CHEMICAL COMPOSITION OF THE ESSENTIAL OIL OF *Tanacetum turcomanicum* AND *T. canescens* FROM IRAN

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The genus *Tanacetum* belongs to the family compositae and contains ca. 200 species distributed over Europe and West Asia [1]. In the flora of Iran this genus is represented by 26 species of which 12 are endemic [2, 3]. The biology and chemistry of the genus *Tanacetum* have been investigated [4]. Feverfew *T. parthenium* has been used since ancient times for medicinal purposes and has gained considerable prominence recently due to its ability to alleviate the symptoms of migraine [5–8], arthritis, and psoriasis [9], and to inhibit blood platelet-aggregation [10]. Parthenolide and a large number of related sesquiterpene lactones, which are typical constituents of this genus, were isolated from *Tanacetum* species. Parthenolide is also present in *T. vulgare*. There are several reports on the antibacterial activity of the essential oil of *T. vulgare* [10, 11]. Rustaiyan et al. have extracted several germacranolides from the aerial parts of *T. polycephalum* [12]. The terpenoid constituents of *T. cilicum, T. corymbosum*, and *T. macrophyllum* are considered to be responsible for the anticoagulant and antifibrinolytic properties of these species [13].

To the best of our knowledge, the essential oil composition of *T. turcomanicum* and *T. canescens* has not been investigated previously. This is the first report on the essential oils of these species.

Hydrodistillation of the plants of *T. turcomanicum* (leaves) and *T. canescens* (aerial part) gave a yellow oil in a yield of 0.4% and 0.3% (w/w), respectively based on the dry weight of the plant. The qualitative and quantitative essential oil compositions are presented in Tables 1 and 2, where the compounds are listed in the order of their elution from DB-1 column. The oil of *T. turcomanicum* is characterized by a high content of *trans*-chrystanthenyl acetate (19.2%), *trans*-thujone (13.5%), chrysanthemone (11.2%), and camphor (7.3%) as the major constituents, followed by α-pinene (2.9%), thymol (2.21%), and 1,8-cineole (2.0%). The oxygenated monoterpenes comprise 66.9% of the total oil and are the most predominant fraction of the oil; after that, oxygenated sesquiterpenes comprise 7.6% of the oil, and monoterpene hydrocarbons constituted 3.7%.

1,8-Cineole was determined to be present at a high percentage (22.2%). The presence of α-pinene (14.9%), *l*-borneol (11.9%), β-eudesmol (8.4%), and α-terpinol (6.0%) is also important for the oil profile. The oxygenated monoterpene fraction comprises 51.4% of the total oil, of which 1,8-cineole and borneol are in appreciable percentage. The hydrocarbon monoterpenes and oxygenated sesquiterpenes comprise 22.9% and 14.5% of the total oil, respectively.

A comparison of the data in this paper with those in the literature for other species of *Tanacentum* shows that oxygenated monoterpenes were in considerable amounts in *T. turcomanicum* and *T. canescens*, in yields of 66.9% and 51.4%, respectively.

The constituents of the essential oils of some other *Tanacetum* species from Iran such as *T. polycephalum, T. balsamita, T. khorassanicum,* and *T. fruticulosum* have already been reported by O. O. Thomas in the number of papers [14]. Previous reports of the other *Tanacetum* species manifested varying compositions. The major components of the leaf essential oil of *T. vulgare* L. var. *vulgare* collected in 20 habitats from Lithuania were divided into four groups, with 1,8-cineole (23.6–46.3%, 11 oils), *trans*-thujone (35.7–78.4%, 6 oils), camphor (19.8–61.8%, 17 oils), and myrtenol (13.1–24.9%, 6 oils) as the main constituents [15].

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TABLE 1. Chemical Composition of the Essential Oil from *Tanacetum turcomanium*

Compound	RI	Percentage	Compound	RI	Percentage
α-Pinene*	939	2.9	*cis*-Verbenyl acetate	1282	1.3
Camphene	954	0.5	*iso*-Bornyl acetate	1285	3.3
β-Pinene*	979	0.3	Thymol*	1290	2.2
1,2,4-Trimethyl benzene	998	0.3	Decanoic acid	1345	0.4
1,8-Cineole*	1031	2.0	Eugenol*	1356	0.1
Filifolone	1095	2.9	2-Undecenyl acetate	1380	0.1
cis-Thujone	1102	0.7	Hotrienyl acetate	1396	4.5
trans-Thujone	1114	13.5	Davana furan	1414	6.9
Chrysanthenone	1123	11.2	*trans*-Nerolidol	1564	0.2
Isothujol	1133	0.5	Spathulenol	1576	0.1
Camphor*	1143	7.3	2-*tetra*-Decyne	1620	0.6
Verbenol	1144	0.2	Tetradecanoic acid	1719	0.3
Pinocarvone	1162	0.5	9-Octadecanoic acid	1790	0.2
Borneol*	1165	1.0	Farnesyl acetone	1818	0.4
Umbellulone	1171	1.0	Palmitic acid	1946	1.1
Terpin-4-ol	1177	0.9	9,12,15-Octadecanoic acid, methyl ester (Z,Z,Z)	1990	0.3
Myrtenol	1193	0.1	Total		87.0
trans-Chrysanthenyl acetate	1235	19.2			

Identification method: RI, MS; * - RI, MS, Co-I.

TABLE 2. Chemical Composition of the Essential Oil from *Tanacetum canescens*

Compound	RI	Percentage	Compound	RI	Percentage
α-Pinene*	956	14.9	*cis*-Jasmone	1394	0.2
Camphene	968	1.0	β-Caryophyllene	1447	0.3
Sabinene	988	0.2	9-epi-β-Caryophyllene	1468	0.1
β-Pinene*	998	5.9	Germacrene D	1508	2.5
p-Cymene	1037	0.3	Valencene	1514	0.1
1,8-Cineole*	1049	22.2	Ledene	1525	2.1
γ-Terpinene*	1070	0.6	δ-Cadinene	1546	0.4
Linalool*	1104	0.9	Elemol	1564	0.7
α-Campholenal	1127	0.5	*trans*-Nerolidol	1573	0.2
Camphor*	1149	4.6	Spathulenol	1601	3.0
Pinocarvone	1165	0.5	Caryophyllene oxide*	1605	0.3
Borneol*	1178	11.9	Guaiol	1654	1.6
4-Terpineol	1191	2.6	β-Eudesmol	1678	8.4
α-Terpineol	1204	6.0	α-Bisabolol	1699	0.1
Myrtenol	1208	0.2	Farnesyl acetone	1853	0.2
Berbenone	1212	0.1	Palmitic acid	1975	1.0
trans-Carveol	1223	0.2	Methyl linoleate	2096	0.3
Bornyl acetate	1293	0.1	Total		94.2

Identification method: RI, MS; * - RI, MS, Co-I.

The oil of other species has also been analyzed, and *cis*-thujone was found to be the main component of *T. argyrophyllum* (C. Koch.) Tzvel. var. *argyrophyllum* (69.9%), whereas camphor (56.9%) was the main component of *T. parthenium* (L.). Schultz Bip. [16]. The oil of *T. polycephalum* was studied and its main components were reported to be camphor (59.1%), camphene (14.9%), and 1,8-cineole (7.8%). The oil of *T. fruticulosum* Ledeb was analyzed and contains mainly monoterpenes such as 1,8-cineole, camphor, lavandulol, and lavandulol acetate [17]. Considerable amounts of *cis*-thujone (about 12%) have been found in the essential oils of *T. argenteum* subsp. *canum* var. *canum* and *T. balsamita* [18, 19]. *Trans*-chrysanthenyl acetate and camphor are considered characteristic constituents of *T. parthenium* essential oil [20, 21].

TABLE 3. Antimicrobial Activity of the Oils

Test organism	Inhibition zone[a]	
	T. turcomanicum	*T. canescens*
Staphylococcus aureus	12	15
Bacillus subtilis	17	14
Escherichia coli	-	12

[a]Diameter of inhibition zones (mm) including diameter of sterile disk (6 mm) (-), Inactive; (7-14), moderately active; (>14), highly active.

As can be seen in Table 3, the essential oil of *T. turcomanicum* showed maximum inhibitory activity against *B. subtilis* and moderate activity against *S. aureus*, but no noteworthy activity was detected against *E. coli.* The essential oil of *T. canescens* indicated significant activity, with inhibition zones about 15 and 14 mm against *S. aureus* and *B. subtilis*, respectively, and showed moderate activity against *E. coli*.

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