



**CONSTITUENTS AND BIOLOGICAL ACTIVITIES SOME OF IRANIAN *NEPETA*
SPECIES-REVIEW**

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ABSTRACT

Nepeta is a genus of flowering plants in the family Lamiaceae also known as catmints. The genus name is reportedly in reference to *Nepeta*, an ancient Etruscan-city. The genus is native to Europe, Asia and Africa and has also naturalized in North America. The present review describes the Chemical and Biological Activities of Iranian *Nepeta* species: *Nepeta asterotricha* Rech. f., *Nepeta binaludensis* Jamzad., *Nepeta bornmuelleri* Hausskn. ex Bornm., *Nepeta bracteata* Benth., *Nepeta cephalotes* Boiss., *Nepeta crispa* Willd., *Nepeta cataria* L., *Nepeta denudata* Benth., *Nepeta depauperata* Benth., *Nepeta fissa* C.A. Mey., *Nepeta glomerulosa* Boiss., *Nepeta heliotropifolia* Lam., *Nepeta haussknechtii* Bornm. and *Nepeta isphanica* Boiss.

KEYWORD: *Nepeta* species, Lamiaceae, Constituents, Biological activities.

INTRODUCTION

The genus *Nepeta* which belongs to the Lamiaceae family, consists of about 280 species.^[1] In Iran 67 species are present, among which 39 are endemics.^[2,3] *Nepeta* species are still used in the traditional medicine of many countries as diuretic, diaphoretic, vulnerary, antitussive, antispasmodic, antiasthmatic, tonic, febrifuge, emmenagogue and sedative agents.^[4,5]

Most of the species are herbaceous perennial plants, but some are annuals. They have study steins with opposite heart-shaped, green to gray-green leaves.^[3] *Nepeta* plants are usually aromatic in foliage and flowers.

***Nepeta asterotricha* Rech. f.**

The chemical constituents from the root, leaf and aerial part of *Nepeta asterotricha* Rech.f., growing in Iran, were obtained by hydrodistillation and analyzed by GC and GC/MS. The root oil was characterized by higher amount of 4 α , 7 β , 7 α -nepetalactone (26.2%), linalool (10.2%), 1,8-cineole (10.2%) and terpinen-4-ol (9.2%). Thirty-two constituents representing 97.6% of the chromatographical leaf oil were identified of which 1,8-cineole (21.0%), 4 α , 7 β , 7 α -nepetalactone (15.0%), terpinen-4-ol (14.3%) and linalool (7.7%) were the major components. The main components of the aerial parts oil were 1,8-cineole (26.1%), terpinen-4-ol (14.8%), 4 α , 7 α , 7 β - nepetalactone (8.7%) and cis-sabinene hydrate (8.6%). The antimicrobial effects of root, leaf and aerial

part essential oils from *N. asterotricha* were studied against seven Gram-positive and Gram-negative bacteria and three fungi by disc diffusion method. The results of the bioassays showed the interesting antimicrobial activity, in which the Gram-positive bacteria, *Bacillus cereus* and *Staphylococcus aureus*, were the most sensitive to the oils, as well the oils exhibited a remarkable antifungal activity against all the tested fungi.^[6]

In another study, Thirty-five compounds representing 93.0% of the stem oil of *Nepeta asterotricha* were identified among which terpinen-4-ol (22.8%) and γ -terpinene (14.1%) were the major ones. The flower oil of the species was characterized by higher amounts of terpinen-4-ol (24.8%), 4 α , 7 β -nepetalctone (18.2%) and 1,8-cineole (11.6%) among the thirty-three components comprising 98.5% of the total oil detected.

The antibacterial activity of the stem, leaf and flower oils of *Nepeta asterotricha* against seven Gram-positive and Gram-negative bacteria were determined using the MIC method. The growth inhibitory zone (mm) was also measured.^[7]

***Nepeta binaludensis* Jamzad.**

The composition of the essential oil of *Nepeta binaludensis* was investigated by means of GC, GC/MS

and H^1 -NMR spectra of the main compounds. 1,8-cineol (42%) was the most abundant component in the oil.

However in addition nepetalactone (25%), linalool (4%), α -terpineol (4%) and β -pinene (3%) were detected in the oil of *N. binaludensis*.^[8]

***Nepeta bornmuelleri* Hausskn. ex Bornm.**

The essential oil from the aerial parts of *N. bornmuelleri* was obtained by hydrodistillation. The oil was analyzed by capillary gas chromatography, using flame ionization and mass spectrometric detected.

Twenty-eight compounds were identified in the oil *Nepeta bornmuelleri* with 4 α β , 7 α , 7 α β -nepetalactone (64.0%) and 1,8-cineole (7.1%) as main components.^[9]

***Nepeta bracteata* Benth.**

Nepeta bracteata is a medicinal plant which widely grows in Province of Khorasan (Iran). This herb is used by the indigenous people as a folkloric medicine in Khorasan Province. The result of this study indicated that the aerial parts, especially the flowers of *N. bracteata* are used by the indigenous people for treatment of many diseases, including asthma, cold, headache and stress. In addition, this herb has used as a sedative. The flowers of *N. bracteata* are used for treatment of respiratory diseases, including asthma, lungspasms, seasonal allergies and cough due to cold.^[10]

In another study, the oil of *N. bracteata* Benth. was obtained by hydro distillation. The oil was analyzed by capillary gas chromatography, using flame ionization and mass spectrometric detection. Twenty-eight compounds were characterized in the oil of *N. bracteata* with spathulenol (14.0%), caryophyllene oxid (12.3%), bicyclogermacrene (11.4%) and β -caryophyllene (11.2%) as the main constituents. The oil of *N. bracteata* consisted of mainly of sesquiterpenes, while nepetalactone was not detected in this oil.^[9]

***Nepeta cephalotes* Boiss.**

The composition of the essential oil of *Nepeta cephalotes* Boiss. Which is endemic to Iran was investigated by means of GC, GC/MS and H^1 -NMR spectra of the main compounds. Ten compounds were identified in the oil of *Nepeta cephalotes* representing 78% of the total oil with 4 $\alpha\alpha$, 7 α , 7 $\alpha\alpha$ -nepetalactone (35.1%), β -pinene (18.2%) and 1,8-cineol (11.4%) as the major constituents. Nepetalactone and β -pinene were confirmed by their H^1 -NMR spectra.^[11]

In another study, the essential oil from the aerial parts of *Nepeta cephalotes* obtained by hydrodistillation. The oil was analyzed by capillary gas chromatography, using flame ionization and mass spectrometric detection. Eight components were identified in the oil of *N. cephalotes* with 4 $\alpha\alpha$, 7 α , 7 $\alpha\alpha$ -nepetalactone (90.1%) and β -pinene (7.5%) as main constituents.^[9]

***Nepeta crispa* Willd.**

The composition of the essential oil of *Nepeta crispa* Willd. was investigated by means of gas chromatography (GC) and GC-mass spectrometry (MS).

1,8-cineol (71.0%) was the most abundant component in the oil of *N. crispa*. The other main components were α -pinene (5%) and γ -terpineol (4.1%) were found to be the major constituents.^[12]

In another study, the oil was analyzed by capillary gas chromatography, using flame ionization and mass spectrometric detection. Twenty-eight components were identified in the oil of *Nepeta crispa* with 1,8-cineol (62.8%), 4 $\alpha\alpha$ -7 α -7 $\alpha\alpha$ -nepetalactone (10.3%) and 4 $\alpha\beta$ -7 α -7 $\alpha\beta$ -nepetalactone (9.2%) as main constituents. The oil of *N. crispa* consists of about 20% nepetalactone.^[13]

***Nepeta cataria* L.**

The composition of the essential oil of flowering catnip (*Nepeta cataria* L.) was analyzed by means of GC/MS. Besides the already known nepetalactones 4 $\alpha\alpha$, 7 α , 7 $\alpha\alpha$ -nepetalactone; 3,4 β -dihydro-4 $\alpha\alpha$, 7 α , 7 $\alpha\alpha$ -nepetalactone; 4 $\alpha\alpha$, 7 α , 7 $\alpha\beta$ -nepetalactone and β -caryophyllene, five new constituents were identified: dimethyl-3,7 oxa-1 bicyclo [3,3,0] oct-2-ene, piperitone, thymol methyl ether, hexenyl benzoate and humulene oxide. The essential oil of two samples of the plant, collected at two different stages of development, was compared as to their nepetalactone content. The oil samples and a hexane extract were subjected to microbiological tests (five bacteria and seven fungi) and compared to natural compounds known for their antimicrobial activities.^[14]

In another study, The chemical composition of the essential oils from *N. cataria* has been analyzed by gas chromatography/mass spectrometry (GC/MS). The analysis of the essential oils indicated that 4 α - α ,7- β ,7 α - α -nepetalactone (55–58%) and 4 α - α ,7- β ,7 α - α -nepetalactone (30–31.2%) were the major compounds of the essential oils at all developmental stages. The results showed that the tested EOs exhibited antimicrobial activities against the food-borne pathogens at concentrations of 0.125–2 μ L/mL. Based on these results, the essential oil of *N. cataria* can possibly be used in food products as a natural preservative agent.^[15]

***Nepeta denudata* Benth.**

The composition of the essential oils of *Nepeta denudata* Benth. which is endemic to Iran, was investigated by means of GC, GC/MS and H^1 -NMR spectra of the main compounds, 1,8-cineole (48.0%), myrtenol (5.0%), β -pinene (4.6%) and trans-pinocarveol (4.5%) were the main components among the 21 constituents characterized in the oil of *N. denudata*, representing 85.7% of the total components detected. The structure of 1,8-cineole, nepetalactone and β -pinene were confirmed by their H^1 -NMR spectra.^[11]

***Nepeta depauperata* Benth.**

The essential oil from flowering aerial parts of *Nepeta depauperata* Benth., an endemic Iranian plant, obtained by steam distillation was analyzed by GC/MS. The constituents were identified by their mass spectra and Kovats' indices. Thirty-three compounds consisting 82.52% of the total components were identified from the oil obtained with a yield of 0.3%v/w. Among them, spathulenol (31.84%), beta caryophyllene (12.93%) and caryophyllene oxide (10.27%) were the major components of the oil.^[16]

The antibacterial and antifungal activities of the total methanolic extract and different sub-fraction of the flowering aerial parts were investigated by cup plate method and disc diffusion assay, respectively. The minimum inhibitory concentrations and minimum bactericidal concentrations of the active extract or subfraction were determined by micro plate dilution method. The crude extract and chloroform sub-fraction of *N. depauperata* had inhibition activity on the growth of *Staphylococcus aureus*, *Bacillus subtilis* and *Pseudomonas aeruginosa* while no antibacterial activity observed against *Staphylococcus epidermidis*, *Escherichia coli* and *Salmonella typhi*. It was concluded from the antifungal assay that just the yeast *C. albicans*, showed a high sensitivity to all the extract and related sub-fractions. No activity was seen against *Aspergillus niger*, *A. fumigatus*, *A. flavus* and *Fusarium oxysporum*. These findings demonstrate that the *N. depauperata* is effective against *S. aureus*, *B. subtilis* and *P. aeruginosa* and could be a natural source of effective natural antifungal compounds against *C. albicans*.^[17]

***Nepeta fissa* C.A.Mey.**

Water-distilled volatile oil from the aerial parts of *Nepeta fissa* C.A.Mey. Was analysed by a combination of GC and GC/MS. Forty-two components were identified, constituting approximately 99.3% of the oil. The constituents of the essential oil were β -caryophyllene (17.4%), caryophyllene oxide (12.3%), γ -muurolene (7.9%), valencene (6.6%), β -pinene (6.0%) and α -pinene (5.8%).^[18]

***Nepeta glomerulosa* Boiss.**

The chemical compositions of the essential oil of *Nepeta glomerulosa* Boiss aerial parts, grown in Iran were determined by GC-MS. Fifty-two compounds (97.2%) were determined. The major compounds were geranyl acetate (17.0%), limonene (12.0%), eucalyptol (5.8%), (bornyl acetate (5.3%), citronellal (4.9%), spathulanol (4.2%), sabinene (3.9%), β -ocimene (3.9), β -sesquiphellandrene (2.8 %), neryl acetate (2.5%), α -humulene (2.4%), α -pinene (2.3%), humulene oxide (2.2%), norsolanadione (2.1%) and terpinen-4-ol (2.0%). The yield of the oil was 1.1(v/w) %. The essential oil showed antibacterial activity for *Staphylococcus aureus*.^[19]

***Nepeta heliotropifolia* Lam.**

The composition of the essential oil from *Nepeta heliotropifolia* Lam. Was obtained by hydro-distillation and analyzed by GC and GC/MS. 1,8-cineol (16.8%), 4 α ,7 α ,7 β nepetalactone (16.3%), cis-sabinene hydrate (16.1%) and linalool (11.9%) were the main components among the 23 constituents characterized in the oil of *Nepeta heliotropifolia*, representing 92.8% of the total components detected.^[20]

***Nepeta haussknechtii* Bornm.**

Water distilled essential oils from aerial parts of *Nepeta haussknechtii* Bornm. Was analyzed by GC and GC/MS. Twenty-seven compounds representing 94.2% of the oil of *Nepeta haussknechtii* were characterized. The major components of the essential oil of *Nepeta haussknechtii* were 1,8-cineol (36.7%) and elemol (11.4%). The oil richer in oxygenated monoterpenes than sesquiterpenes.^[21]

***Nepeta ispanhanica* Boiss.**

The essential oil from *Nepeta ispanhanica* Boiss. Was obtained by hydro-distillation and mass spectrometric detection. Twenty-seven compounds were characterized in the oil with 1,8-cineol (71.7%) as the main constituent.^[13]

In another study, The composition of the essential oil of *Nepeta ispanhanica* Boiss. was investigated by means of GC, GC/MS and H^1 -NMR spectra of the main compounds. 1,8-cineol (66%) was the most abundant component in the oil.^[8]

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