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Feverfew (*Tanacetum parthenium*): GC-MS Analysis and Therapeutic Insights

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Abstract

Background: Feverfew (*Tanacetum parthenium* L. Family Asteraceae) is a widespread plant in Syria, which is used traditionally in the treatment of Migraine, which is considered as one of the most disabling neurological disorders. **The Aim of the Study:** This study aimed to investigate the phytochemical composition of feverfew extracts using Gas Chromatography-Mass Spectrometry (GC-MS) and to assess their potential therapeutic role in migraine management. **Methods:** Fresh flowers of feverfew were collected, processed, and analyzed with GC-MS (HP-5MS column, temperature ramp 40˚C - 260˚C, Agilent 7890A system, University of Damascus laboratory). Both aqueous and oil extracts were studied. **Results:** The oil extract revealed abundant of terpenes (e.g., Z-Ocimene 16.75%), hydrocarbons (Methylcyclohexane 33.49%), and phenolics (2,6-di-tert-butylphenol 1.62%). The aqueous extract showed phenolics and steroid-like compounds (Preg-4-en-3-one, 10.18%; Oxaspirodione, 11.23%) with terpenoids. These compounds are known for anti-inflammatory, antimicrobial, and neuroactive properties. **Conclusion:** The findings ensure the presence of anti-migraine compounds, and support the traditional use of feverfew in migraine relief.

Keywords

Feverfew, Migraine, *Tanacetum parthenium*, GC-MS, Phytochemicals, Asteraceae

1. Introduction

Migraine is a prevalent neurovascular disorder characterized by recurrent headaches often accompanied by nausea, photophobia, and phonophobia [1] [2]. Ac-

cording to the World Health Organization, migraine is one of the leading causes of disability worldwide. Conventional treatments include triptans, gepants, and preventive medications; however, many patients turn to herbal remedies due to side effects or limited efficacy of drugs [3]. Feverfew (*Tanacetum parthenium*) (**Figure 1**), a traditional medicinal plant belonging to the Asteraceae family, has been used in folk medicine for headache relief [4] [5]. Its bioactive compounds, particularly sesquiterpene lactones such as parthenolide with other compounds such as 2-Methyltricosane and methyl cyclohexane, have been suggested to exert anti-inflammatory and neuroprotective effects [6]-[10]. This study integrates phytochemical profiling with a focus on migraine therapy to provide scientific support for feverfew use, as it is especially used as antimigraine in folk medicine in Syria [11] [12].

Figure 1. Flowers of *Tanacetum parthenium* L. Researcher Photo.

2. Objectives

1) Analyze the phytochemical profile of feverfew water and volatile oil extracts using GC-MS analyzer.

2) Evaluate the potential therapeutic implications of identified compounds in migraine management.

3. Materials and Methods

Feverfew (*Tanacetum parthenium*) flowers were collected in April 2025 from local cultivated sources in Damascus-Syria (The plant was identified by Dr. Naseh Olapy, Department of Botany, Faculty of Science Aleppo University-Syria). The material (200 g) was subjected to steam distillation using a Clevenger apparatus, the yield of the essential oil was 0.23%.

To prepare the water extract it was used 200 g of the Flowers and brought to a boil with 2000 ml of water for about two hours under cooling condenser. The aqua extract dried using rotavapor, and the yield of the extraction was 9.5% [9]. Samples of booth extracts were analyzed at the Faculty of Science, University of Damascus, using Agilent 7890A GC-MS system equipped with an HP-5MS column.

The temperature program ranged from 40˚C to 260˚C [10]. The identification of the detected compounds was based on mass spectral libraries and retention indexes that showed a lot of Pics that belongs to the main compounds in the Essential Oil (Figure 2, Table 1).

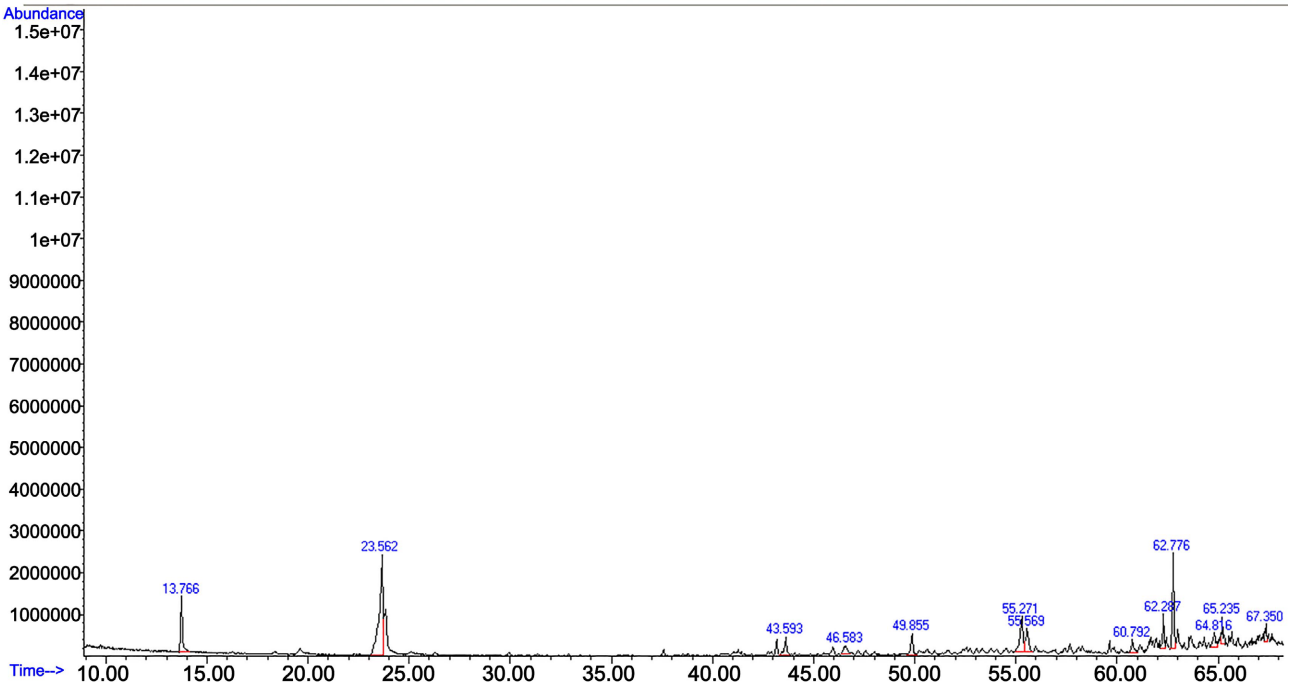

Figure 2. GC-MS chromatogram of oil extract.

Table 1. GC-analysis of the essential oil extracts, showed the main compounds detected in the essential oil of feverfew.

Compounds	R.T. in min.	%
Methyl Cyclohexane	13.7644	33.49
Z-Ocimene	23.5627	16.75
2-Methylheptadecane	43.5935	1.88
2,6-Di-tert-butylphenol	46.5861	1.62
n-Hexadecane	49.8545	2.07
2-Methyldecane	55.2742	4.75
2-Methyltricosane	55.5707	2.79
n-Pentadecane	60.7904	1.29
4-Methylheptadecane	62.2867	1.68
7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione	62.7762	5.80
Pentatriacontane	64.8173	1.62
3-Methyl-1,2-benzisoxazole-N-oxide	65.2379	1.56
Heneicosane	67.3478	1.27

Using the same parameter of the essential oil, water extract analyzed using GC-

MS. GC-MS chromatogram showed pics belong to the main compounds in the water Extracts (Figure 3, Table 2).

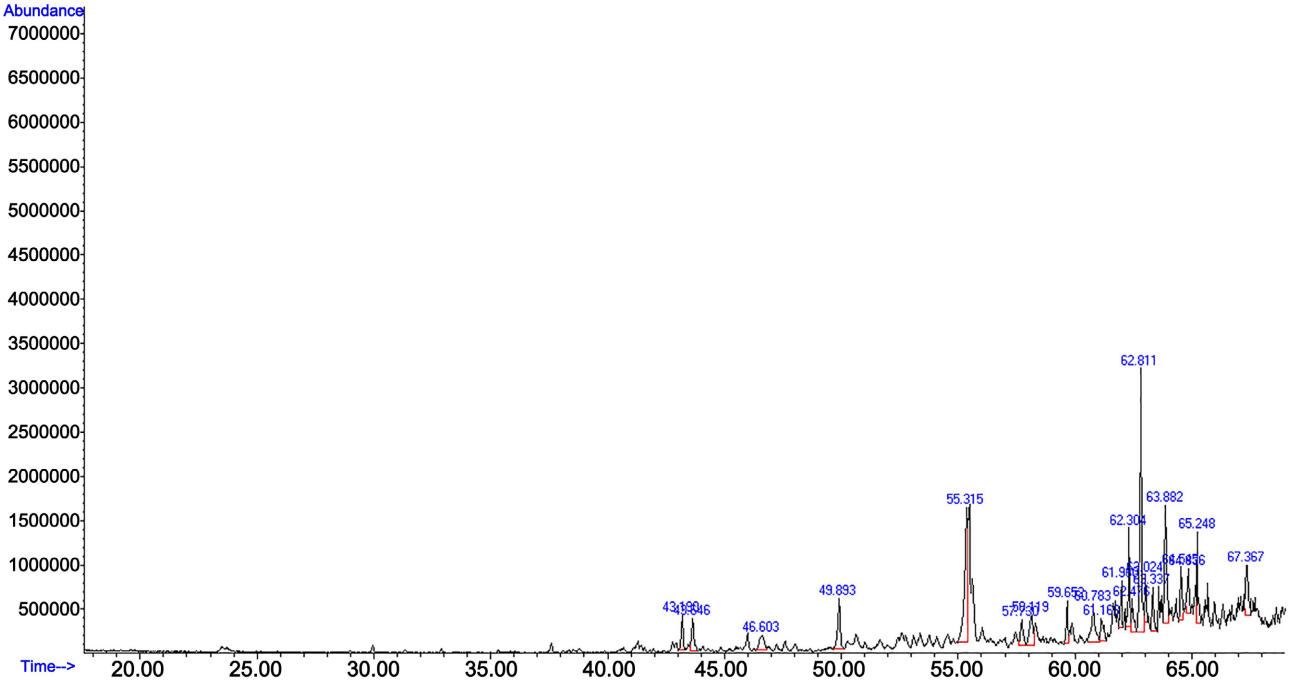

Figure 3. GC-MS chromatogram of aqueous extract.

Table 2. Chemical composition of aqueous extract using GC-MS, showed the main compounds detected in the water extract of feverfew.

Compound	R.T. min.	%
2-Methylheptadecane	43.1936	1.63
n-Pentadecane	43.6487	1.92
2,4-Di-tert-butylphenol	46.6068	1.86
n-Hexadecane	49.8958	3.07
Preg-4-en-3-one, 17α-hydroxy-17β-cyano-	55.3155	10.18
Sulfurous acid, hexyl pentyl ester	57.7289	1.68
(Z,Z)-α-Farnesene	58.1219	2.61
n-Octadecane	59.6527	1.53
n-Hexadecane	60.7835	3.18
N-[3-[N-Aziridyl]propylidene] tetrahydrofurfuryl amine	61.1696	1.68
n-Nonadecane	61.9626	1.45
1-Iodohexadecane	62.3005	2.83
7,9-Dimethylhexadecane	62.4729	1.55
7,9-di-tert-butyl-1-oxaspiro[4.5]deca-6,9-diene-2,8-dione	62.8107	11.23
1-Iodooctadecane	63.0245	1.45
Mehp	63.3348	2.02

Continued

1,5-Hexadiene, 2,5-dimethyl-3-methylene-	63.8795	6.50
1-Methoxy-1,4-cyclohexadiene	64.5483	2.41
n-Heneicosane	64.8380	2.08
Phytane	65.2448	2.98
2-(2,3-Dimethylbut-2-enyl)-4-methyl-2H-1,4-benzothiazin-3-one	67.3685	3.29

4. Results

GC-MS analysis revealed a complex profile of hydrocarbons, terpenoids, alcohols, phenolics, and steroid like compounds. In the oil extract, the dominant constituents were Methylcyclohexane (33.49%), Z-Ocimene (16.75%), and Heptacosanol (8.74%). In the aqueous extract, Preg-4-en-3-one (10.18%) and Oxaspiro-dione (11.23%) were among the major compounds in addition to (2.02%) MEHP (Mono(2-ethylhexyl) phthalate).

5. Discussion

The results demonstrate the phytochemical diversity of feverfew, consistent with previous reports on Asteraceae plants. Terpenes such as Z-Ocimene and α-Farnesene have recognized antioxidant and anti-inflammatory properties [5]-[8], which may contribute to migraine alleviation.

But also, this study showed that sesquiterpene lactones parthenolide is not present in the essential oil and in water extracts of extracted plant material, collected from Syria as mentioned above, (Water extract and essential oil of feverfew are used traditionally as anti-migraine remedy). That means that, other compounds contribute to the anti-migraine activity, which are present in both extracts such as Methylcyclohexane and MEHP (Mono(2-ethylhexyl) phthalate). In addition, the presence of steroid-like compounds in the aqueous extract suggests potential neuroactive effects. Similar studies on Tanacetum species reported comparable terpenoid and phenolic profiles, supporting the reliability of our findings. Together, these compounds may act synergistically, offering multi-targeted benefits for migraine prevention and symptom relief [13] [14].

6. Conclusions

Feverfew (*Tanacetum parthenium*) contains a diverse range of bioactive compounds with known anti-inflammatory, antioxidant, and neuroprotective properties. The findings validate its traditional use for migraine management [11] [12] and highlight the importance of standardized extracts for clinical application.

At the end, we suggest future studies should focus on controlled trials to further establish its efficacy and safety.

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Supporting

I agree that the data and materials supporting the results or analyses in our paper, and our data will be made available on reasonable request.

Conflicts of Interest

No conflicts of interest are declared.

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