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Turgut KILIÇ
Science Education Department, Faculty of Necatibey Education, Balikesir University, Balikesir, Turkey

Tuncay DİRMENCİ
Biology Education Department, Faculty of Necatibey Education, Balikesir University, Balikesir, Turkey

Sema ÇARIKÇI
Chemistry Department, Faculty of Arts & Science, Balikesir University, Balikesir, Turkey

Ahmet Ceyhan Gören
Chemistry Department, TUBİTAK - UME, Gebze-Kocaeli, Turkey

Correspondence
Turgut KILIÇ
Science Education Department, Faculty of Necatibey Education, Balikesir University, Balikesir, Turkey

Chemical composition of *Lophanthus turcicus* Dirmenci, Yıldız & Hedge. Essential oil from Turkey

Turgut KILIÇ, Tuncay DİRMENCİ, Sema ÇARIKÇI and Ahmet Ceyhan Gören

Abstract
Aerial parts of *Lophanthus turcicus* Dirmenci, Yıldız & Hedge. were subjected to hydrodistillation and the obtained oil was analyzed by GC and GC-MS. Thirty-six compounds were identified representing 96.4% of the total oil, and the main compounds were found to be spathulenol (14.3%), globulol (13.8%), ledene (11.8%) and pulegone (10.2%). The oil was consisted of sesquiterpenes abundantly and species is a new source of oxygenated sesquiterpenoids.

Keywords: *Lophanthus turcicus*, essential oil, sesquiterpenoids, spathulenol, globulol, α-cadinol

1. Introduction
The genus *Lophanthus* Adans contains twenty-two (22) species distributed in Turkey, Iran, Afghanistan, Central Asia, Mongolia, and China. Its species grow in all alpine or high alpine regions from 2000 to 4400 m [1-6]. The genus is divided to two sections: *Lophanthus* (11 species) and *Psilonepeta* (Benth.) A.L. Budantzev (Syn.: *Nepeta* sect. *Psilonepeta p.p.*) (11 species) [1, 7]. The genus *Lophanthus* is recorded for the first time from Turkey [7]. Specimens collected from Van province, East Anatolia, are described as the new species *Lophanthus turcicus* Dirmenci, Yıldız & Hedge. *L. turcicus* included in section *Psilonepeta*. The discovery of *L. turcicus* is a significant and disjunct extension of the range of the genus, and its most western locality [7].
There are limited publications on the chemical composition of the genus *Lophanthus.* Uses of the aerial part of *L. chinensis* Benth in Tibetan medicine for treatment of cardiovascular and central nervous system disorders was reported [8]. Polysaccarides [9] and phenolics and flavonoid contents have been investigated from *L. chinensis* Benth [9]. There is no study on the chemical composition of *L. turcicus* in the literature.

2. Materials and methods
2.1 Plant material
Aerial parts of *Lophanthus turcicus* were collected during the flowering stage in July, 2009 from Van (Çatak, Kavuşşahap mountain, 2750 m), Turkey. The voucher specimens were deposited in the Herbarium of ISTE (Herbarium No: 93134) and Department of Biology Education, Necatibey Education Faculty, Balıkesir University, Turkey (Dirmenci 3707).

2.2Isolation of Essential oil
Fresh plant material (250 g) was chopped and subjected to hydro distillation for 4 hours using a modified Clevenger apparatus to obtain the essential oil, and subsequently it was dried over anhydrous sodium sulphate and, after filtration, stored under N_2 atmosphere in amber vials at 4 ^oC until analysis [10].

2.3 GC/MS analysis
GC/MS analysis was performed on Thermo Electron Trace 2000 GC model gas chromatography and Thermo Electron DSQ quadrupole mass spectrometry. A nonpolar Phenomenex DB5 fused silica column (30 m× 0.32mm, ∅ with 0.25 µm film thickness) was used with helium at 1 mL/min (20 psi) as a carrier gas. Detailed programme has been given in the literature [11-12].

2.4 Identification of the components

Identification of the essential oil components was based on the comparison of their retention times and mass spectra with those obtained from authentic samples and/or the NIST and Wiley spectra as well as the literature data [13, 14].

3. Results & Discussion

The oil yield obtained from leaves of *Lophanthus turcicus* was 2.1% (w/v). The Chemical constituents present in the essential oil of *L. turcicus* were identified by GC and GC-MS. Thirty-six compounds representing 96.4% of the essential oil of *L. turcicus* were identified (Table.1). The oil was characterized by its high proportion of sesquiterpene hydrocarbons and oxygenated sesquiterpenes (30.5% and 42.3% respectively). Spathuleneol (14.3%) was the most abundant compound in the volatile oil, followed by, Globulol (13.8%), Ledene (11.8%), Pulegone (10.2%) and α-Cadinol (9.1%). The monoterpenoids also observed in the essential oil of species.

3.1 Tables

Table 1: Chemical composition of the essential oil of *Lophanthus turcicus*

KI	Compounds	(%)
939	α-Pinene	2.0
954	Camphene	t
979	β-Pinene	1.2
991	β-Myrcene	t
991	3-Octanol	t
1025	*p*-Cymene	t
1029	Limonene	t
1031	1,8-cineole	1.3
1089	α-Terpinolene	1.9
1141	Verbenol	1.4
1150	Isopulegol	t
1169	Borneol	t
1172	Menthol	2.6
1177	4-Terpineol	1.5
1183	Isomenthol	t
1196	Myrtenal	t
1205	Verbenone	t
1237	Isopulegone	t
1237	Pulegone	10.2
1253	Piperitone	1.5
1343	Piperitenone	t
1369	Piperitenone oxide	t
1377	α-Copaene	t
1388	ß-Bourbonene	t
1391	Jasmone	t
1419	*trans*-Caryophyllene	5.1
1463	Aromadendrene,dehydro	3.1
1485	Germacrene-D	2.0
1497	Ledene	11.8
1500	Bicycloelemenene	3.9
1523	δ-Cadinene	4.5
1546	α-Calacorene	2.5
1585	Globulol	13.8
1578	Spathulenol	14.3
1641	Aromadendrene	2.7
1654	α-Cadinol	9.1
	Monoterpene Hydrocarbons	23.6
	Sesquiterpene Hydrocarbons	30.5
	Oxygenated Sesquiterpene	42.3
	Total	96.4

[a]RI= retention indices relative to C_9-C_{23} *n*-alkanes on the DB-5 column; t= trace (<0.1%)

4. Conclusions

Essential oil of the new species, *Lophanthus turcicus* can be used a new sources of oxygenated sesquiterpenes especially for spathulenol (14.3%), globulol (13.8%) and α-cadinol (9.1%).

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