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ESSENTIAL OILS OF *Nepeta* SPECIES GROWING IN TURKEY

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Essential oils from 22 Nepeta *species growing in Turkey have been studied. Results of GC/MS analyses of the essential oils have shown that four Nepeta species contain 4aα-7α-7aα-nepetalactone as the major component. 4aα-7α-7aβ-Nepetalactone was the main constituent in N. racemosa. Seven Nepeta species contained caryophyllene oxide as the main constituent in their essential oils. 1,8-Cineole/linalool were the major components in the essential oils of six species. β-*Pinene, *α-*terpineol, *germacrene-*D, *and spathulenol were the main constituents in the essential oils from* N. phyllochlamys, N. viscida, N. sorgerae, *and* N. trachonitica, *respectively.*

Key words: *Nepeta* species, essential oils, hydrodistillation, GC/MS analyses.

The genus *Nepeta* (*Lamiaceae*) comprises 280 species that are distributed over a large part of Central and Southern Europe, and West, Central, and Southern Asia. About half of the existing species are recorded in Iran. The genus *Nepeta* is represented in Turkey by 33 species and altogether 38 taxa, 17 of these being endemic in Turkey (*ca*. 45%) [1].

Nepeta species are widely used in folk medicine because of their antispasmodic, diuretic, antiseptic, antitussive, antiasthmatic, and febrifuge activities. The feline attractant properties of several *Nepeta* species have been known for a long time. Nepetalactone and its isomers are considered to be responsible for the feline attractant activity of *Nepeta* species [2–4].

Essential oils were obtained from dried aerial parts, leaves, stems, and flowering or fruiting aerial parts of *Nepeta* species by water distillation. Results of GC/MS analyses of the essential oils are given in Tables 1–4. According to the essential oil composition, *Nepeta* species can be divided into two groups nepetalactone-containing and nepetalactone-less. 4aα-7α-7aα-Nepetalactone is the most frequently encountered nepetalactone in *Nepeta* oils. Four *Nepeta* species contained 4aα-7α-7aα-nepetalactone as the main constituent while in one species the main constituent was 4aα-7α-7aβ-nepetalactone (Table 1). Nepetalactone-less species contain caryophyllene oxide or 1,8-cineole/linalool as the main constituent in their essential oils. In seven *Nepeta* oils caryophyllene oxide was the main constituent (Table 2). In six *Nepeta* oils 1,8-cineole/linalool was the major compounds (Table 3). b-Pinene, a-terpineol, germacrene-D, and spathulenol were identified as major components in the essential oils of *N. phyllochlamys*, *N. viscida*, *N. sorgerae*, and *N. trachonitica*, respectively (Table 4).

Several *Nepeta* species have also been previously studied by other groups. The essential oils were obtained by hydrodistillation. Water distilled essential oils of *N. italica* and *N. sulfuriflora* were reported to contain 1,8-cineole (80.8% and 61.5%, respectively) [14].

Caryophyllene oxide (40.7%) was reported as the main constituent of the essential oil of *N. cilicia* [15].

N. cataria oils have been extensively studied. This species is characterized by the presence of nepetalactone and its isomers [2–4, 16–19]. In the essential oil of *N. nuda* ssp. *albiflora* 4aα-7α-7aα-nepetalactone (37.5%) and 4aα-7α-7aβ-nepetalactone (37.6%) were found as the main constituents [20]. Nerolidol (17.8%) was reported as the main constituent in the oil of *N. nuda* ssp. *glandulifera* [21]. β-Caryophyllene (21.8%) and spathulenol (13.8%) were reported as the main components of the essential oil of *N. nuda* ssp. *nuda* [22].

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TABLE 1. *Nepeta* Oils with Nepetalactone as the Main Constituent

Name	Material	Collection site	ESSE	Yield (%)	%	Ref.
Nepeta caesarea Boiss.	Aerial parts	Eskisehir:Saricakaya	9751	0.86	91.2 (**1**)	5
(Endemic)	Leaves	Eskisehir:Saricakay	9751	2.74	94.6 (**1**)	5
	Flowers	Eskisehir:Saricakay	9751	1.12	93.0 (**1**)	5
	Stems	Eskisehir:Saricakay	9751	0.30	95.3 (**1**)	5
N. cataria L.	Aerial parts	Antalya:Altinozu-Hadim	12682	0.40	89.0 (**1**)	**
N. cadmea Boiss.(Endemic)	Aerial parts	Antalya:Gundogmus	12629	0.45	78.6 (**1**)	**
	Aerial parts	Mugla:Koycegiz	11399	0.71	44.5 (**1**)	6
	Aerial parts	Konya:Hadim	12683	0.41	21.7 (**1**)	**
	Aerial parts	Antalya:Kemer	11294	0.54	75.0 (**1**)	6.7
N. pilinux P. H. Davis (Endemic)	Aerial parts	Antalya:Alanya	12707	0.50	66.7 (**1**)	**
N. racemosa Lam.	Flowering aerial parts	Erzurum	*	0.11	91.5 (**2**)	8
	Flowering aerial parts	Kars	8994	0.70	31.5 (**2**)	8

*An authentic specimen is kept at the Herbarium of Erzurum Ataturk University.
Results are reported here. **1: 4aα-7α-7aα-nepetalactone, **2**: 4aα-7α-7aβ-nepetalactone.

TABLE 2. *Nepeta* Oils with Caryophyllene Oxide as the Main Constituent

Name	Material	Collection site	ESSE	Yield (%)	%	Ref.
N. betonicifolia C. A. Meyer	Aerial parts	Sivas:Taslidere	12464	Tr.	39.2	*
N. cilicia Boiss. Apud Bentham	Aerial parts	Antalya:Gundogmus	12598	0.04	19.2	*
N. fissa C. A. Meyer	Aerial parts	Antalya:Alanya	11520	Tr.	36.4	7
N. Nuda L. subsp. Glandulifera Hub.-Mor. & Davis (Endemic)	Aerial parts	Sivas:Taslidere	12465	0.02	24.0	9
		Antalya:Anamur	11622	0.10	30.7	7
N. concolor Boiss. & Heldr. apud Bentham (Endemic)	Aerial parts	Antalya:Alanya	12235	0.06	17.1	*
N.conferta Hedge & Lamond (Endemic)	Aerial parts	Antalya:Elmali	11331	0.10	15.8	7
N. isaurica Boiss. & *Heldr. apud Bentham* (Endemic)	Aerial parts	Antalya:Alanya	11509	0.50	15.5	7

*Results are reported here. Tr: Trace (<0.01 %)

EXPERIMENTAL

The essential oils were analysed by GC/MS using a Hewlett-Packard MSD system. An Innowax FSC column (60 m × 0.25 mm Ø with 0.25 mm film thickness) was used with Helium as a carrier gas. The GC oven temperature was kept at 60°C for 10 min and programmed to 220°C at a rate of 4°C/min and then kept constant at 220°C for 10 min and then programmed to 240°C at a rate of 1°C/min. The split ratio was adjusted at 50:1. The injector temperature was at 250°C. MS were taken at 70 eV. Mass range was from *m/z* 35 to 425. A library search was carried out using the Wiley GC/MS Library and the TBAM Library of Essential Oil Constituents. The relative percentage amounts of the separated compounds were calculated from total ion chromatograms by a computerized integrator.

Plant materials were collected from different regions of Turkey. Authentic specimens are kept at the Herbarium of the Anadolu University Faculty of Pharmacy in Eskisehir, Turkey (ESSE). The studied materials, their collection sites, ESSE, and oil yields are listed in Table 1 – 4.

Plant materials were hydrodistilled for 3 h using a Clevenger-type apparatus. The percentage yields of the oils were calculated on a moisture free basis.

TABLE 3. *Nepeta* Oils with 1,8-Cineole (A) and / or Linalool (B) as Main Constituents

Name	Material	Collection Site	ESSE	Yield (%)	A %	B %	Ref.
N. italica L.	Aerial parts	Kastamonu: Karabuk	10625	0.40	18.9	13.8	*
	Aerial parts	Balikesir:Dursunbey	13264	0.80	31.9	21.1	*
	Leaves	Eskisehir:Mayislar	9207	3.96	40.0	0.4	*
	Aerial parts	Icel:Gulnar	12005	1.12	46.6	1.3	*
	Aerial parts	Mugla:Fethiye	11342	3.70	51.6	0.4	7
	Aerial parts	Eskisehir:Mayislar	8451	0.66	14.5	24.6	*
	Aerial parts	Bilecik	8828	0.60	11.4	31.6	*
	Aerial parts	Kahramanmaras: Andirin	12160	1.43	27.4	35.9	*
	Aerial parts	Kahramanmaras	9213	1.83	11.8	61.7	*
N. sulfuriflora P. H. Davis (Endemic)	Flowering aerial	Antalya:Anamur	11623	0.40	46.3	-	7.10
	parts	Antalya:Gaziosman pasa to	11640	0.30	24.2	-	7.10
	Fruiting aerial parts	Anamur					
N. congesta Fisch. & Mey. var.		Sivas:Ulas	12416	0.12	40.0	-	*
Cryptantha (Boiss.) Hedge & Lamond	Aerial Parts						
N. flavida Hub.-Mor.		Adana:Duzici	11618	1.40	22.7	37.7	7.11
N. nuda L. subsp. Nuda	Aerial Parts	Kutahya:Radar	9199	0.20	14.9	-	7
N. nuda L. subsp. Albiflora (Boiss.)	Aerial Parts	Rise	10055	0.10	10.6	-	7
Games	Aerial Parts						

*Results are reported here.

TABLE 4. Other *Nepeta* Oils

Name	Material	Collection site	ESSE	Yield (%)	Main constituent (%)	Ref.
N. phyllochlamys P. H. Davis (Endemic)	Aerial parts	Antalya:Kemer	11296	1.10	β-Pinene (16.3)	7
N. viscida Boiss.(Endemic)	Aerial parts	Mugla:Fethiye	11350	0.40	α-Terpineol (18.7)	7.12
N. sorgerae Hedge & Lamond (Endemic)	Aerial parts	Kahramanmaras: Ahir dagi	12424	0.07	Germacrene-D (45.0)	*
N. trachonitica Post	Aerial parts	Malatya:Beydagi	12163	0.09	Spathulenol (22.1)	13

*Results are reported here.

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