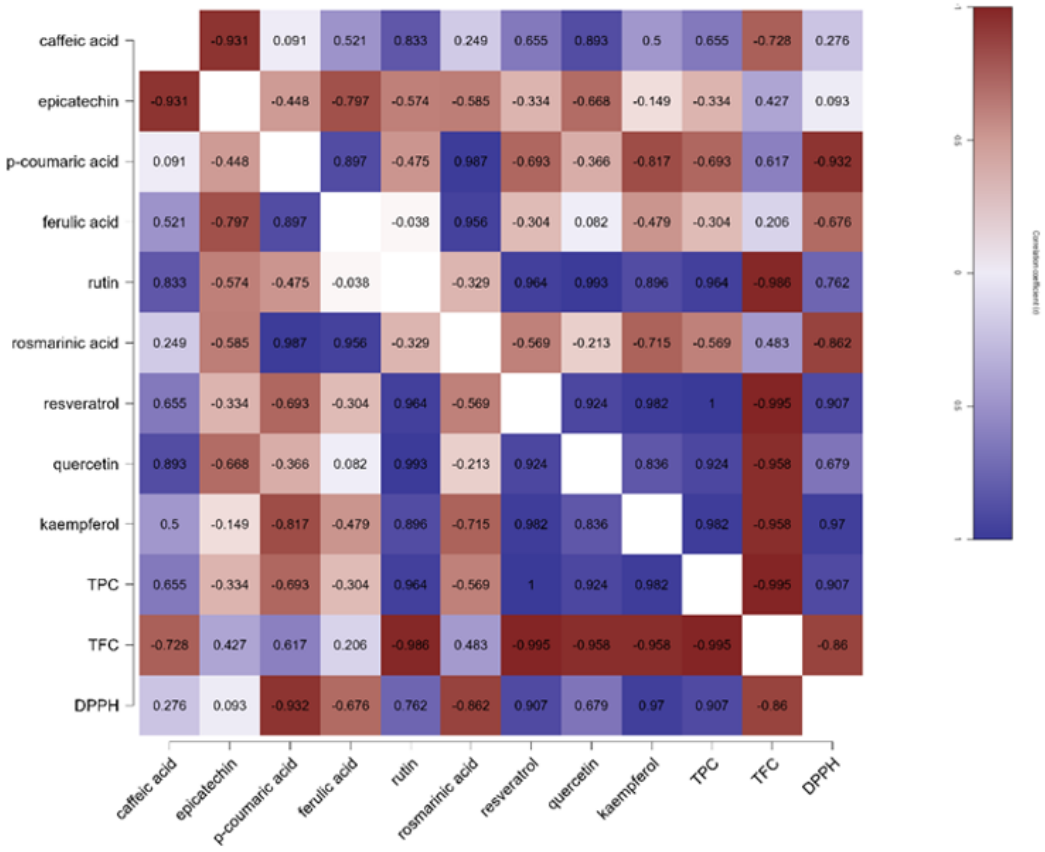

Figure 1. Pearson correlation matrix illustrating the relationships between individual polyphenols, TPC, TFC, and DPPH radical scavenging activity in *Platycladus orientalis* extract.

A strong positive correlation was observed between TPC and resveratrol (r = 1.000), as well as with kaempferol (r = 0.982) and quercetin (r = 0.924), suggesting that these compounds contribute substantially to the overall phenolic content. Similarly, rutin showed a very high correlation with TPC (r = 0.964), confirming its

dominant contribution to the phenolic profile. These findings are consistent with previous studies indicating that flavonoids, particularly rutin and quercetin derivatives, are major contributors to total phenolic content and antioxidant activity in plant extracts (XU ET AL., 2024).

Regarding antioxidant activity, as measured by DPPH, strong positive correlations were observed with kaempferol (r = 0.970), resveratrol (r = 0.907), and TPC (r = 0.907), indicating that these compounds play a key role in radical scavenging. This observation is consistent with the well-established mechanism of phenolic antioxidants, which neutralise free radicals through hydrogen atom transfer and single electron transfer processes, thereby interrupting oxidative chain reactions (PLATZER ET AL., 2021). In contrast, p-coumaric acid showed a strong negative correlation with DPPH (r = −0.932), suggesting a lower or even antagonistic contribution to antioxidant capacity in this specific matrix.

Interestingly, TFC showed strong negative correlations with most phenolic compounds and antioxidant activity, including TPC (r = −0.995) and DPPH (r = −0.860). This inverse relationship may suggest differences in the composition of flavonoid subclasses, where not all flavonoids contribute equally to antioxidant activity. Similar findings have been reported in studies by ORSAVOVÁ, J ET AL., who demonstrated negative correlations between phenolic parameters and DPPH activity, emphasising that the relationship depends on the type of compounds and the assay used (ORSAVOVÁ ET AL., 2023).

The correlation analysis demonstrates that antioxidant activity is strongly associated with specific phenolic compounds, particularly flavonoids such as rutin, kaempferol, and resveratrol, as well as with total phenolic content. These findings confirm that not only the total amount but also the qualitative composition of phenolic compounds plays a crucial role in determining the biological activity of plant extracts.

CONCLUSIONS

The results confirm that *Platycladus orientalis* leaves are abundant in phenolic and flavonoid compounds, which underpin their notable antioxidant capacity. Rutin emerged as the predominant constituent, accompanied by several phenolic acids and flavonoids that together form a complex and biologically active phytochemical profile.

The correlation analysis further indicates that antioxidant activity is closely associated with the presence and interactions of specific phenolic constituents, emphasising that the extract's bioactivity depends not only on the total content of phenolics and flavonoids but also on their qualitative composition and synergistic effects.

These findings position *P. orientalis* as a valuable natural source of bioactive compounds with promising pharmaceutical, nutraceutical, and cosmetic applications, underscoring the need for further studies on its biological activities and underlying mechanisms.

BIBLIOGRAPHY

BURANGE, P. J., TAWAR, M. G., BAIRAGI, R. A., MALVIYA, V. R., SAHU, V. K., SHEWATKAR, S. N., MAMURKAR, R. R., 2021 -. Synthesis of silver nanoparticles by using *Aloe vera* and *Thuja orientalis* leaves extract and their biological activity: a comprehensive review. Bulletin of the National Research Centre, 45(1), 181.

CHARLTON, N. C., MASTYUGIN, M., TÖRÖK, B., TÖRÖK, M., 2023 - Structural Features of Small Molecule Antioxidants and Strategic Modifications to Improve Potential Bioactivity. Molecules, 28(3), 1057.

CHAUDHARY, P., JANMEDA, P., DOCEA, A. O., YESKALIYEVA, B., ABDULL RAZIS, A. F., MODU, B., SHARIFI-RAD, J., 2023 - Oxidative stress, free radicals and antioxidants: potential crosstalk in the pathophysiology of human diseases. Frontiers in Chemistry, Volume 11 - 2023. doi:10.3389/fchem. 2023.1158198.

EKOR, M., 2014 - The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. Frontiers in Pharmacology, Volume 4 - 2013. doi:10.3389/fphar.2013.00177

FARNAD, N., HEIDARI, R., ASLANIPOUR, B., 2014 - Phenolic composition and comparison of antioxidant activity of alcoholic extracts of Peppermint (*Mentha piperita*). Journal of Food Measurement and Characterization, 8(2), 113-121. doi:10.1007/s11694-014-9171-x.

FLOARES, D., COCAN, I., ALEXA, E., POIANA, M.-A., BERBECEA, A., BOLDEA, M. V., RADULOV, I., 2023 - Influence of Extraction Methods on the Phytochemical Profile of *Sambucus nigra* L. Agronomy, 13(12), 3061.

IMTIAZ, F., AHMED, D., ABDULLAH, R. H., IHSAN, S., 2023 - Green extraction of bioactive compounds from *Thuja orientalis* leaves using microwave- and ultrasound-assisted extraction and optimization by response surface methodology. Sustainable Chemistry and Pharmacy, 35, 101212. doi:https://doi.org/10.1016/j.scp.2023.101212.

IMTIAZ, F., AHMED, D., MOHAMMED, O. A., YOUNAS, U., IQBAL, M., 2025 - Optimised recovery of phenolic and flavonoid compounds from medicinal plant extracts for enhanced antioxidant activity: A mixture design approach. Results in Chemistry, 13, 101960. doi:https://doi.org/10.1016/j.rechem.2024.101960.

JAFARI KHORSAND, G., MORSHEDLOO, M. R., MUMIVAND, H., EMAMI BISTGANI, Z., MAGGI, F., KHADEMI, A., 2022 - Natural diversity in phenolic components and antioxidant properties of oregano (*Origanum vulgare* L.) accessions, grown under the same conditions. Scientific Reports, 12(1), 5813.

KAPANCIK, S., ÇELIK, M. S., DEMIRALP, M., ÜNAL, K., ÇETINKAYA, S., TÜZÜN, B., 2024 - Chemical composition, cytotoxicity, and molecular docking analyses of *Thuja orientalis* extracts. Journal of Molecular Structure, 1318, 139279. doi:https://doi.org/10.1016/j.molstruc.2024.139279.

KIM, J., JOO, J. H., KIM, J., RIM, H., SHIN, J. Y., CHOI, Y. H., KANG, N. G., 2024 - *Platycladus orientalis* Leaf Extract Promotes Hair Growth via Non-Receptor Tyrosine Kinase ACK1 Activation. Curr Issues Mol Biol, 46(10), 11207-11219. doi:10.3390/cimb46100665.

MOSTAFA, R. M., BAZ, M. M., EBEED, H. T., ESSAWY, H. S., DAWWAM, G. E., DARWISH, A. B., EL-SHOURBAGY, N. M., 2024 - Biological effects of *Bougainvillea glabra*, *Delonix regia*, *Lantana camara*, and *Platycladus orientalis* extracts and their possible metabolomics therapeutics against the West Nile virus vector, *Culex pipiens* (Diptera: Culicidae). Microbial Pathogenesis, 195, 106870. doi:https://doi.org/10.1016/j.micpath.2024.106870.

MUMIVAND, H., SHAYGANFAR, A., HASANVAND, F., MAGGI, F., ALIZADEH, A., DARVISHNIA, M., 2021- Antimicrobial activity and chemical composition of essential oil from *Thymus daenensis* and *Thymus fedtschenkoi* during phenological stages. Journal of Essential Oil Bearing Plants, 24(3), 469-479.

ORSAVOVÁ, J., JURÍKOVÁ, T., BEDNAŘÍKOVÁ, R., MLČEK, J., 2023 - Total Phenolic and Total Flavonoid Content, Individual Phenolic Compounds and Antioxidant Activity in Sweet Rowanberry Cultivars. Antioxidants, 12(4), 913.

PLATZER, M., KIESE, S., HERFELLNER, T., SCHWEIGGERT-WEISZ, U., MIESBAUER, O., EISNER, P., 2021 - Common Trends and Differences in Antioxidant Activity Analysis of Phenolic Substances Using Single Electron Transfer Based Assays. Molecules, 26(5), 1244.

SRIVASTAVA, P., KUMAR, P., SINGH, D., SINGH, V., 2012 - Biological properties of *Thuja orientalis* Linn. Adv Life Sci, 2(2), 17-20.

XU, C., DAI, J., DU, W., JI, H., 2024 - Antioxidant Properties of *Platycladus orientalis* Flavonoids for Treating UV-Induced Damage in Androgenetic Alopecia Hair. Molecules, 29(12), 2876.

YEDJOU, C. G., GRIGSBY, J., MBEMI, A., NELSON, D., MILDORT, B., LATINWO, L., TCHOUNWOU, P. B., 2023 - The management of diabetes mellitus using medicinal plants and vitamins. International Journal of Molecular Sciences, 24(10), 9085.

ZHANG, N. N., PARK, D. K., PARK, H. J., 2013 - Hair growth-promoting activity of hot water extract of *Thuja orientalis*. BMC Complement Altern Med, 13, 9. doi:10.1186/1472-6882-13-9.