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SHORT COMMUNICATION

VOLATILE LEAF OIL CONSTITUENTS OF *OCIMUM AMERICANUM* L. OCCURING IN WESTERN KENYA

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ABSTRACT. Steam distilled volatile oils from the leaves of *Ocimum americanum* L. growing in Western Kenya were analysed by GC and GC-MS. A total of 36 compounds, representing a total of 88.51% of the total oil, were identified. The oil was classified as terpinen-4-ol-type according to the terpinen-4-ol content (43.21%). To the best of our knowledge this chemotype of *O. americanum* has not yet been reported from the East African region. This chemotype of *O. americanum* has only been reported from Togo. Other notable components include 1,8-cineole (16.13%), α-terpineol (4.01%), *trans*-caryophyllene (3.06%), α-bergamotene (2.68%) and *cis*-sabinene hydrate (2.59%). The oil contains mainly oxygenated monoterpenes which accounted for 71.24% of the total oil. The yield obtained was 4% w/w on a dry weight basis.

KEY WORDS: *Ocimum americanum*, Lamiaceae, Chemotype, Terpinen-4-ol, 1,8-Cineole, ∝-Terpineol, *trans*-Caryophyllene, Kenya

INTRODUCTION

The genus *Ocimum* of the family Lamiaceae (Labiatae) includes at least 60 species and numerous varieties [1]. It undergoes abundant cross-pollination resulting in large numbers of sub-species and varieties, which differ in essential oil composition and morphological characteristics. Therefore, the taxonomy of the group is difficult. It represents an important source for essential oils and is used in food, perfumery and cosmetic industries. *Ocimum americanum* L. (syn. *O. canum* Sims) is a resilient shrub unattacked by most plant pests and animal predators.

Previous studies on this plant report the occurrence of seven chemotypes in view of the qualitative and quantitative differences in the chemical composition of its essential oils. The essential oil of the chemotype from Africa, the Commodore Islands and the French Congo have methyl cinnamate as the major constituent, whereas the oil from plants growing in the USA and Nigeria showed eugenol in high contents, and the oil of plants from Somalia, Zimbabwe and India have camphor as the main constituent. Other chemotypes of *americanum* contain mainly fenchone, limonene, methyl chavicol and α-terpineol [2-5].

Some *Ocimum* spp. are used in traditional medicine for different applications, especially in many Asian and African countries [6]. *O. americanum* L. is used in the traditional system of medicine to treat conjunctivitis, malaria and headache. It has been reported in Somalia for its essential oils, flavones and triterpenic acids and is used for flavouring foods and in traditional medicine [7, 8]. In South Africa, it is often referred to as camphor basil [9]. In Zimbabwe, its traditional uses range from flavour and fragrance, to insect repellence and as a preservative for corpses [9-12].

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O. americanum L. is also grown in parts of India for flavour and fragrance industry and as a source of natural camphor, since the plant was introduced there from Kenya in the second World War [13]. However, there is little data available about the chemical characterization of the essentials of the O*cimum* species growing in Kenya.

This paper deals with the results of chemical analysis of the oil obtained from the leaves of O*cimum americanum* L. growing in Western Kenya.

EXPERIMENTAL

*Plant material***.** The leaves of *O. americanum* were collected in the month of August 2003 from Suba and Rachuonyo Districts of Western Kenya. The plants were identified at the Botany Department, Egerton University, Kenya, where a voucher specimen was deposited.

Essential oil extraction, GC and GC-MS analyses. The leaves were air-dried under shade to constant weight and ground to a fine powder using a laboratory electric mill. The essential oil obtained by steam distillation using a modified clevenger-type apparatus had a pale yellow colour with a yield of 4% w/w on a dry weight basis.

The relative proportions of the essential oil constituents were expressed as percentages obtained by peak area normalization, all relative response factors being taken as one.

It was analysed on an Agilent GC-MSD apparatus equipped with Rtx-5sil MS ("Restek") (30 m x 0.25 mm i.d., 0.25 μm film thickness) fused-silica capillary column. Helium (at 0.8 mL/min) was used as a carrier gas. The injector was kept at 250 ^{o}C and the transfer line at 280 ^{o}C. The column was maintained at 50 ^{o}C for 2 min and then programmed to 260 ^{o}C. The MS was operated in the EI mode at 70 eV in the *m/z* range 42-350.

Identification of the compounds. The identification of the compounds was performed by comparing their retention indices and mass spectra with those obtained from authentic samples or with those found in literature [14] and supplemented by Wiley Libraries.

RESULTS AND DISCUSSION

In the oil of *O. americanum* analysed within this study, 36 components were identified which represent 88.51% of the whole oil. Of the 36 compounds identified, 10 were aliphatic hydrocarbons.

The main component was terpinen-4-ol (43.21%), followed by 1,8-cineole (16.13%) and α-terpineol (4.01%). Other constituents present in appreciable amounts are *cis*-sabinene hydrate (2.59%), α-bergamotene (2.68%) and *trans*-caryophyllene (3.06%).

This oil contains mainly oxygenated monoterpenes which accounted for 71.24% of the oil with 18 components identified, while the non-oxygenated ones represent about 5.76% of the oil. This oil presented a very complex monoterpene fraction. The sesquiterpene and aliphatic hydrocarbons represent 8.13 and 3.58% of the total oil, respectively. Within this sesquiterpene fraction, only 1.1% was oxygenated. However, *O. americanum* oil with 10 components is qualitatively rich in aliphatic hydrocarbons but not quantitatively. In Table 1 we report the detailed identification and percentages of the volatile oil.

Table 1. Percentage composition of essential oil of *Ocimum americanum* L. from Western Kenya.

No.	Components	RI	Composition (%)	Method of identification
1	α-Thujene	935	0.23	RI, GC-MS
2	α-Pinene	938	0.46	RI, GC-MS
3	β-Pinene	978	0.39	RI, GC-MS
4	β-Myrcene	991	0.58	RI, GC-MS
5	α-Terpinene	1018	0.42	RI, GC-MS
6	*p*-Cymene	1029	0.29	RI, GC-MS
7	*l*-Limonene	1031	0.80	RI, GC-MS
8	**1,8-Cineole**	1034	**16.13**	RI, GC-MS
9	**γ-Terpinene**	1062	**2.59**	RI, GC-MS
10	***cis*-Sabinene hydrate**	1068	**1.94**	RI, GC-MS
11	α-Terpinolene	1089	0.34	RI, GC-MS
12	***l*-Linalool**	1097	**1.42**	RI, GC-MS
13	***trans*-Sabinene hydrate**	1109	**1.48**	RI, GC-MS
14	Oct-1-en-3-ylacetate	1114	0.53	RI, GC-MS
15	z-β-Terpineol	1120	0.46	RI, GC-MS
16	*Trans*-pinene hydrate	1137	0.37	RI, GC-MS
17	Camphor	1143	0.71	RI, GC-MS
18	δ-Terpineol	1170	0.38	RI, GC-MS
19	**Terpinen-4-ol**	1177	**43.21**	RI, GC-MS
20	**α-Terpineol**	1191	**4.01**	RI, GC-MS
21	Myrtenyl acetate	1312	0.26	RI, GC-MS
22	***Trans*-Caryophyllene**	1420	**3.06**	RI, GC-MS
23	***Trans*-α-Bergamotene**	1430	**2.68**	RI, GC-MS
24	Aromadendrene	1438	0.67	RI, GC-MS
25	Pentadecane	1498	0.28	RI, GC-MS
26	δ-Guaiene	1500	**1.43**	RI, GC-MS
27	Nerolidol	1566	0.29	RI, GC-MS
28	Heptadecane	1700	0.33	RI, GC-MS
29	Nonadecane	1900	0.51	RI, GC-MS
30	10-Methyleicosane	2000	0.31	RI, GC-MS
31	Docosane	2200	0.31	RI, GC-MS
32	Octacosane	2800	0.30	RI, GC-MS
33	Dotriacontane	3200	0.32	RI, GC-MS
34	Tetratriacontane	3400	0.40	RI, GC-MS
35	Pentatriacontane	3500	0.31	RI, GC-MS
36	Hexatriacontane	3600	0.31	RI, GC-MS
	Total		**88.51%**	

RI- Retention indices (Kovat indices).

Terpenes, the main constituents of essential oils, play an important role in insect communication systems offering prospects of opportunities for manipulating pests [17]. In the light of this, investigations on essential oils and their isolates have revealed their great potential as insect and pest control agents [16, 17]. The monoterpene 1,8-cineole, which is a constituent of the oil here analysed has been shown to be involved in cases of both direct plant defence [18, 19], and pollination [20]. It has also been reported in allelopathic effects as toxic, deterrent or inhibitory compounds [21], repellency and toxicity against three storage pests; C*allosobruchus maculatus* F., *Rhyzopertha dominica* F., and *Sitophilus oryzae* L. [22].

The qualitative and quantitative composition of this oil differs considerably from other *O. americanum* described in literature [23, 24], in which methyl cinnamate and geranial were the main components.

According to the terpinen-4-ol content, this oil could be classified as terpinen-4-ol type which to the best of our knowledge has not yet been reported from the East African region, but literature [25] shows that this chemotype has been observed in Togo.

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