https://doi.org/10.26651/allelo.j/2025-66-1-1549 0971-4693/94 Euro 20.00
Allelopathy Journal 66 (1): 113-122 (September, 2025) International Allelopathy Foundation 2025
Figs : 2, Tab: 9

Comparative Pharmacognostic and Phytochemical Profiling of Leaves of *Matricaria chamomilla* L. and *Petroselinum crispum* (Mill.) Fuss

Harsh Pratap Singh, Avijit Mazumder* and Bhavani Pentela
Department of Pharmacology, Noida Institute of Engineering and Technology (Pharmacy Institute), Plot no. 19, Knowledge Park-II, Greater Noida, Uttar Pradesh-201306, India.
E. Mail: avijitmazum@yahoo.com

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ABSTRACT

We investigated the phytochemical profiling and pharmacognostic assessment of medicinally species: *Matricaria chamomilla* L. (Asteraceae) and *Petroselinum crispum* (Mill.) Fuss (Apiaceae). The ethanol extracts were prepared using Soxhlet extraction, resulting in yields of 7.5 % w/w for *M. chamomilla* and 10 % w/w for *P. crispum*. Ash value and stomatal index (11.76 % for *M. crispum* and 13.63 % for *P. crispum*) were determined to support botanical authentication. Phytochemical screening confirmed the presence of diverse bioactive constituents (flavonoids, alkaloids, terpenoids, phenolic compounds, saponins and tannins). Notable constituents such as apigenin and myristicin were identified as pharmacologically relevant markers. Solvent-specific differences in phytochemical solubility were observed. These findings highlight the therapeutic use of both species and reinforce their relevance in herbal and integrative medicine.

Keywords: Medicinal plants, *Matricaria chamomilla* L., *Petroselinum crispum* (Mill.) Fuss, Phytochemical screening.

1. INTRODUCTION

Plants are rich in a diverse array of phytochemicals, including flavonoids, terpenoids, alkaloids and phenolic compounds, which play a critical role in mitigating the risk of various chronic diseases by modulating physiological functions and enhancing the performance of vital organ systems. *Matricaria chamomilla* L., (synonym *Matricaria recutita* L.), family Asteraceae is a well-documented medicinal species for its pharmacologically active constituents and broad-spectrum therapeutic properties (16). *M. chamomilla* L. is an annual, herbaceous and highly branched 30 to 60 cm plant. Fertilized flowers develop into achenes during the fruiting stage (15). The species is native to Europe and Western Asia but has been extensively naturalized in temperate regions across the globe due to its adaptability and medicinal value. This plant has been used in

*Correspondence author,

traditional medicine since 7000-9000 BC (14). Its essential oil and aqueous or ethanolic extracts of contains approximately 120 secondary metabolites. Among these, flavonoids (36 identified compounds) and terpenoids (28 identified compounds) are pharmacologically significant and are responsible for the plant's therapeutic activities, including anti-inflammatory, antioxidant, antimicrobial and antispasmodic effects (18). The principal bioactive compound in *M. chamomilla* L. is apigenin, which is a key phytochemical marker for quality assessment. Chamomile contains minimum of 0.25 % apigenin-7-O-glucoside, a glycosylated form associated with its biological activity (5). It is traditionally used to treat liver problems, lung issues, gastrointestinal issues (11), common cold and neuropsychiatric issues. It is used in topical applications to treat infections, pain and inflammatory conditions affecting the skin, eyes and oral mucosa (7) (Figure 1).

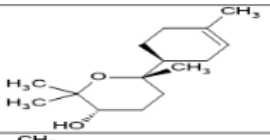
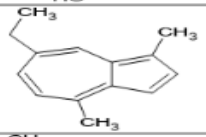
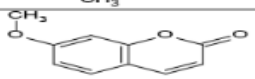
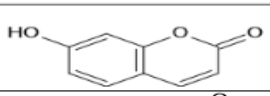
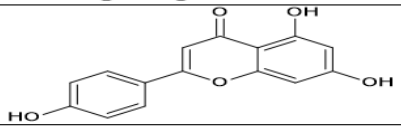
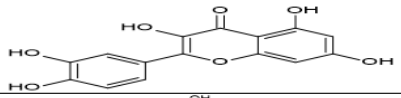
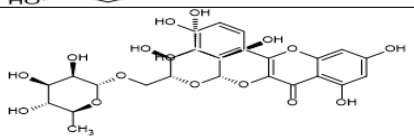
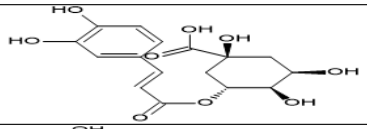
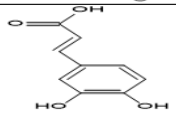
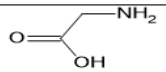
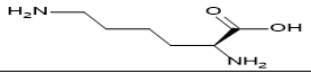
Petroselinum crispum (Mill.) Fuss, parsley (Apiaceae family) is used for food, cosmetic and pharmaceutical industries due to its aromatic, therapeutic and culinary properties (13). It is a bright green, aromatic and medicinal biennial herb, originally native to Mediterranean region, now cultivated globally due to its adaptability and multifaceted applications (1). Parsley near maturity enters the flowering phase, lasting 2-3 weeks with small greenish-white flowers (9). Parsley is a nutrient-rich herb containing a wide range of bioactive constituents that contribute to its diverse therapeutic potential. Its primary phytochemical components include essential oils, flavonoids, vitamins and minerals, which collectively confer notable pharmacological properties such as diuretic, anti-inflammatory and antioxidant activities (3). It is traditionally used for its antihypertensive effects and in the management of various conditions, including dysmenorrhea, hemorrhoids, diabetes mellitus and urinary tract infections. Moreover, it exhibits a broad spectrum of pharmacological activities, including antibacterial, antifungal, anti-obesity, analgesic, anti-hyperuricemic, hepatoprotective, nephroprotective, antiplatelet, wound-healing, estrogenic, anticancer and neuroprotective properties (2) (Figure 2).

Figure 1. *Matricaria chamomilla* L.

Figure 2. *Petroselinum crispum* (Mill.) Fuss

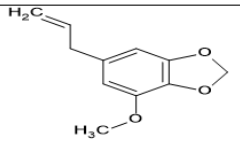
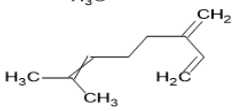
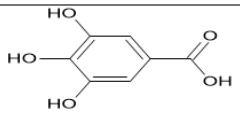
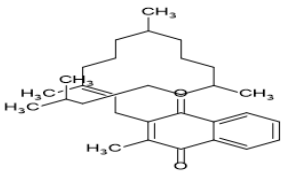
Several phytoconstituents were reported to be isolated from *Matricaria chamomilla* L. (Table 1).

Table 1. Chemical structures of phytochemicals present in *Matricaria chamomilla* L.

Phytoconstituents	Phytochemicals	Chemical Structures
Sesquiterpenes	Bisabolol oxide A	
	Chamazulene	
Coumarin	Herniarin	
	Umbelliferone	
Flavonoids	Apigenin	
	Quercetin	
	Rutin	
Phenolic acid	Chlorogenic acid	
	Caffeic acid	
Amino acid	Glycine	
	Lysine	

The phytochemicals isolated from *Petroselinum crispum* are reported in Table 2 below**.**

Table 2. Chemical structures of phytochemicals present in *Petroselinum crispum* (Mill) Fuss

Phytoconstituents	Phytochemicals	Chemical Structures
Essential oil	Myristicin	
	Myrcene	
Tannin	Gallic acid	
Vitamins	Vitamin K	

2. MATERIAL AND METHODS

Procurement of Plant

In December 2024, plants were collected from the Botanic Garden of Indian Republic in Gautam Budh Nagar, Noida. The researcher identified the plant through physical inspection of its leaves, collected samples for a herbarium sheet and sent them for identification.

Study Site and Study Period

Table 3. Agroclimatic and Geographical Conditions of the Study Site

Parameter	**Value**
Location Name	NIET Pharmacy Institute, Greater Noida, India
Latitude	28.462632° N
Longitude	77.49123° E
Mean Height Above Sea Level	200 m (656 feet)
Average Annual Rainfall	786 mm
Maximum Temperature	45 °C (in peak summer, May-June)
Minimum Temperature	5 °C (in peak winter, December-January)
Start of experiment	December 2024
End of Experiment	April 2025

20 gm of dried *Matricaria chamomilla* and *Petroselinum crispum* leaf powder were individually subjected to extraction. Dried powder from each plant was extracted using 500 mL of ethanol at 40-60 °C for 48 h employing a Soxhlet apparatus. After extraction, the solvent was evaporated, yielding a brownish residue, which was subsequently dried under reduced pressure using a rotary evaporator to obtain the dry extract (4). Quantitative analysis was conducted to determine the concentrations of tannins, alkaloids, saponins, phenolic compounds, flavonoids, terpenoids, sterols, glycosides and other bioactive phenolic acids (10).

Measurement of Ash Value

Ash value refers to the amount of inorganic material left after the complete combustion of plant material and it serves as an important indicator of the purity and quality of herbal substances. This value is used to assess the presence of mineral content and contaminants such as sand or soil (6).

Formula: Ash Value (%) = $\frac{\text{Weight of Dry Sample(g)}}{\text{Weight of Ash (g)}} \times 100$

Measurement of Stomatal Index (SI)

The stomatal index (SI) reflects the proportion of stomata to the total number of epidermal cells (including stomata) in leaf tissue. It is a useful diagnostic tool in plant taxonomy, pharmacognosy and physiological studies (8).

Formula: Stomatal Index (SI) = $\frac{\text{Number of Stomata + Number of Epidermal Cells}}{\text{Number of Stomata}} \times 100$

Preliminary Phytochemical Screening

Phytochemical assays are essential in phytomedical research to detect bioactive compounds with therapeutic potential (17).

(i). Alkaloids: Dragendorff's test (Potassium bismuth iodide solution): Confirmation of a positive result was based on the precipitation of orange-brown precipitates.

Mayer's test: The plant extract is added with 1-2 drops of Mayer's reagent. A positive result indicates a creamy white/yellow precipitate.

(ii). Terpenoids: Copper Acetate test: Diterpenes in the plant extract were identified by dissolving the extract in water and adding cupric acetate. The development of a vibrant emerald-green hue verified the existence of diterpenes.

(iii). Flavonoids: Lead acetate test: Treatment of the extract with Goulard's extract resulted in the formation of yellow precipitates, indicating a positive result

(iv). Saponins: Frothing test: Sodium carbonate was added to the extract, shaken vigorously and left to stand. Foam formation indicated the presence of saponins.

(v). Phenols: Ferric chloride test: The extract was mixed dropwise with a solution of ferric chloride. A positive result was validated through precipitate formation in various colors (yellow, blue, red, green).

(vi). Tannins: Gelatine test: A 1 % gelatin solution containing sodium chloride was combined with the extract. The presence of precipitates with a distinct white appearance indicated a positive result

Bromine water test: The plant extract was mixed with 10 mL of bromine water. The decolorization of bromine indicated a positive result (12).

3. RESULTS AND DISCUSSION

Percentage Yield

Dried leaves of *Matricaria chamomilla* L. and *Petroselinum crispum* (Mill.) Fuss was extracted using ethanol in a Soxhlet apparatus. The residue obtained was taken in a warm water bath to dry. Percentage yields for *Matricaria chamomilla* L. and *Petroselinum crispum*, (Mill.) Fuss resulting in yields of 7.5 % w/w and 10 % w/w, respectively (Table 4).

Percentage Yield = $\frac{\text{Weight of plant extract}}{\text{Weight of dried plant material}} \times 100$

Table 4. Calculation of Percentage Yield of the Plant

Plant	Calculation of PY/TY×100	Extract yield
Matricaria chamomilla L.	1.5/ 20 × 100	7.5 %w/w
Petroselinum crispum (Mill) Fuss	2/ 20 × 100	10 %w/w

Ash Value for *Matricaria chamomilla* L.: The total ash content of *Matricaria chamomilla* L. was measured at 10 %, which represents the cumulative amount of inorganic substances present in the plant material after complete combustion. This includes both intrinsic mineral content and potential external contaminants. The water-soluble ash accounted for 1 %, indicating the proportion of the total ash that dissolves in water, which reflects the presence of readily soluble salts. Meanwhile, the acid-insoluble ash was 4 %, signifying the portion that remains undissolved in dilute hydrochloric acid, primarily composed of siliceous matter such as sand and other earthy materials (Table 5).

Table 5. Ash value for *Matricaria chamomilla* L.

Serial No.	Evaluation Parameter	Value (%)
1.	Total ash	10 %
2.	Water-soluble ash	1 %
3.	Acid-insoluble ash	4 %

Ash Value for *Petroselinum crispum* (Mill.) Fuss

The determination of ash content in *Petroselinum crispum* indicated that the total ash was 8 %, signifying the total amount of inorganic matter present after the complete combustion of the plant material. The water-soluble ash was found to be 2 %, representing the portion of ash constituents that are soluble in water and typically associated with physiologically important minerals. Meanwhile, the acid-insoluble ash value was 3 %, reflecting the presence of silica and other acid-insoluble materials, often linked to extraneous matter such as soil or sand (Table 6).

Table 6. Ash value for *Petroselinum crispum* (Mill.) Fuss

Serial No.	Evaluation Parameter	Value %
1.	Total ash	8 %
2.	Water-soluble ash	2 %
3.	Acid-insoluble ash	3 %

Stomatal Index

The stomatal index was calculated by examining a defined area under the microscope, where four stomata and thirty epidermal cells for *Matricaria chamomilla* and six stomata and thirty-eight epidermal cells for *Petroselinum crispum* were observed. Using the standard formula for stomatal index, the value was determined to be 11.76 % and 13.63 %. This parameter reflects the proportion of stomata to the total number of epidermal cells and stomata and is a key indicator of the plant's capacity for gas exchange and environmental adaptation (Table 7)**.**

Table 7. Stomatal index of *Matricaria chamomilla* L. and *Petroselinum crispum* (Mill.) Fuss

Plant Name	Stomata Number	Number of epidermal cells	Stomatal index (%)
Matricaria chamomilla	4	30	11.76 %
Petroselinum crispum	6	38	13.63 %

Preliminary Phytochemical Analysis

The results of various phytochemical assays were examined, employing multiple solvents to conduct comprehensive phytochemical profiling. This approach facilitated the detailed analysis of the chemical composition of phytoconstituents present in the leaves of *Matricaria chamomilla* L. and *Petroselinum crispum* (Mill) Fuss revealing a diverse array of bioactive compounds with potential therapeutic relevance in Tables 8 and 9.

Table 8. Phytochemical screening of leaves of *Matricaria chamomilla* L.

Phytochemicals	Test	Ethanol	Methanol	Distilled Water	Hydro-alcoholic	n-hexane	Diethyl ether
Saponins	Frothing test	+	+	-	-	-	-
	Sodium Bicarbonate test	+	+	+	-	-	+
Tannins	Gelatin test	+	+	-	-	-	+
	Bromine water test	+	+	+	-	-	-
Alkaloids	Dragendroff's reagent test	+	+	+	-	-	+
	Mayer's test	+	+	+	-	-	+
Phenols	Ferric chloride test	+	+	-	-	-	+
Terpenoids	Copper acetate test	+	-	-	+	-	+
Flavonoids	Lead acetate test	+	+	-	-	-	+
	Ferric chloride test	-	-	+	+	-	-

Table 9. Phytochemical screening of leaves of *Petroselinum crispum* (Mill.) Fuss.

Phytochemicals	Test	Ethanol	Methanol	Distilled Water	Hydro-alcoholic	n-hexane	Diethyl ether
Saponins	Frothing test	-	-	+	+	+	-
	Sodium Bicarbonate test	-	-	+	-	-	-
Tannins	Gelatin test	+	+	-	-	-	+
	Bromine water test	+	+	-	-	-	+
Alkaloids	Dragendroff's reagent test	+	+	+	+	+	+
	Mayer's test	+	+	+	+	-	-
Phenols	Ferric chloride test	+	+	-	-	+	+
Terpenoids	Copper acetate test	+	+	-	-	-	+
Flavonoids	Lead acetate test	+	+	-	+	-	+
	Ferric chloride test	+	+	+	-	-	-

The phytochemical screening of *Petroselinum crispum* (Mill.) Fuss leaf extracts was screened for qualitative estimation using a range of solvents and it revealed the presence of various bioactive compounds. Saponins were predominantly observed in the distilled water and hydro-alcoholic extracts, while tannins were present in ethanol, methanol and diethyl ether extracts. Alkaloids were consistently detected in all extracts except for the n-hexane extract in Mayer's test. Phenolic compounds were evident in ethanol, methanol, n-hexane and diethyl ether extracts. Terpenoids were identified in ethanol, methanol and diethyl ether extracts. Flavonoids were detected in ethanol, methanol, hydro-alcoholic and diethyl ether extracts, with additional evidence from ferric chloride tests showing flavonoid presence in distilled water. These findings underscore the rich phytochemical profile of *P. crispum* leaves, which may be associated with the plant's known medicinal and therapeutic effects (Table 9). The phytochemical analysis of *Matricaria chamomilla* L. leaf extracts, conducted using various solvents, revealed the presence of multiple classes of secondary metabolites. Saponins were consistently detected in ethanol, methanol, distilled water and diethyl ether extracts, while tannins were predominantly present in ethanol, methanol and diethyl ether extracts. Alkaloids were observed in ethanol, methanol, distilled water and diethyl ether extracts. Phenolic compounds were identified in ethanol, methanol and diethyl ether extracts and terpenoids were evident in ethanol, hydro-alcoholic, and diethyl ether extracts. Furthermore, flavonoids were detected in ethanol, methanol, hydro-alcoholic and diethyl ether extracts. These findings highlight the rich and diverse phytochemical composition of *M. chamomilla* leaves, which may contribute to its well-documented medicinal and pharmacological properties (Table 8).

4. CONCLUSIONS

The present research highlights the significant pharmacognostic and phytochemical profiles. percentage yield, ash values, stomatal index and preliminary phytochemical screening of *Matricaria chamomilla* L. and *Petroselinum crispum* (Mill.) Fuss. Ethanol extracts of both plants demonstrated notably high yields of 7.5 % and 10 % (w/w), respectively. Ash value analysis revealed that *M. chamomilla* had a higher total ash

content (10 %) compared to *P. crispum* (8 %), while their acid-insoluble fractions suggested minimal contamination with extraneous matter. The stomatal index, which was 11.76 % for *M. chamomilla* and 13.63 % for *P. crispum*, provided insights into leaf anatomical adaptations. Importantly, the preliminary phytochemical screening confirmed the presence of several bioactive compounds, including flavonoids, alkaloids, phenols, terpenoids, saponins and tannins, underscoring the therapeutic potential of these medicinal plants. Ethanol and methanol were particularly effective in extracting a broad range of phytoconstituents, highlighting their suitability for future phytopharmacological investigations. These findings support the traditional medicinal use of these plants and pave the way for more detailed studies on their pharmacological activities and clinical applications.

AUTHOR'S CONTRIBUTISONS

In this review, HPS, AM and BP have made a significant contribution to prepare the manuscript, conducted the systemic evaluation and provided detailed conclusions. All authors have carefully examined.

DECLARATION

We declare that all authors of this Ms. have made substantial contributions. We have not excluded any author that substantially contributed to this Ms. We have followed our ethical norms established by our respective institutions.

ACKNOWLEDGEMENTS

The authors express their profound appreciation to the esteemed Directors and administrations of the Department for their unwavering support and for furnishing the indispensable materials required to carry out this scholarly pursuit

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

ETHICAL STATEMENT

This is to let you know that we haven't worked on any project involving humans or animals.

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