

CHEMICAL COMPOSITION OF THE ESSENTIAL OIL OF *Cyclotrichium depauperatum*

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Four species of the genus *Cyclotrichium* (Lamiaceae) are found in the flora of Iran, of which *C. haussknechtii* (Bunge) Manden. & Scheng., *C. straussii* (Bornm.) Rech. f., and *C. depauperatum* (Bunge) Manden. & Scheng. are endemic. Another species, *C. leucotrichum* (Staph ex Rech. f.) Leblebici, is growing in Iran, Iraq, and southeast of Turkey [1].

The chemical constituents of the essential oil of several *Cyclotrichium* species have been previously studied. Pulegone, pinocamphone, β -caryophyllene, *cis*-isopulegone, and 1,8-cineole are reported as the major components of the essential oil of *C. niveum* [2], *C. stamineum*, *C. leucotrichum* [3], *C. organifolium* [4], and *C. glabrescens* [5], respectively.

All *Cyclotrichium* species are Irano-Turanian elements except for *C. organifolium* which is an East Mediterranean Mountain element growing at high altitudes and is also found in Lebanon [6].

C. depauperatum is known as "Reihani" in Persian [1]. The plant is one of the Iranian endemic species which can be found in the southwestern part of the country [7]. According to the literature, *C. depauperatum* has not been the subject of research up to now. In continuation of our investigations of the chemical composition of the essential oils obtained from various aromatic species growing in Iran, the chemical composition of the essential oil from *C. depauperatum* is reported for first time.

Aerial parts of *C. depauperatum* were collected from Khuzestan Province in June at an altitude of 2100 m. The plant identity as *C. depauperatum* was confirmed by the Botany Department of Isfahan University, Isfahan, Iran. A voucher specimen of the plant was deposited in the herbarium of the Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan, Iran.

The air-dried aerial parts of *C. depauperatum* were reduced to a coarse powder and the oil was isolated by hydrodistillation using a Clevenger-type apparatus for 3 h. The oil was subsequently dried over anhydrous sodium sulfate.

The aerial parts of *C. depauperatum* yielded 0.3% (v/w) of a yellowish oil with an aromatic odor. Forty-six components were detected in the essential oil of *C. depauperatum*. The identified components and their percentages are given in Table 1, where the components are listed in the order of their elution on the HP-5 column. As can be seen, the major components of the oil are *cis*-pinocamphone (19.1%), pulegone (9.8%), linalool (9.4%), *cis*-isopulegone (9.3%), linalyl acetate (8.8%), menthone (4.5%) and α -terpinyl acetate (3.4%).

The oil of *C. depauperatum* consisted of eleven monoterpene hydrocarbons (5.8%), twenty oxygenated monoterpenes (80.6%), seven sesquiterpene hydrocarbons (7.1%), and seven oxygenated sesquiterpenes (3.2%).

GC/MS analysis was carried out on a Hewlett-Packard 6890 gas chromatograph fitted with a fused silica HP-5MS capillary column (30 m \times 0.25 mm; coating thickness 0.25 μ m). The oven temperature was programmed from 60–280°C at 4°C/min. Helium was used as a carrier gas at a flow rate of 2 mL/min. The gas chromatograph was coupled to a Hewlett-Packard 5972 mass selective detector. The MS operating parameters were: ionization voltage, 70 eV; ion source temperature, 200°C. Identification of components of the essential oil was based on retention indices relative to *n*-alkanes and computer matching with the WILEY275.L library, as well as by comparison of the fragmentation patterns of the mass spectra with those reported in the literature [8–9].

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TABLE 1. Composition of the Essential Oil of *Cyclotrichium depauperatum*

RI	Compound	%	RI	Compound	%
941	α -Pinene	0.1	1273	Geranial	0.1
978	Sabinene	0.4	1293	Thymol	0.6
982	β -Pinene	1.6	1301	Carvacrol	0.2
993	Myrcene	0.5	1336	Bicycloelemene	0.5
1021	α -Terpinene	0.4	1350	α -Terpinyl acetate	3.4
1028	<i>p</i> -Cymene	0.3	1355	Citronellyl acetate	1.3
1033	Limonene	0.8	1358	Eugenol	0.1
1035	1,8-Cineole	0.7	1364	Neryl acetate	0.9
1041	<i>cis</i> - β -Ocimene	0.1	1382	Geranyl acetate	1.4
1052	<i>trans</i> - β -Ocimene	0.3	1416	(<i>E</i>)-Caryophyllene	1.7
1063	γ -Terpinene	1.1	1452	α -Humulene	0.2
1070	<i>cis</i> -Sabinene hydrate	2.5	1459	<i>allo</i> -Aromadendrene	0.4
1090	Terpinolene	0.2	1477	Germacrene-D	2.1
1100	Linalool	9.4	1491	Bicyclogermacrene	1.9
1157	Menthone	4.5	1520	δ -Cadinene	0.3
1163	<i>trans</i> -Pinocamphone	2.3	1571	Germacrene-D-4-ol	0.4
1176	<i>cis</i> -Pinocamphone	19.1	1573	Spathulenol	1.2
1184	<i>cis</i> -Isopulegone	9.3	1578	Caryophyllene oxide	0.3
1193	α -Terpineol	2.9	1628	γ -Eudesmol	0.1
1197	Myrtenol	2.1	1636	T-Cadinol	0.5
1231	Citronellol	1.2	1637	<i>epi</i> - α -Muurolol	0.1
1240	Pulegone	9.8	1642	α -Muurolol	0.6
1259	Linalyl acetate	8.8	1670	Unknown ^a	2.8

^aMS, 70 eV, 200°C, *m/z* (rel. int.): 222 [M]⁺ (5), 204 (6), 161 (20), 121 (22), 109 (31), 105 (23), 84 (100), 67 (36), 55 (57), 41 (89).

RI: retention indices on HP-5 capillary column.

%: calculated from TIC data.

Previous studies on the essential oil of members of *Cyclotrichium* genus have shown a number of similar terpenic compounds. The oil of *C. depauperatum* also contains the monoterpenes usually found in the *Cyclotrichium* oils. Pinocamphone, the dominant compound of the essential oil of *C. depauperatum*, was reported as the major components of the essential oil of *C. stamineum* [3]. According to the available data, it can be concluded that the constituents of the essential oil of *C. depauperatum* is similar to the composition of other *Cyclotrichium* species.

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