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Chemical Composition of Essential Oil of *Nepeta nuda* L. subsp. *nuda* (Lamiaceae) from Turkey

OMER KILIC[1], SUKRU HAYTA[2] and EYUP BAGCI[3,*]

[1]Department of Biology, Faculty of Art & Science, Bingol University, Bingol, Turkey
[2]Department of Biology, Faculty of Art & Science, Bitlis Eren University, Bitlis, Turkey
[3]Plant Products and Biotechnology Laboratory, Department of Biology, Faculty of Science, Firat University, Elazig, Turkey

*Corresponding author: E-mail: ebagci@firat.edu.tr

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The chemical composition of the essential oil of dried aerial parts of *Nepeta nuda* L. subsp. *nuda* (Lamiaceae) from Turkey were analyzed by GC and GC-MS. The essential oil of *Nepeta nuda* subsp. *nuda* were obtained by hydrodistillation and 45 components representing 94.7 % of the total oil were identified. The main compounds of *Nepeta nuda* subsp. *nuda* were determined as camphor (23.5 %), 1,8 cineole (21 %), borneol (18.77 %) and camphene (6.50 %). The chemical distribution of the essential oil compounds in the genus pattern were discussed in means of chemotaxonomy and natural products.

Key Words: *Nepeta nuda* L. subsp. *nuda*, Lamiaceae, Essential oil, Camphor, 1,8-Cineole.

INTRODUCTION

The genus *Nepeta* (Lamiaceae) genus, comprises about 250 species distributed in the central and southern parts of Europe, Asia and the Middle East[1]. The genus *Nepeta* L. (Lamiaceae) is represented in Turkey by 33 species, 17 of them endemic[2]. *Nepeta* genus are herbaceous perennials, rarely annuals, often pleasantly aromatic herbs. *Nepeta nuda* species contains four subspecies (subsp. *nuda*, subsp. *glandulifera*, subsp. *lydiae* and subsp *albiflora*) in Flora of Turkey and subspecies *nuda* studied is the most widespread taxon in Turkey. It varies considerably in flower colour, indumentum, inflorescence and calyx characters[3].

Several *Nepeta* species are used in folk medicine as fungistatic[4], bacteriostatic and disinfectant[5,6], as well as against eczema-type skin disorders[7]. *Nepeta* species are used also as antifebrile and diuretic and as a remedy for stomach ache and dropsy[8] and they contain monoterpenes, sesquiterpenes, cyclopentanoid iridoid derivatives and nepetalactone[9]. *Nepeta* leaves are used to add flavour to sauces, soup, stews and salad. The dried leaves, can be used as herbal tea. Essential oils are used for flavouring, as perfumes or as fragrances[10]. The activity of nepetalactone and also its isomers on the olfactory sense of domestic cats was demonstrated and they function also as insect attractants and repellants[11].

Various compounds have been identified by different groups of workers in the essential oil of *Nepeta* genus, the composition of which vary from region to region, genetically, variety, analytical and extraction methods, climatic conditions and vegetation period.The main constituents so far identified, include β-caryophyllene, caryophyllene oxide, 1,8-cineol, citronellol, geraniol, elemol, nerol, nerolidol, spathulenol, β-elemene, geranyl acetate, citronellyl acetate and geranial. In addition, the plant also contained nepetalactones and alkaloids, such as, actinidine and iridomyrmecine[12-14].

Here we report on the essential oil composition of *Nepeta nuda* subsp. *nuda* from the Eastern Anatolian region of Turkey. The results were discussed with the genus patterns in means of natural products and renewable resources.

EXPERIMENTAL

Samples were collected from their natural habitats. *Nepeta nuda* L. subsp. *nuda* were collected from Elazig-Keban, Eastern Anatolian region, on june 2009 an altidude of 1300 m. Kilic, 1290. *Nepeta nuda* L. subsp. *nuda* Voucher specimen kept at the Firat University Herbarium (FUH) and Plant Products and Biotechnology Research Laboratory.

Isolation of the essential oils: Air-dried aerial parts of the plant materials were subjected to hydrodistillation using a Clevenger-type apparatus for 3 h.

Gas chromatographic (GC) analysis: The essential oil was analyzed using HP 6890 GC equipped with and FID detector and an HP-5 MS column (30 m × 0.25 mm i.d., film tickness 0.25 μm) capillary column was used. The column and analysis conditions were the same as in GC-MS. The percentage composition of the essential oils was computed from GC-FID peak areas without correction factors.

Gas chromatography/mass spectrometry (GC-MS) analysis: The oils were analyzed by GC, GC-MS, using a

Hewlett Packard system. HP-Agilent 5973 N GC-MS system with 6890 GC in Plant Products and Biotechnology Research Laboratory (BUBAL) in Firat University. HP-5 MS column (30 m × 0.25 mm i.d., film tickness (0.25 μm) was used with helium as the carrier gas. Injector temperature was 250 ºC, split flow was 1 mL/min. The GC oven temperature was kept at 70 ºC for 2 min and programmed to 150 ºC at a rate of 10 ºC/min and then kept constant at 150 ºC for 15 min to 240 ºC at a rate of 5 ºC/min. Alkanes were used as reference points in the calculation of relative retention indices (RRI). MS were taken at 70 eV and a mass range of 35-425. Component identification was carried out using spectrometric electronic libraries (WILEY, NIST). The identified constituents of the essential oils are listed in Table-1.

TABLE- 1
CONSTITUENTS OF THE ESSENTIAL OIL FROM *Nepeta nuda* L. subsp. *nuda*

No.	Compounds	RRI	Percentage (%)
1	3-Methyl-1-pentanol	959	0.01
2	2-Hexanol	964	0.01
3	1-Butanol, 3-methyl, acetate	980	0.03
4	1-Butanol, 2-methyl, acetate	981	0.01
5	Tricyclene	1015	0.30
6	α-Thujene	1016	0.08
7	α-Pinene	1022	0.55
8	Camphene	1035	6.50
9	Benzenealdehyte	1044	0.05
10	Sabinene	1052	2.83
11	β-Pinene	1056	0.52
12	α-Terpinene	1086	0.50
13	1,8-Cineole	1100	21.00
14	γ-Terpinene	1117	1.18
15	α-Terpinolene	1137	0.21
16	3-Methyl butanoic acid	1153	0.05
17	Sabinene	1167	0.20
18	Camphor	1186	23.50
19	Isocyclocitral	1195	2.75
20	Borneol	1203	18.77
21	3-Cyclohexen-1-ol	1207	4.95
22	Benzene, 1-methyl-4	1211	0.13
23	Mrytenol	1214	0.15
24	3-Cyclohexene-1-methanol	1216	1.50
25	2-Cyclohexen-1-one	1250	0.53
26	Chavicol	1257	0.11
27	Chrysanthenylacetate	1259	1.03
28	Bicyclo[2,2,1]heptan-2ol	1283	3.30
29	Benzenemethanol	1289	0.07
30	Cyclohexane, 1-methylene-4	1302	0.20
31	Eugenol	1340	0.05
32	1,3,8-*p*-Menthatriene	1346	0.20
33	*cis*-Jasmone	1373	0.11
34	Isobornyl N-butanoate	1389	0.20
35	β-Caryophyllene	1393	0.20
36	1,6,10-Dodacatriene	1415	0.25
37	α-Humulene	1419	0.02
38	Germacrene D	1436	0.55
39	Naphthalene	1441	0.20
40	Bicyclogermacrene	1445	0.30
41	Isolongifolene	1495	0.63
42	β-Selinene	1539	0.63
43	Cyclopentadecane	1634	0.21
44	Kaur-16 ene	1752	0.01
45	Neophytadiene	1794	0.05
	Total		94.7

RESULTS AND DISCUSSION

The chemical composition of the essential oil of dried aerial parts of *Nepeta nuda* subsp. *nuda* were analyzed by GC and GC-MS. The chemical compounds of the essential oil of plant is shown in Table-1. The essential oils of *Nepeta nuda* subsp. *nuda* were studied and 45 components representing 94.7 % of the total oil were identified. Among the compounds, camphor (23.5 %), 1,8-cineole (21 %) borneol (18.77 %) and camphene (6.50 %) were identified as the major components in the essential oil of *Nepeta* subspecies.

Camphor was found as the main major compound in essential oil of *Nepeta* subspecies from Turkey (23.5 %). This compound is not reported in the essential oil of *Nepeta cadmea* from Turkey[15]; in the *N. cataria* from Iran[16] and *Nepeta foliosa* from Italy[17]. On the other hand; 1,8-cineole (12.54 %) has been detected as main compound in the essential oil of aerial parts of *Nepeta foliosa* from Sardinia (Italy)[17] and in *N. haussknechtii* (36.7 %)[18] like in this study (21.5 %). Camphene is also main constituent in the oil of *Nepeta nuda* subsp. *nuda* (6.50 %). However the absence of this compound in *Nepeta cataria*[19] and *N. cadmea*[15] are noteworthy.

β-Pinene was reported as the main compound of essential oil of *Nepela cataria* L. from Italy (1.80 %)[20] and in the essential oil composition of aerial parts of *Nepeta foliosa* from Sardinia (Italy) (8.93 %)[17]. But it is determined as minor monoterpene in the *Nepeta* subspecies studied (0.52 %) (Table-1). β-Caryophyllene is reported as one of the major component in essential oil of *Nepeta catari* (9.72 %)[16,19]. But it is determined as minor in *Nepeta nuda* subsp. *nuda* studied (0.20 %).

From the sesquiterpenes, caryophyllene oxide (2.37 %) was the main constituent in the essential oil of *Nepeta cataria* (Lamiaceae)[16] and the essential oil isolated from *N. cadmea* (1.91 %)[15] and also geranyl acetate have been detected in the essential oil of *Nepeta foliosa* from Sardinia (Italy) (5.52 %)[17] and *Nepeta cataria* (8.21 %)[20], but both components were not found in the essential oil of *Nepeta nuda* subsp. *nuda* studied in here.

Linalool (15.24 %), while the major compounds in *N. foliosa*, it was not determined in the essential oils of *N. cataria* and N. *nuda* subspecies and also α-humulene (14.14 %), was among the main components of *N. cataria*, it is not determined as major component of the *Nepeta cataria* from Central Iran (Kashan area) and in this study pattern, *Nepeta nuda* subsp. *nuda*.

In the study of the essential oils from 22 *Nepeta* species growing in Turkey[21]; the major components of the essential oils in these species were reported as 4aα-7α-7aα-nepetalactone (4 spp.), 4aα-7α-7aβ-nepetalactone (only in *N. racemosa* Lam.), caryophyllene oxide (7 spp.), 1,8-cineole/linalool (6 spp.), β- pinene (only *N. phyllochlamys* Davis), α-terpineol (only *N. viscida* Boiss), germacrene-D (only *N. sorgerae* Hedge and Lamond) and spathulenol (only *N. trachonitica* Post.). The major components of the essential oils of *Nepeta glomerata* Montbret et Aucher ex Bentham were determined as carvacrol, germacrene D and α-bisabolol from Turkey[22]. The studies showed that, there are three main chemotypes for the essential oils of *Nepeta* genus. The first one is the nepetalactone chemotype, the second group is the

caryophyllene oxide chemotype and the last group is the 1,8-cineole chemotype[23]. On the other hand, it is reported that some of the *Nepeta* species showed different type of essential oil, like α/β-pinene in *N. cataria*[19], carvacrol/germacrene D in *N. glomerata*[22]. It is possible to say that, the essential oils of *N. nuda* subsp. *nuda* has camphor/1,8-cineole chemotype in Eastern Anatolian region of Turkey.

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