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Composition of the essential oils of *Nepeta ispahanica* Boiss. and *Nepeta binaludensis* Jamzad from Iran

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ABSTRACT: The composition of the essential oils of *Nepeta ispahanica* Boiss. and *N. binaludensis* Jamzad was investigated by means of GC, GC–MS and ^{1}H-NMR spectra of the main compounds. 1,8-Cineole was the most abundant component in both oils: *Nepeta ispahanica* (66%) and *N. binaludensis* (42%). However, nepetalactone (25%), linalol (4%), α-terpineol (4%) and β-pinene (3%) were major constituents of *N. binaludensis*. The structures of 1,8-cineole, nepetalactones and β-pinene were confirmed by their ^{1}H-NMR spectra. Copyright © 1999 John Wiley & Sons, Ltd.

KEY WORDS: *Nepeta ispahanica* Boiss.; *Nepeta binaludensis* Jamzad; Lamiaceae; essential oil; 1,8-cineole; nepetalactone

Introduction

The genus *Nepeta* (Lamiaceae), with almost 280 species, is widespread in Europe, Asia and in a few parts of Africa.[1] Some species are used in folk medicine, *N. cataria* (catnip), for instance, is used as a fortifier, a disinfectant and cure against colds.[2] Bacteriostatic and fungistatic properties of the essential oil from *N. cataria* have been investigated by F. Perineaw *et al*.[3]

Chloroform extracts of *N. kopetdaghensis* were found to be active as a bacteriostatic, a diuretic and a cure against eczema-type skin disorders.[4] Alcoholic preparations of *N. hindostana* decreased the level of serum lipids and lipoproteins, and might thus supplement remedies against artherosclerosis.[5]

Many *Nepeta* species contain the diasteromeric nepetalactones, substituted cyclopentanoid iridodial derivatives,[6] which are known as powerful attractants for cats.[7]

Experimental

The aerial parts of *N. ispahanica* Boiss. growing wild in Roodshoor, between Saveh and Tehran in north-west Iran at an altitude of 1900 m, were collected in July 1993 (voucher No. AR, 129) and the aerial parts of *N. binaludensis* Jamad. growing wild on Binalud mountain (2300 m elevation, province Khorassan in north-east Iran) were collected in July 1993 (voucher No. AR, 130).

Vouchers are deposited at the Herbarium of the Department of Botany, Shahid Beheshty University, Tehran, Iran.

Isolation of the Essential Oils

The aerial parts of the two species were ground and the essential oils isolated by hydrodistillation for 4 h, using a Clevenger-type apparatus. After decanting and drying over anhydrous sodium sulphate, the corresponding yellowish coloured oils were recovered.

Gas Chromatography and GC–MS

GC analysis was performed using a Packard 439 chromatograph equipped with a CP Sil 5CB column, (25 m × 0.25 mm i.d., film thickness 0.39 μm), oven temperature programme from 60°C at 5°C/min to 220°C. N_2 was used as carrier gas at a flow rate of 0.8 ml/min; injector and detector temperatures were 270°C.

GC–MS

Varian 3700 chromatograph with a CP Sil 5CB column, (25 m × 0.25 mm i.d., film thickness 0.39 μm) combined with Varian MAT 44S ionization energy 70 eV,

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Table 1. Composition of the essential oils from *Nepeta ispahanica* Boiss. and *N. binaludensis* Jamzad. (column: 25 m CP Sil 5CB)

Compound	RRI	*N. ispahanica* %	*N. binaludensis* %	Identification
α-Thujene	926	–	0.4	GC/MS
α-Pinene	935	3.1	1.1	GC/MS
Sabinene	970	1.9	0.8	GC/MS
β-Pinene	976	10.7	3.2	GC/MS, ^{1}H-NMR
Dehydro-1,8-cineole	986	–	0.5	GC/MS
p-Cymene	1018	–	2.7	GC/MS
1,8-Cineole	1027	65.2	42.3	GC/MS, ^{1}H-NMR
β-Phellandrene	1032	–	0.8	GC, GC/MS
trans-Sabinene hydrate	1059	0.6	0.4	GC, GC/MS
Linalol oxide (furanoid)	1065		0.2	GC/MS
cis-Sabinene hydrate	1088	0.4	–	GC, GC/MS
Linalol	1091	–	4.0	GC/MS
trans-Pinocarveol	1129	1.2	–	GC/MS
Verbenol	1134	0.5	–	GC/MS
Pinocarvone	1144	0.8	–	GC/MS
δ-Terpineol	1153	1.0	3.0	GC/MS
Terpinen-4-ol	1167	1.0	2.8	GC, GC/MS
Myrtenal	1175	1.0	–	GC/MS
α-Terpineol	1177	2.0	4.0	GC, GC/MS
Myrtenol	1184	1.0	–	GC/MS
4aβ,7α,7aα-Nepetalactone	1324	–	0.7	GC/MS
4aα,7α,7aα-Nepetalactone	1337	–	25.2	GC/MS, ^{1}H-NMR
β-Caryophyllene	1422	0.2	–	GC/MS
β-Caryophyllene oxide	1575	2.1	–	GC/MS

carrier gas He and injector temperature 270°C. Approximately 0.1 µl of neat oil was injected under split conditions (100:1) and the oven temperature was held at 60°C for 5 min, programmed at 5°C/min to 220°C and then held at this temperature for 20 min.

Results and Discussion

The essential oil was obtained from the air-dried parts of *N. ispahanica* in 0.2% yield; that from *N. binaludensis* in 0.8% yield. The identification of the compounds was carried out by comparison of their MS and/or ^{1}H-NMR spectra (Table 1) with those of authentic samples together with the relative retention indices (RRI). Only the compounds representing at least 0.1% of the mixture are given in the Table in order of their elution on the CP Sil 5CB column. Altogether, 24 constituents, accounting for 92.7% and 91.6% of the oils respectively, were identified. The results shown in Table 1 reveal a clear difference in the chemical composition of the oils studied.

While the oil obtained from *N. binaludensis* contains the monoterpenes usually found in the *Nepeta* oils (1,8-cineole 42.3%, 4aα,7α,7aα-nepetalactone, 25.2%; and 4aβ,7α,7aα-nepetalactone, 0.75%) the proportion of monoterpenes in the essential oil of *N. ispahanica* is quite different. In this oil we could not find any trace of nepetalactone or its stereoisomers. On the other hand the amount of 1,8-cineole was higher (65.2%) than that found in the oil of *N. binaludensis*. In the oils isolated from other *Nepeta* species, the percentage of 1,8-cineole varied from traces to 80%.[4,8–11]

Recently the chemical constituents of the essential oils of *Nepeta italica* L. and *Nepeta sulfuriflora* P. H. Davis from Turkey have been described.[10] Both contain 1,8-cineole (80.8% and 61.5%, respectively). Concerning other significant monoterpenes, both samples are qualitatively similar, although they contain different constituents that characterize the *Nepeta* oils. The lack of nepetalactones is known in the oils of some *Nepeta* species; *N. leucophyl*,[12] *N. discolor*[13] (Himalayan species), *N. italica* from Turkey[10] and *N. cataria* L. cv. *citriodora* growing wild in the Drome region of France.[11] Concerning the sesquiterpenes, the essential oil of *N. ispahanica* contained β-caryophyllene (0.24%) and β-caryophyllene oxide (2.16%) that did not occur in the oil *N. binaludensis*. In the oil of this species we were not able to identify any sesquiterpenes.

The sesquiterpene region (RRI 1375–1980) showed only some trace constituents which could not be identified.

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