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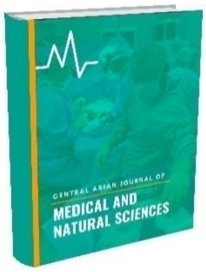


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# Gc-Ms Analysis of the Chemical Composition of Essential Oil Isolated From Achillea Millefolium L.

**Istamkulova M.M.[1], Mukhamadiev N.K.[1], Keldiyarov O.X.[1], Makhmudova G.N.[2], Mukhamadiev A.N.[1]**

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*[1]Samarkand State University named after Sh.Rashidova, Samarkand, Republic of Uzbekistan*

*[2]Andijan State University, Andijan, Republic of Uzbekistan*
*E-mail:* m_nurali@mail.ru

**Abstract:** This article focuses on analyzing the chemical composition of the essential oil extracted from Achillea millefolium L. The GC-MS method was employed to identify a total of 34 compounds, which were categorized into various classes such as monoterpenes, sesquiterpenes, oxygenated monoterpenes, and oxygenated sesquiterpenes. The two most abundant components found in the oil were 2-karen and ascaridole. Monoterpenes were found in a large number and were the predominant class of compounds in the essential oil. The findings of this study have potential implications in the development of new medicines and natural products. Moreover, exploring the chemical composition of Achillea millefolium L. essential oil could serve as a starting point for further research in the field of herbal medicine and phytotherapy.

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**Key words:** Achillea millefolium L., essential oil, GC-MS, chemical composition, monoterpenes, sesquiterpenes, phenols, oxides.

## Introduction

Achillea millefolium L. is a medicinal plant with a long history of use in treating various ailments. One of its notable components is essential oil, which has been studied extensively and found to possess diverse biological properties such as anti-inflammatory, antimicrobial, and antioxidant effects [1,2].

The chemical composition of the essential oil derived from Achillea millefolium L. is highly significant in understanding its pharmacological properties and potential applications in various fields [1-18]. The essential oil of Achillea millefolium L. possesses beneficial properties, making it suitable for use in areas such as aromatherapy, cosmetics, and the treatment of various diseases [19-29]. Additionally, this essential oil exhibits a range of physiological properties due to its constituent compounds [20-29]. Some of these compounds demonstrate biological activity that may prove beneficial to humans [23-25, 27-29].

Analyzing the essential oil isolated from Achillea millefolium L. through the GC-MS method holds several noteworthy advantages:

a) It allows for the determination of the chemical composition of the essential oil, including its individual components and their concentrations. This understanding aids in comprehending the oil's mechanism of action and its effectiveness across different applications.

b) Analysis enables quality control of Achillea millefolium L. essential oil.

c) The chemical data obtained through analysis can be utilized to identify the mechanisms of action of the oil and explore its potential medicinal applications.

d) Industrial production processes can benefit from the analysis of the essential oil as it assists in determining the composition and concentration of components in products that contain this ingredient.

e) Analyzing different samples of Achillea millefolium L. essential oil obtained from various sources or through distinct isolation methods facilitates comparative studies.

f) Analysis plays a role in identifying new potential applications of Achillea millefolium L. essential oil by discovering novel biologically active components within its composition.

In this article, we will analyze the chemical composition of the essential oil isolated from Achillea millefolium L. through the utilization of gas chromatography-mass spectrometry (GC-MS).

**Materials and methods**

GC-MS is a highly effective analytical technique used for the separation and identification of individual constituents within a complex mixture, such as essential oils. In this study, essential oil was extracted from the aboveground portions of Achillea millefolium L. specifically from the collection site in Ilansoy, Samarkand region on June 17, 2022, using the hydrodistillation method.

The analyzes were carried out on a YL6900 GC-MS chromatograph with an HP5 capillary column 30 m long, 0.32 mm in inner diameter, and 0.25 µm thick stationary phase.

Chromatography conditions: column thermostat temperature - initial - 60°C for 3 min (isothermal mode); heating at a rate of 15°C/min (temperature programming mode) up to 250°C and at 250°C (isothermal mode) 3 min. Injector temperature - 250°C, helium gas flow - 1 ml/min, SplitRatio-1/100. Detector mass parameters - Solvent delay - 3 minutes, Emission - 50mA, scanning range - 30-350 a.u.m., scanning speed - 1600 a.u.m./sec, ion source temperature - 230°C, transfer temperature - 280°C. Analysis time - 30 min [3,18].

**Results and discussion**

The results of this analysis are presented in Table 1, and the corresponding chromatogram can be seen in Figure 1.

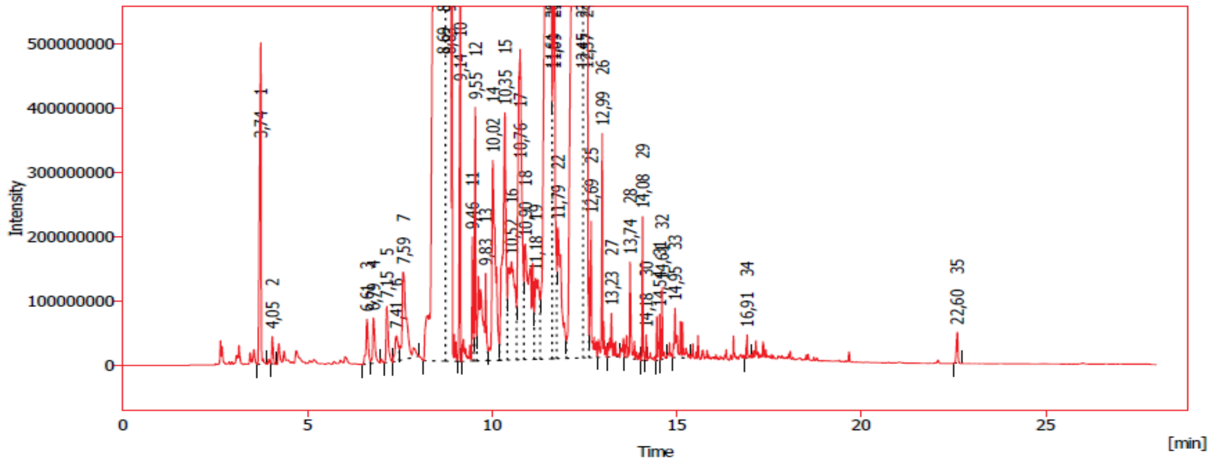
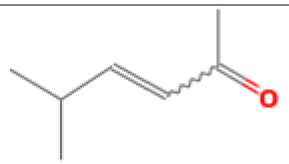
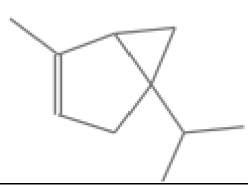
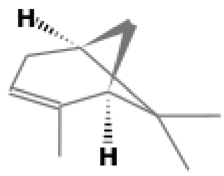
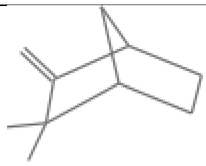
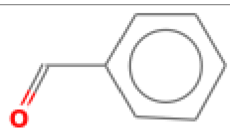
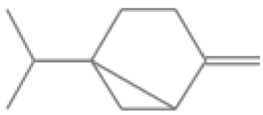
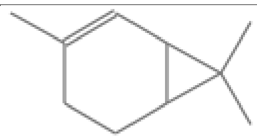
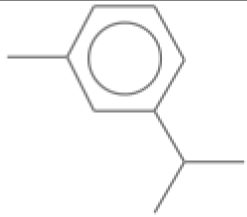
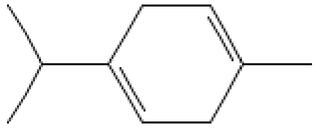
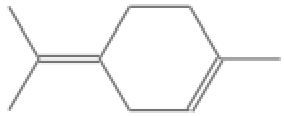
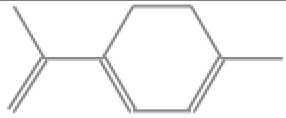
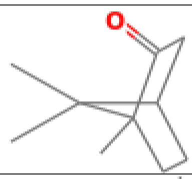
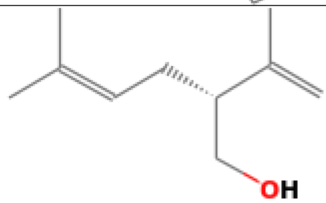
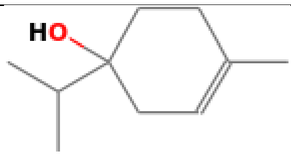
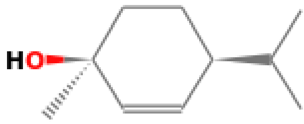
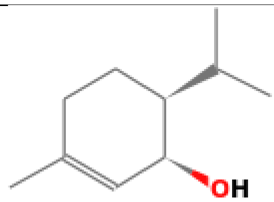


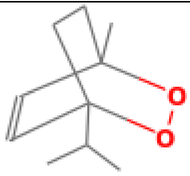
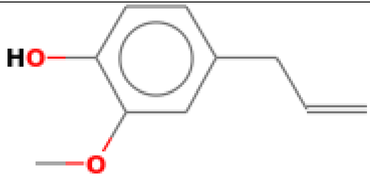
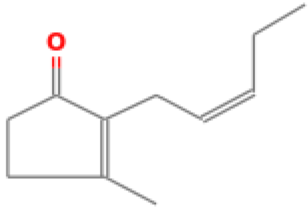
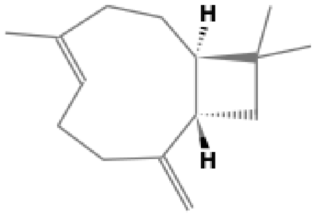
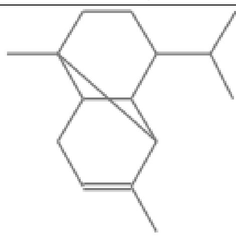
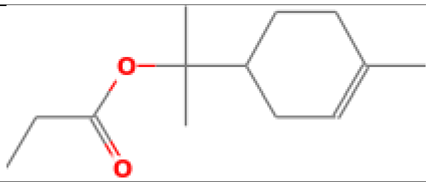
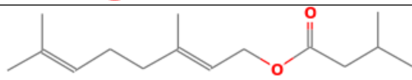
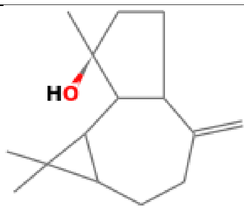
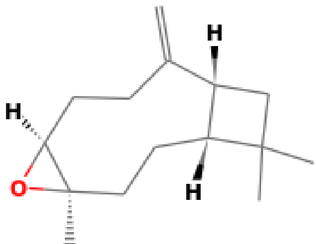

Fig.1. Chromatogram of essential oil isolated from Achillea millefolium L.

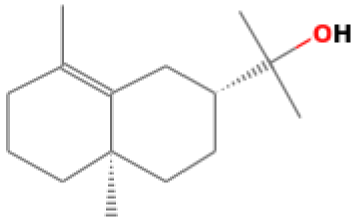
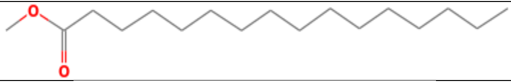
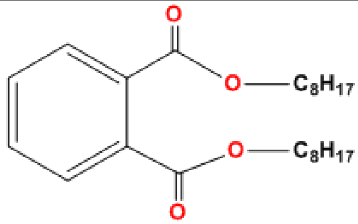
Table 1.

**The chemical composition of the essential oil isolated from Achillea millefolium L.**

| N | Name of components | Retention time, [min] | Content, % | Structural formula |
|---|---|---|---|---|
| 1 | 3-Hexen-2-one, 5-methyl- | 4,049 | 0,11 |   |
| 2 | trans-Thujene | 6,611 | 0,28 |  |
| 3 | α-Pinene | 6,787 | 0,33 |   |
| 4 | Camphene | 7,149 | 0,36 |  |
| 5 | Benzaldehyde | 7,414 | 0,27 |   |
| 6 | cis-sabinene | 7,593 | 1,44 |  |
| 7 | 2-Carene | 8,69 | 20,60 |  |

| | | | | |
|---|---|---|---|---|
| 8 | m-Cymene | 8,833 | 8,78 |  |
| 9 | γ-Terpinene | 9,141 | 1,18 |  |
| 10 | X1 | 9,464 | 0,52 | |
| 11 | α-Terpinolene | 9,546 | 1,10 |  |
| 12 | 1,3,8-p-Menthatriene | 9,829 | 0,31 |  |
| 13 | X2 | 10,023 | 1,95 | |
| 14 | Camphor | 10,345 | 2,31 |   |
| 15 | (R)-Lavandulol | 10,524 | 1,90 |   |
| 16 | Terpinen-4-ol | 10,761 | 3,35 |   |
| 17 | p-Menth-2-en-1-ol | 10,897 | 1,73 |   |
| 18 | Piperitol | 11,184 | 1,05 |   |
| 19 | X3 | 11,614 | 11,37 | |
| 20 | X4 | 11,689 | 2,99 | |
| 21 | X5 | 11,786 | 1,58 | |
| 22 | X6 | 12,452 | 21,32 | |

| | | | | |
|---|---|---|---|---|
| 23 | Ascaridole | 12,567 | 10,06 |  |
| 24 | Eugenol | 12,685 | 0,66 |  |
| 25 | (E)-Jasmone | 12,986 | 0,76 |  |
| 26 | Caryophyllene | 13,233 | 0,41 |  |
| 27 | Copaene | 13,739 | 0,35 |  |
| 28 | α-Terpinyl propionate | 14,079 | 0,29 |  |
| 29 | Geranylisovalerate | 14,176 | 0,11 |  |
| 30 | Spatulenol | 14,538 | 0,21 |  |
| 31 | Caryophylleneoxi de | 14,606 | 0,17 |  |

| | | | | |
|---|---|---|---|---|
| 32 | γ-Eudesmole | 14,953 | 0,39 |   |
| 33 | Hexadecanoicacid, methylester | 16,906 | 0,17 |   |
| 34 | Diisooctylphthalate | 22,6 | 0,14 |   |

*Note: The designated connections X are unidentified connections.*

The chemical composition analysis of the essential oil revealed the presence of 34 compounds. The major components include 2-karen (20,60%), benzene, 1-methyl-3-(1-methylethyl) - (8,78%), and ascaridol (10,06%). There were also other significant compounds, such as x6 (21,32%), which could not be identified using the current method, as well as X3 (11,37%), X4 (2,99%), and X5 (1,58%), which also remained unidentified.

The identified compounds were categorized into several classes, including monoterpenes, sesquiterpenes, oxygenated monoterpenes, and oxygenated sesquiterpenes.

The essential oil of Achillea millefolium L. consists of various classes of chemical compounds, including monoterpenes, sesquiterpenes, phenols, and oxides. Among these components, the most abundant ones include 2-karen (20,60%), X6 (21,32%), ascaridole (10,06%), and X3 (11,37%).

The composition of Achillea millefolium L. essential oil can be categorized as follows:

1. Monoterpenes: trans-toujene (0,28%), α-pinene (0,33%), camphene (0,36%), sabinene (1,44%), α-terpinolene (1,10%), 1,3,8-p-menthatrien (0,31%), camphor (2,31%), eugenol (0,66%), yasmon (0,76%), α-terpinylpropionate (0,29%)
2. Sesquiterpenes: 2-karen (20,60%), m-cimene (8,78%), γ-terpinene (1,18%), terpinen-4-ol (3,35%), p-menth-2-en-1-ol (1,73%), piperitol (1,05%), ascaridole (10,06%), caryophyllene (0,41%), copaene (0,35%), spatulenol (0,21%), γ-eudesmole (0,39%)
3. Other compounds: 3-hexen-2-one,5-methyl-(0,11%), benzaldehyde (0,27%), X1 (0,52%), X2 (1,95%), (r)-lavandulol (1,90%), X3 (11,37%), X4 (2,99%), X5 (1,58%), X6 (21,32%), hexadecanoic acid, methylester (0,17%), diisooctylphthalate (0,14%)

Thus, the essential oil of Achillea millefolium L. contains a diverse range of chemical compounds, including monoterpenes, sesquiterpenes, and other compounds.

In conclusion, the essential oil extracted from Achillea millefolium L. was analyzed for its chemical composition using the GC-MS method. The analysis revealed the presence of numerous compounds, with 2-karen, benzene, 1-methyl-3-(1-methylethyl)-, and ascaridol identified as the major components. Monoterpenes were found to be the most abundant class of compounds, followed by sesquiterpenes, as well as oxygenated monoterpenes and sesquiterpenes. These findings provide valuable insights into the potential applications of Achillea millefolium L. essential oil, such as the development of new medicines and natural products.

**Conclusions:**

1. The analysis of the chemical composition of Achillea millefolium L. essential oil reveals the presence of numerous compounds from different classes, including mono- and sesquiterpenes, phenols, and oxides. The most predominant class of compounds is monoterpenes, which contribute significantly to the oil composition.
2. Among the abundant components, 2-karen and ascaridole stand out. These findings highlight the potential of Achillea millefolium L. essential oil in the development of new medicines and natural products.
3. The analysis conducted enables the classification of the identified compounds into distinct classes, which could serve as a valuable foundation for further research.

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**Mukhamadiev N.K.**
https://orcid.org/0000-0003-4776-4625
ResearcherID: S-1264-2018
Scopus Author ID: 57220325255