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# GC and GC-MS analysis of essential oil from leaves and flowers of *Ocimum urticifolium*

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**Abstract**

Volatile fractions from leaves (0.21 %) and flowers (0.48 %) of *Ocimum urticifolium* Roth were analysed by GC and GC-MS. Twenty-seven compounds comprising 89.0 % of the leaves oil and fifty-five compounds representing 63.9 % of the flower oil have been characterised. The main sesquiterpenes found in the leaf oil were δ-cadinene (17.2 %) followed by β-caryophyllene (14.5 %) and γ-muurolene (10.5 %), while the monoterpene (*Z*)-β-ocimene (22.7 %) and the phenylpropanoid elemicine (8.8 %) were detected as other major oil components. In flower oil, β-bisabolene (19.2 %) and β-caryophyllene (10.5 %) were the main sesquiterpenes while linalool (2.3 %), (*Z*)-β-ocimene (2.4 %) and camphor (1.5 %) were major monoterpenic hydrocarbons beside elemicine (6.4 %). The presence of elemicine, a biologically active phenylpropanoid compound in these oils is significant.

**Key words:** *Ocimum urticifolium*, essential oil, gas chromatography-mass spectrometry (GC-MS), monoterpenes, sesquiterpenes.

## Introduction

*Ocimum urticifolium* Roth, traditionally called Zulu basil in South Africa, is a herbaceous medicinal plant growing wild in Africa and has been reported from several countries such as Swaziland, Zimbabwe, Tanzania, Rwanda, Kenya and Nigeria. *O. urticifolium* is also a native plant of the Ethiopian highlands [9] and grows at high altitude between 2200 and 2300 m.

The essential oil of *O. urticifolium* and the variation of its composition due to pedological factors and altitudinal location has been reported from species found in Rwanda [1,5, 8] and Zimbabwe [2]. Ethnobotanical studies from Ethiopia describe the plant's medicinal use against the febrile disease MICH [3], its termite control property [4] and antimicrobial activity [5]. Chagonda and co-workers [2] gave a detailed essential oil description of *O. urticifolium* samples from Zimbabwe with the main components of linalool, α-farnesene, eugenol, (*Z*)- and (*E*)-ocimene, β-elemene, caryophyllene and elemicine, while investigation Rwandian plants report eugenol, methyleugenol methylisoeugenol as the main constituents [1]. To best of our knowledge, the essential oil of *urticifolium* from Ethiopia has not been investigate far. The aim of this study is to determine the chem constituents present in the volatile fractions from lea and flowers of *O. urticifolium*.

## Materials and methods

Aerial parts of flowering *Ocimum urticifol* Roth were collected from Gudar town, West S region, Ethiopia in early November 2001. The m soil type for the area where *O. urticifolium* collected from, was a stonic phase chromic luvisol, the mean annual temperature and rainfall are 15.1- °C and 1,333 mm, respectively [6]. Mr. Mel Wondifrash of the National Herbarium, Departme

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Biology, Addis Ababa University, where a herbarium specimen has been deposited, authenticated the specimen collected. Leaves and flowers of the plant were separated and used fresh for this analysis. 500 g each of the fresh leaf or flower material was hydrodistilled in duplicates for 2 hours in a modified Dean and Stark apparatus.

The essential oils were analysed by GC and GC-MS. The following capillary columns were used in the analysis: a semipolar Chrompack CP-Wax 52CB (fused silica, 30 m x 0.32 mm i.d. with a film thickness of 0.25 µm) and an unpolar DB-5 (30 m x 0.25 µm i.d. with a film thickness of 0.25 µm). The carrier gas was He (5 & 12 psi for the Chrompack and DB-5 columns respectively) at 50 ml/min through the injector and 30 cm/sec through the column. Injector temperature was 220 °C for all the analyses done. The GC temperature program was 40-220 °C at a rate of 3 °C /min and a hold up at 220 °C for 3 minutes. A Varian Star 3400 CX gas chromatograph coupled with a Varian Saturn 3 mass spectrometer were used for the analysis. The MS detector was set at 175 °C and a mass range of 40-400 (m/z) was recorded. All mass spectra were acquired in EI mode. The compounds in the volatile fraction were identified by the use of a combination of mass spectrum database search (IMS Terpene Library, 1989; NIST MS Database, 1992 & 1998), the relative retention index (ESO Database of Essential oils, 1999) and comparison of mass spectra. Relative retention indices on Chrompack and DB-5 columns were calculated by co-injecting a series of aliphatic hydrocarbons (C12-C25). Quantitative analysis (in %) was performed by peak area normalization measurements (TIC= total ion count). The compounds detected are listed in the increasing order of their retention index on a DB-5 column (Table-1).

**Table-1. Chemical constituents of essential oils of *Ocimum urticifolium***

| Name of compound | KI | Leaf oil | Flower oil |
|---|---|---|---|
| α-Pinene | 319 | 0.03 | 0.07 |
| Camphene | 340 | 0.03 | 0.27 |
| β-Pinene | 386 | 0.47 | 0.07 |
| β-Myrcene | 408 | 0.03 | 0.07 |
| *o*-Cymene | 465 | - | 0.07 |
| *p*-Cymene | 471 | 0.03 | 0.07 |
| Limonene | 481 | - | 0.07 |
| 1,8-Cineole | 485 | 0.03 | 0.13 |
| (*Z*)-β-Ocimene | 498 | 22.65 | 2.40 |
| (*E*)-β-Ocimene | 519 | 1.83 | 0.07 |
| Eucarvone | 604 | - | 0.07 |
| Terpinolene | 608 | 0.03 | - |
| Linalool | 632 | 1.00 | 2.34 |
| Camphor | 734 | 0.10 | 1.53 |
| Borneol | 789 | - | 0.07 |
| 4-Terpineol | 820 | - | 0.07 |
| α-Terpineol | 852 | - | 0.07 |
| *iso*-Dihydrocarveol | 913 | - | 0.07 |
| Thymol methylether | 968 | - | 0.07 |
| α-Cubebene | 1267 | 0.17 | 0.20 |
| Ylangene | 1322 | - | 0.07 |
| α-Copaene | 1334 | 2.63 | 2.07 |
| β -Patchoulene | 1345 | - | 0.20 |
| β -Bourbonene | 1355 | 1.47 | 0.93 |
| β -Cubebene | 1371 | 1.53 | 0.60 |
| β-Elemene | 1375 | - | 0.47 |
| Methyl eugenol | 1403 | - | 0.20 |
| β-Caryophyllene | 1442 | 14.49 | 10.54 |
| β-Gurjunene | 1475 | - | 0.34 |
| α-Himachalene | 1512 | - | 0.07 |
| Aromadendrene | 1525 | 0.43 | 0.07 |
| α-Caryophyllene | 1527 | 1.37 | 1.01 |
| *allo*-Aromadendrene | 1546 | - | 0.80 |
| γ-Gurjunene | 1575 | - | 0.07 |
| γ-Muurolene | 1586 | 10.49 | 0.47 |
| Germacrene D | 1594 | - | 2.94 |
| Valencene | 1624 | 0.13 | 0.07 |
| Viridiflorene | 1628 | 1.93 | 0.13 |
| Germacrene B | 1632 | - | 0.40 |
| α-Muurolene | 1643 | - | 0.33 |
| β-Bisabolene | 1661 | 0.13 | 19.21 |
| (1S, Z)-Calamenene | 1695 | - | 0.13 |
| δ-Cadinene | 1700 | 17.18 | 1.20 |
| β-Sesquiphellandrene | 1702 | - | 0.20 |
| (*E*, γ)-Bisabolene | 1721 | - | 0.07 |
| Elemicine | 1772 | 8.82 | 6.40 |
| (*E*)-Nerolidol | 1796 | - | 0.74 |
| Spathulenol | 1825 | 0.93 | 0.47 |
| Globulol | 1841 | 0.27 | 0.67 |
| Viridiflorol | 1859 | 0.83 | 0.27 |
| Cubenol | 1944 | - | 0.54 |
| τ-Muurolol | 1976 | - | 0.74 |
| δ-Cadinol | 1984 | - | 0.67 |
| α-Cadinol | 2003 | - | 1.93 |
| (Z, α)-Santalol | 2061 | - | 0.34 |
| 3,4,5-Trimethoxy benzaldehyde | 2265 | - | 0.74 |

KI Kováts indices on a DB-5 capillary column.
- not detected

## Results and discussion

The volatile fractions obtained from the flowers (0.48 %) and the leaves (0.21 %) contained fifty-five (63.9 %) and twenty-seven (89.0 %) compounds, respectively. Sesquiterpenes were the most abundant compounds in both fractions. However, high portions of distinct monoterpene compounds were also observed to be present in the hydrodistillates. Only two of the commonly occurring essential oil volatiles in the genus *Ocimum* such as linalool and β-caryophyllene [7] were detected in significant amounts in *O. urticifolium*.

All the compounds detected in the leaf essential oil except terpinolene, were also detected in the flowers. The major terpene constituent in the hydrodistillate of the flowers was β-bisabolene (19.2 %). Monoterpenes such as (*Z*)-β-ocimene, linalool, camphor, 1,8-cineole and sesquiterpenes such as β-caryophyllene, germacrene D, δ-cadinene and α-cadinol were also observed to be present in appreciably large quantities in the flower essential oil. The phenylpropanoid methyl eugenol could only be detected in trace amounts in contrast to earlier results [1], whereas elimicine was detected in comparable concentrations in flower and leaf essential oil [2]. (*Z*)-β-ocimene, β-caryophyllene and δ-cadinene were observed to be the major essential oil compounds of the leaves. In contrast to recently published results [2], the *trans*-form of ocimene was only detected in minor amounts in leaf and flower oil.

A total of fifty-six compounds were detected in *Ocimum urticifolium*, but several peaks of the complex flower hydrodistillate remained unidentified. Besides the main essential oil constituents, the presence of the phenylpropanoid elemicine (8.8 and 6.4 %, respectively) especially underscores the potential biological activity of *Ocimum urticifolium* essential oil. Based on the presented data and earlier results [1, 2], the chemotypical and morphological variation of the essential oil emphasizes the necessity of further investigations of this species.

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