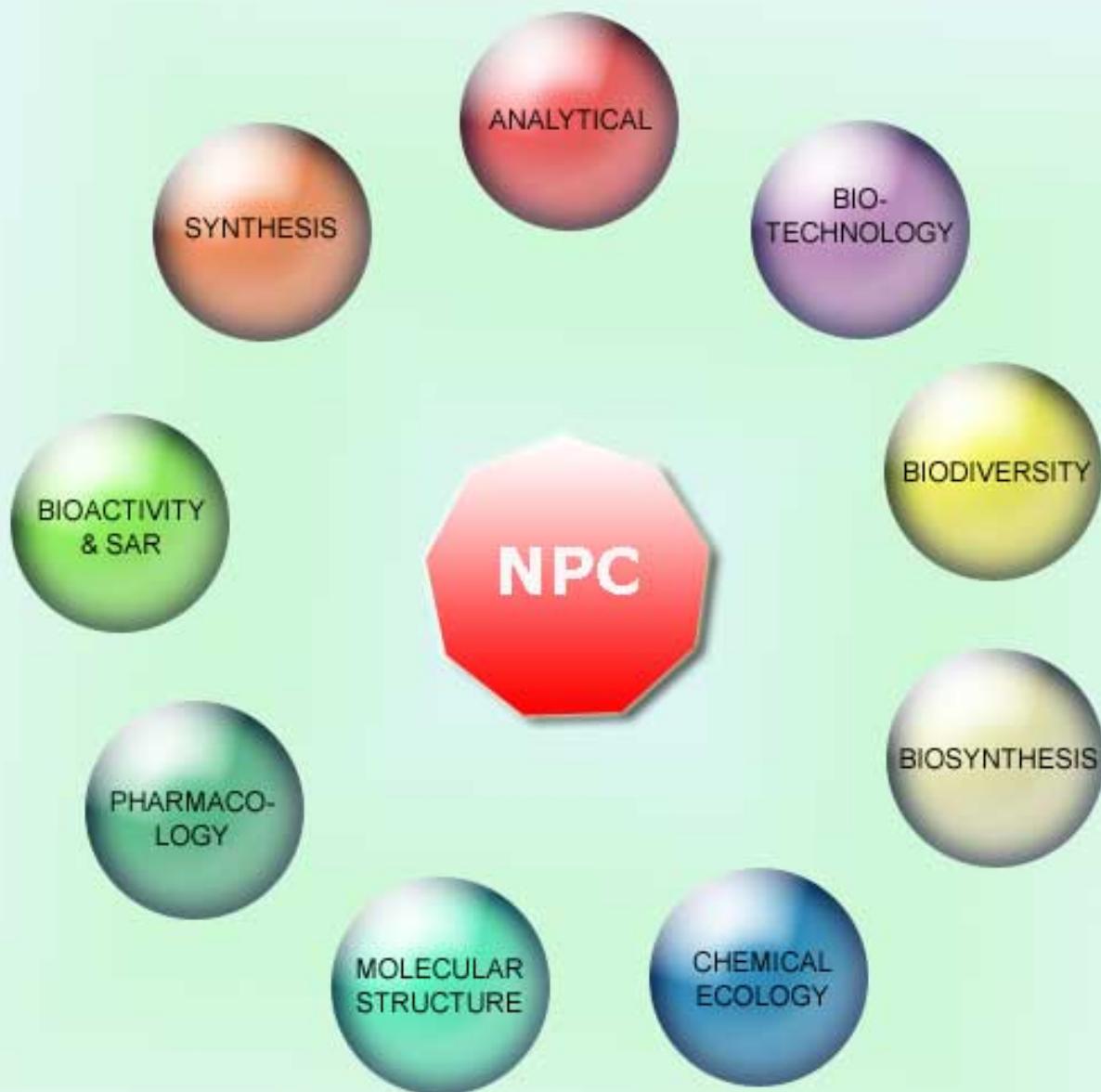


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## ***Thymus ciliatus* – The Highest Thymol Containing Essential Oil of the Genus**

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The essential oil obtained by hydrodistillation of the aerial parts of *Thymus ciliatus* Desf. collected at Batna (Eastern Algeria) in May 2008 was investigated by GC and GC/MS. Eighteen components, representing 99.6% of the essential oil, were detected of which thymol (79.1%) and *p*-cymene (5.6%) were the major components.

**Keywords:** *Thymus ciliatus* Desf., Lamiaceae, essential oil composition, thymol, carvacrol, *p*-cymene.

*Thymus* species (Lamiaceae family) have been found to possess significant pharmacological and biological activities [1a-1j]. Most of the biological activities of *Thymus* species are related to their major constituents, namely thymol and carvacrol. Twelve species are distributed in Algeria [2a], nine of them endemic. In continuation of our works on *Thymus* essential oils [2b-2d], we present here the composition of the endemic *T. ciliatus* Desf. (Arabic 'Zaatar'), which is used in the Aures region (eastern Algerian) as a folk remedy for bronchitis, pulmonary infection, flu, cough and some gastrointestinal disorders. To our knowledge, no previous research has been conducted on *T. ciliatus*.

Hydrodistillation of the aerial parts of *T. ciliatus* yielded 2.1 % of a yellowish oil. Eighteen components were identified, representing 99.6% of the essential oil, mainly characterized by thymol (79.1%) and *p*-cymene (5.6%) (Table 1).

From our results on the antibacterial species *T. numidicus* growing in Constantine (Eastern Algeria) [2c,2d], the percentages of thymol (68.2%) and carvacrol (16.9%) formed the highest amounts of phenols to be found in a *Thymus* species. The oil of the antibacterial species *T. fontanesii* [2b] was also reported as a high thymol chemotype (67.8%), in contrast with the antimicrobial oil of *T. algeriensis*, endemic to north central Algeria [2e], which was

**Table 1:** Chemical composition of *Thymus ciliatus* essential oil.

RI <sup>a</sup>	Compound	% composition
924	$\alpha$ -Thujene	0.4
932	$\alpha$ -Pinene	1.6
961	1-octen-3-ol	0.1
963	$\beta$ -Pinene	t
975	$\beta$ -myrcene	0.4
997	$\alpha$ -Phellandrene	t
1002	$\alpha$ -Terpinene	0.3
1006	<i>p</i> -Cymene	5.6
1015	1,8-Cineole	t
1035	$\gamma$ -Terpinene	4.1
1074	Linalool	3.5
1178	Terpin-4-ol	t
1235	Thymol methyl ether	0.1
1275	Thymol	79.1
1286	Carvacrol	4.4
1416	$\beta$ -Caryophyllene	t
1575	Spathulenol	t
1595	Caryophyllene oxide	t

<sup>a</sup>RI = retention indices as determined on DB-5MS column using homologous series of *n*-alkanes; t = trace (< 0.01%).

mainly characterized by linalool (47.3%), thymol (29.2%) and *p*-cymene (6.8%). More recent studies have reported high percentages of thymol in essential oils of *T. vulgaris* from Germany (49.6%) [2j], *T. serrulata* from Ethiopia (43.8%) [3a], and *T. vulgaris* from Jordan (67.3%) [3b] and Poland (67.3%) [3c]. Compared with the reported chemotype essential oils, the present oil of *T. ciliatus*, characterized mainly by thymol (79.1%) and *p*-cymene (5.6%), seems to be the highest thymol-containing chemotype.

## Experimental

**Plant materials:** The aerial parts of *T. ciliatus* were collected during the flowering period from wild-growing plants around Batna, Eastern Algeria, in May 2008. A voucher specimen (No: ZK ATc 05/08) was deposited in the Faculty of Sciences, University Mentouri-Constantine, Algeria.

**Oil extraction:** Fresh aerial parts of *T. ciliatus* (200 g) were subjected to hydrodistillation using a Clevenger-type apparatus for 3 h, yielding 2.1% (mean value) of a yellowish oil. This was dried over anhydrous sodium sulfate and stored in sealed vials under refrigeration prior to analysis.

**Gas chromatography-mass spectrometry:** The essential oil was analyzed using a Hewlett Packard 6890 GC-MS spectrometer. The oil (0.1 µL) was introduced directly into the source of the MS via a transfer line (280°C) with a split ratio of 1:50. Ionization was obtained by electron impact (70 eV, source temperature 200°C, resolution 1000). The GC

column was an HP-5ms fused silica capillary with a (5% phenyl)-methylpolysiloxane stationary phase, film thickness 0.25µm, length 30 m, and an internal diameter of 0.25 mm. Helium was the carrier gas with a 2.0 mL/min flow rate. Inlet temperature was 200°C and MSD detector temperature was 280°C. The oven temperature was programmed as isothermal at 60°C for 1 min, then raised to 275°C at 4°C/min and held at this temperature for 4 min. Quantitative data were obtained by electronic integration of the FID area data, without response factor correction. Essential oil components were identified based on their retention indices, and by comparison of their mass spectral fragmentation patterns with those reported in the literature [4a-4c] and stored on the MS library Wiley database.

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## References

- [1] (a) Duke JA. (1989) *CRC Handbook of Medicinal Herbs*. CRC Press, Boca Raton, FL, 483-484; (b) Daferera DJ, Ziogas BN, Polissiou MG. (2000) GC-MS analysis of essential oils from some Greek aromatic plants and their fungitoxicity on *Penicillium digitatum*. *Journal of Agricultural Food Chemistry*, **48**, 2576-2581; (c) Vardar- Unlü G, Candan F, A Sökmen A, Daferera DJ, Polissiou MG, Sökmen M, Dönmez E, Tepe B. (2003) Antibacterial and antioxidant activity of the essential oil and methanol extracts of *Thymus pectinatus* Fisch. et Mey var. *pectinatus* (Lamiaceae). *Journal of Agricultural and Food Chemistry*, **51**, 63-67; (d) Azaz AD , Irem HA , Kurkcuglu M. (2004) Composition and the *in vitro* antimicrobial activities of the essential oils of some *Thymus* species. *Zeitschrift fuer Naturforschung*, **59c**, 75-80; (e) Kim J, Lee YS, Lee SG, Shin SC, Park IK. (2008) Fumigant antifungal activity of plant essential oils and components from West Indian bay (*Pimenta racemosa*) and thyme (*Thymus vulgaris*) oils against two phytopathogenic fungi. *Flavour and Fragrance Journal*, **23**, 272-277; (f) Rota MC, Herrera A, Rosa M, Sotomayor JA, Jordan MJ. (2008) Antimicrobial activity and chemical composition of *Thymus vulgaris*, *Thymus zygis* and *Thymus hyemalis* essential oils. *Food Control*, **19**, 681-687; (g) Golmakani MT, Rezaei K. (2008) Comparison of microwave-assisted hydrodistillation with the traditional hydrodistillation method in the extraction of essential oils from *Thymus vulgaris* L. *Food Chemistry*, **109**, 925-930; (h) Soković MD, Vukojević J, Petar D, Marin PD. (2009) Chemical composition of essential oils of *Thymus* and *Mentha* species and their antifungal activities. *Molecules*, **14**, 238-249; (i) Miguel MG, Costa LA, Cristina A, Barroso JG, Pedro LG. (2007) Assessment of the antioxidant ability of *Thymus albicans*, *T. mastichina*, *T. camphoratus* and *T. carnosus* essential oils by TBARS and micellar model systems. *Natural Product Communications*, **2**, 399-406; (j) Buchbauer G, Krastanov A, Stoyanova A, Schmidt E, Jirovetz L. (2008) Chemical composition, olfactory evaluation and antioxidant effects of an essential oil of *Thymus vulgaris* L. from Germany. *Natural Product Communications*, **3**, 1047-1050.
- [2] (a) Quezel P, Santa S. (1963) *Nouvelle Flore de l'Algérie et des Régions Désertiques Méridionales*. C.N.R.S., Paris, France; (b) Ghannadi A, Sejjadi E, Kabouche A, Kabouche Z. (2004) *Thymus fontanesii* Boiss. et Reut. – a potential source of thymol rich essential oil in North Africa. *Zeitschrift fuer Naturforschung*, **59c**, 187-189; (c) Kabouche Z, Kabouche A, Boutaghane N, Laggoune S, A. Kabouche A, Ait-Kaki Z, Benlabed K. (2005) Comparative antibacterial activity of five Lamiaceae essential oils from Algeria. *International Journal of Aromatherapy*, **15**, 129-133; (d) Kabouche A, Kabouche Z, Bruneau C. (2005) Analysis of the essential oil of *Thymus numidicus* Poiret from Algeria. *Flavour and Fragrance Journal*, **20**, 235–236; (e) Dob T, Dahmane D, Benabdellkader T, Chelghoum D. (2006) Studies on the essential oil composition and antimicrobial activity of *Thymus algeriensis* Boiss. et Reut *International Journal of Aromatherapy*, **16**, 95-100.
- [3] (a) Tirillini B, Pellegrino RM, Chessa M, Pintore P. (2008) Chemical composition of *Thymus serrulatus* Hochst. ex Benth. essential oils from Ethiopia: a statistical approach *Natural Product Communications*, **3**, 2069-2074; (b) Hudaib M, Aburjai T. (2007) Volatile components of *Thymus vulgaris* L. from wild-growing and cultivated plants in Jordan. *Flavour and Fragrance Journal*, **22**, 322-327; (c) Kowalski R, Wawrzynowski J. (2009) Essential oils analysis in dried materials and granulates obtained from *Thymus vulgaris* L., *Salvia officinalis* L., *Mentha piperita* L. and *Chamomilla recutita* L. *Flavour and Fragrance Journal*, **24**, 31-35.
- [4] (a) Adams RP. (2007) *Identification of Essential Oil Components by Gas Chromatography / Mass Spectrometry*, 4th Ed. Allured Publishing Co. Carol Stream, Illinois; (b) McLaugherty FW, Stauffer DB. (1991) *The Important Peak Index of the Registry of Mass Spectral Data*. John Wiley & Son, New York; (c) Swigar AA, Silverstein RM. (1981) Monoterpenes- Infrared, Mass, Proton-NMR, Carbon-NMR Spectra and Kovats Indices. Aldrich Chemical Company Inc., Madison.

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