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Research Article

# Chemical Composition of Essential Oil of *Stachys lavandulifolia* Vahl. From Iran

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**ABSTRACT**

In order to investigate essential oils from local wild plants, one of the *Stachys* species, *S. lavandulifolia*, was screened. The essential oil was obtained from the aerial parts of the plant by hydro-distillation, and was analyzed for their chemical composition by gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS). Were the major compounds of the 62 identified components which accounted for 97.46% of the total oil of *S. lavandulifolia*. The major components of the oil were Trans-Caryophyllene (13.41%), Spathulenol (11.97%), Caryophyllene oxide (8.44%), Germacrene D (8.08%), Bicyclogermacrene (6.83%), β-phellandrene (5.82%), β-Myrcene (3.75%), Limonene (2.51). This shows that the volatile oil composition of *S. lavandulifolia*, in Iran is extremely variable.

**Keyword:** Essential oil, GC-MS, *Stachys lavandulifolia* Vahl

## INTRODUCTION

Historically, plants have provided a source of inspiration for novel drug compounds, as plant derived medicines have made large contributions to human health and well being.[1] Traditional medicine using plant extracts continues to provide health coverage for over 80% of the world's population, especially in the developing world.[2] The Lamiaceae family is one of the themes and is one of the largest and most distinctive families of flowering plants, with about 220 genera and almost 4000 species worldwide. The genus *Stachys* is one of the largest representative genera of the Lamiaceae family and includes about 300 species, in the subtropical and tropical regions of both hemispheres. In Iran this genus is represented by 34 species.[3] Flavonoids, quinines, iridoids, phenolic acids and diterpenoids are reported as secondary metabolites of different species of this genus.[4] For thousands of years people used plants and herbs as healing compounds.[5] Plants of this genus have been used in folk medicine for centuries to treat genital tumors, sclerosis of the spleen, inflammatory diseases, cough, ulcers, and infected wounds.[6] Among the species of Iranian plants, which are known as the source of folk medicine, *Stachys lavandulifolia* has been commonly used for its useful effects on insomnia and anxiety. Germacrene-D, beta pinene, alpha pinene, myrcene and beta phellandrene have been reported to be the main compounds of the essential oil *S. lavandulifolia*.[7] In the present study a sample of *S. lavandulifolia* with different chemical composition has been reported.

## MATERIALS AND METHODS

*Plant material and essential oil preparation*

The aerial parts of *S. lavandulifolia* was collected at full flowering stage from Touyserkan, Hamedan province from west Iran. A voucher specimen of population was deposited at the Herbarium of Biology Department, Payame Noor University, Touyserkan, Hamedan, Iran. The air-dried materials were finely ground, then subjected to hydro-distillation for 3 hours with water as solvent, using a Clevenger apparatus according to the standard procedures. The oils were stored at 4 °C for further analyses.

*Gas chromatography–mass spectrometry (GC–MS)*

Volatile components were identified by GC-MS using a Finnigan TRACE GC-MS (Thermo Quest Finnigan Co., USA) equipped with a DB-1 capillary column (60 m × 0.25 mm × 25µm). Helium (flow rate, 1.1 ml/min) was used as the carrier gas, and injection volumes were 0.2 µl. The oven temperature was raised from 60 °C to 250 °C at a rate of 5 °C /min, held at 250 °C for 5 min; transfer line temperature was 250 °C. Split ratio was 100. The quadruple mass spectrometer was scanned over the 40-460 amu with an ionizing voltage of 70 eV and the injector temperatures were kept at 250 °C. The constituents of the oils were identified by calculation of their retention indices under programmed temperature conditions for n-alkanes (C8-C24) and the oil on a DB-1 column under the same conditions. Identification of individual compounds was made by comparison of their mass spectra with those of the internal reference mass spectra library or with authentic compounds and confirmed by comparison of their retention indices with authentic compounds or with those reported in the literature.[8]

## RESULTS

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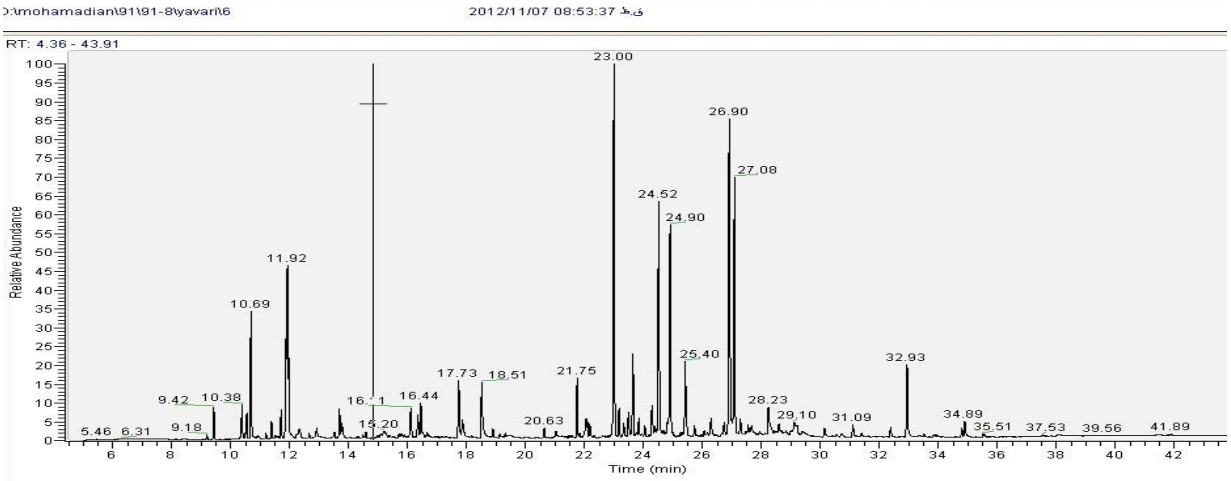


Figure 1: GC of the essential oil of *Stachys lavandulifolia*

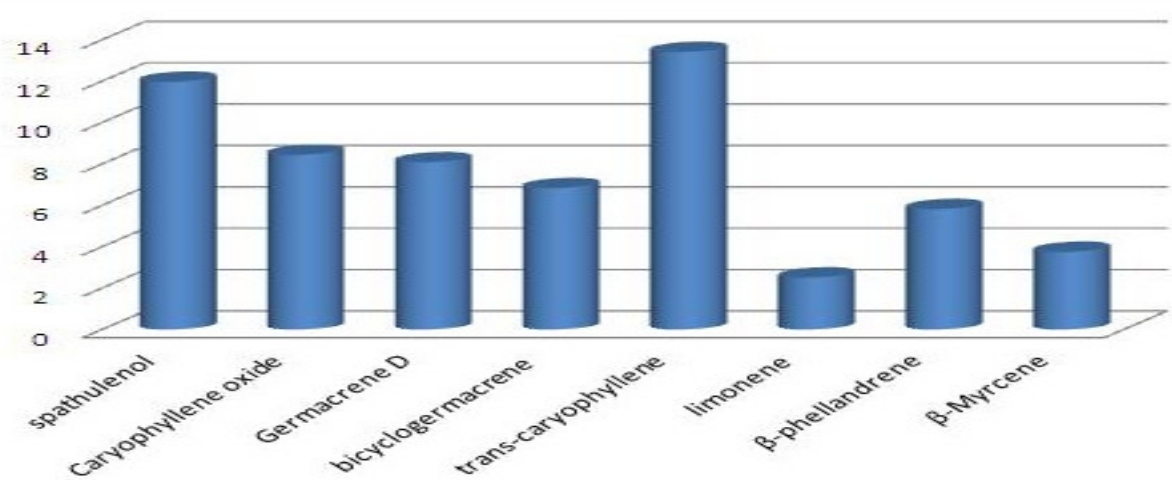


Figure 2: The major components of essential oil of *Stachys lavandulifolia*

The yield of the oil obtained from *S. lavandulifoila* was 0.17%. Table 1 reports the chemical composition of the essential oil under study. 62 components were identified, accounting for 97.46% of the total oil. The major components of the oil were Trans-Caryophyllene (13.41%), Spathulenol (11.97%), Caryophyllene oxide (8.44%), Germacrene D (8.08%), Bicyclogermacrene (6.83%), β-phellandrene (5.82%), β-Myrcene (3.75%), Limonene (2.51) (Figure 1 - 2).

## DISCUSSION

Chemical polymorphisms have been reported for many medicinal plants. The essential oils of the dried flowering aerial parts of *Stachys* L collected from Iran were isolated. *S. lavandulifolia* is a medical plant that can be a potential source of monoterpenes and sesquiterpenes According to previous studies, various components of essential oil on *S. lavandulifolia* have been reported.[9,10,11,12,13,14,15,16,17] in this reports, germacrene-D, thymol , γ-cadinene, α-pinene, trans-caryophyllene, α-terpinene, myrcene, β-phellandrene, β-pinene, Z-β-ocimene, Spathulenol, caryophyllene oxide, carvacrol, bis (2-ethylhexyl)phthalate, decane, p-Xylene, dodecane were presented as the major components of the *S. lavandulifolia* oil. In our study, the major components of the oil were Trans-Caryophyllene (13.41%), Spathulenol (11.97%), Caryophyllene oxide (8.44%), Germacrene D (8.08%), Bicyclogermacrene (6.83%), β-phellandrene (5.82%), β-Myrcene (3.75%), Limonene (2.51). it is of the interest to note that the dominant compound in the oil of *S. lavandulifolia* was Trans-Caryophyllene (13.41%). These findings were different in quantity and quality oil with each others. Several reports have indicated that extracts of *S. lavandulifolia* have favorable medical activity in a dose-dependent manner. Hydroalcoholic extracts of *S. lavandulifolia* leaves have the strong antileishmanial activities.[18] The work of Hajhashemi et al.[19] showed that *S. lavandulifolia* had an antispastic effect, so, other abortifacient mechanisms should be considered in this study. The use of *S. lavandulifolia* during pregnancy may cause abortion and consequently the plant should be considered contraindicated or be used with caution.[20]

## CONCLUSION

Growth and development of plants and quantity, quality of secondary metabolites in different ecosystems and natural habitat is effected by different environmental factors like climate conditions, altitude, soil, etc. In conclusion, S. lavandulifolia Vahl with different chemical compositions have been reported. It is known that many factors influence the chemical constitution of S. lavandulifolia Vahl oils. The differences in the quantity or quality of the oils

Table 1. Composition of the essential oil of *Stachys lavandulifolia*

| Component | RI | Area% |
|---|---|---|
| α-thujene | 930.8 | 0.09 |
| α-pinene | 940.4 | 0.79 |
| sabinene | 978.8 | 0.85 |
| β-Pinene | 985.2 | 0.66 |
| β-Myrcene | 991.2 | 3.75 |
| n-decane | 1000 | 0.09 |
| α-phellandrene | 1010.108 | 0.13 |
| d-3-carene | 1016.968 | 0.42 |
| P-Cymene | 1028.881 | 0.76 |
| Limonene | 1034.657 | 2.51 |
| β-phellandrene | 1036.462 | 5.82 |
| 1,8-Cineol | 1038.267 | 1.69 |
| γ-Terpinene | 1063.177 | 0.13 |
| cis-sabinene hydrate | 1072.202 | 0.36 |
| terpinolene | 1094.224 | 0.15 |
| linalool | 1100 | 0.86 |
| pirollene | 1103.169 | 0.63 |
| α-campholenal | 1132.042 | 0.15 |
| trans-pinocarveol | 1149.648 | 0.14 |
| trans- verbenol | 1153.521 | 0.37 |
| 4-Terpineol | 1185.563 | 0.85 |
| cryptone | 1193.662 | 0.74 |
| α-Terpineol | 1197.183 | 1.17 |
| Mytenal | 1205.054 | 0.09 |
| Z-citral (Neral) | 1243.682 | 1.99 |
| cumin aldehyde | 1248.014 | 0.8 |
| E-Citral( Geranial) | 1271.841 | 2.33 |
| phellandrene | 1285.199 | 0.23 |
| bicyclo Elemene | 1350.187 | 0.25 |
| 4a-α,7-α,7a-α-Nepetalactone | 1364.794 | 0.21 |
| α-copaene | 1392.135 | 1.72 |
| Daucene | 1395.506 | 0.14 |
| n-tetradecane | 1400.791 | 0.16 |
| β-bourbonene | 1402.767 | 0.63 |
| β-elemene | 1404.743 | 0.61 |
| trans-caryophyllene | 1441.107 | 13.41 |
| trans-α-bergamotene | 1447.431 | 0.83 |
| 6,9-Guaiadiene | 1453.755 | 0.41 |
| E-β-Farnesene | 1460.474 | 0.74 |
| Sesquisabinene | 1466.008 | 2.54 |
| α-humulene | 1474.308 | 0.52 |
| ar-Curcumine | 1491.7 | 1.02 |
| E-β-Ionone | 1495.652 | 0.31 |
| Germacrene D | 1501.245 | 8.08 |
| bicyclogermacrene | 1517.012 | 6.83 |
| δ-Cadinene | 1537.759 | 2.3 |
| cis-β-bisabolene | 1551.037 | 0.34 |
| cis-sesquisabinene hydrate | 1565.145 | 0.17 |
| E-Nerolidol | 1569.295 | 0.14 |
| spathulenol | 1600 | 11.97 |
| Caryophyllene oxide | 1607.86 | 8.44 |
| Viridiflorol | 1616.594 | 0.48 |
| humulene epoxide | 1633.188 | 0.3 |
| isospathulenol | 1658.079 | 1.06 |
| α-Cadinol | 1673.799 | 0.39 |
| Intermedeol | 1683.843 | 0.15 |
| α-bisabolol | 1696.07 | 0.62 |
| pristane | 1708.756 | 0.17 |
| 6,10,14-trimethyl-2-pentadecanone | 1848.341 | 0.28 |
| isobutyl phthalate | 1874.408 | 2.84 |
| Cembrene | 1964.078 | 0.25 |
| Dibutylphthalate | 1968.932 | 0.6 |
| Total | | 97.46 |
| Yield of the oil | | 0.17 |

composition of the present and previous studies may be because of the genetic, chemotypes, phenological stage, drying conditions, mode of distillation and geographic and climatic factors

We can say that the essential oils and their components have many uses, both in pharmacology and in food. In addition, they are endowed with interesting biological activities and have a therapeutic potential. For example, essential oils exhibit antimicrobial activities, antiviral activities with broad spectrum, and may be useful as natural remedies and it seems that essential oils can be used as a suitable therapy for many pathologies. In the cosmetic and in the food industry, essential oils uses are an integral part, as they may play different roles. Therefore, economic importance of essential oils is indisputable. It appears therefore imperative to preserve our natural, diverse flora and support its protection in order to keep this inexhaustible source of molecules destined for multiple targets.

*S. lavandulifolia* with different chemical compositions have been reported. It is known that many factors influence the chemical constitution of *S. lavandulifolia* oils. We have shown that the volatile oil composition of *S. lavandulifolia*, in Iran is extremely variable. The composition of the essential oil of *S. lavandulifolia* depends on many factors of genetic, environmental and their interaction effects, such as plant part, harvest-time, extraction-method, ecotype and geographic origin (climate, edaphic, elevation and topography). With regard to the wide distribution of *S lavandulifolia* in Iran can explain that this species in different ecological conditions will be exiting chemical components.

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