AROMA PROFILE OF *THYMUS VULGARIS* L. GROWING WILD IN TURKEY

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Abstract. The establishment of aromatic profile of essential oil isolated by hydrodistillation of the overground parts of *Thymus vulgaris* was examined by a combination of GC and GC/MS. Identified were thirty components. They constituted approximately 100 % of the main elements of the essential oil, as follows: thymol (46.2%), γ-terpinene (14.1%), *p*-cymene (9.9%), linalool (4.0%), myrcene (3.5%), α- pinene (3.0%) and α-thujene (2.8%). The essential *T.vulgaris* characteristic was its high content of thymol (46.2%).

Keywords: thyme, *Thymus vulgaris*, Lamiaceae, essential oil, composition, thymol

INTRODUCTION

Thyme (*Thymus vulgaris* L.), belonging to the Lamiaceae family, is a pleasent smelling perennial shrub, which grows in several regions in the world (Davis, 1982). Thyme is one of the species used for seasoning. It is commonly known that the composition of the essential oils determines the specific aroma of plants and the flavor of the condiments. Many of the aromatic species belonging to the Lamiaceae family grow wild in the Mediterranean region (Marotti *et al*., 1996; Martins *et al*., 1999).

T.vulgaris is a well-known aromatic plant and its essential oil and aromatic water are used in the mountain regions of the Mediterranean parts of Turkey (Baytop, 1984; Akgül, 1993).

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Thyme is native to the Western Mediterranean region and Southern Italy. It is cultivated all over the world and has naturalized in some areas including the North-eastern US. Thyme is used for seasoning fish, poultry, soups and vegetables, for flavoring liqueur, in herbal teas prepared for colds and flues, as well.

Thyme and its oil have been used as fumigants, antiseptics, antioxidant, and mouth washes. The main essential oil in thyme, thymol, is active against *Salmonella* and *Ataphylococcus bacteria*. The main constituents of thyme include thymol, carvacrol and flavonoids often thought to have antibacterial, anti-flatulent and anti-worm properties. The known primary constituents of thyme include essential oil (borneol, carvacrol, linalool, thymol), bitter principle, tannin, saponins, and triterpenic acids. It is also used to suppress coughing, ease chest congestion and stimulate production of salvia (Baytop, 1984; Jellin *et al*., 2000; Lueng and Foster, 1996; Barnes *et al*., 2002).

Previous studies show that thymol has antifungal activity in a number of species, including *Cryptococcus neoformans, Aspergillus, Saprolegnia,* and *Zygorhynchus* species. Further studies confirm the antibacterial properties of this constituent, with demonstrated activity against *Salmonella typhimurium*, *Staphylococcus aureus*, *Escherichia coli* and the bacterial species (WHO, 1999).

Thyme, also known as creeping thyme, mountain thyme and wild thyme, a small shrubby plant with a strong, spicy taste and odor, is extensively cultivated in Europe and the U.S. for culinary use.

Bath additive made from the decoction stimulates blood flow towards the surface of the human body, alleviating thus the nervous exhaustion. An infusion of leaves is thought to relieve the headache.

Characteristic compounds of *T.vulgaris* essential oil have been established, namely: thymol (44.4-58.1%), p-cymene (9.1-18.5%), gamma-terpinene (6.9-18.9%) and carvacrol (2.4-4.2%) (Baranauskiene *et al*, 2003). However, studies on the *T.vulgaris* oil are not sufficient yet (Venskutonis *et al*., 1998; Guillen and Manzanos, 1998; Zambonelli *et al*., 2004). Therefore, in the present study, we focus on the chemical composition of the essential oils obtained from air-dried parts of *Thymus vulgaris* plants growing wild in Turkey.

MATERIAL AND METHODS

Plant material

Dried aerial parts of *Thymus vulgaris* were collected at the flowering stage in Icel (Mut) in August, 2003. Plants were identified and authenticated by a plant taxonomist.

Recovery of the essential oil

Dried overground parts of the plants (about 100 g) were cut into small pieces and subjected to hydrodistillation for 3 hrs using a Clevenger-type apparatus; the oils obtained were dried using anhydrous sodium sulphate. Essential oil yielded from the air-dried overground parts of *Thymus vulgaris* was 1.6%.

Identification of components

For the identification of the components, analytical Hp 5890 gas chromatograph equipped with FID (GC) was used, as well as DELSI 121 C apparatus fitted with a flame ionization detector and a CP WAX 51 fused silica column (25 m x 0.3 mm; 0.25 mm film thickness). Temperature was fixed on 50°C for 5 min and programmed to reach 220°C at the rate of 3°C per min. ACP WAX 51 fused silica WCOT column (60 m x 0.3 mm) for GC/ MS was used with helium as a carrier gas. For GC/MS a CPWAX 52 fused silica CB column (50m x 0.25 mm) was used with helium as a carrier gas (flow rate 1 ml/min), and then, coupled to a HP mass spectrometer: ionization energy 70 eV. Temperature programming was from 50-240°C at the rate 3°C/min. The samples were injected at the injector temperature of 240°C. Components were identified by comparing linear Kovats indices (KI), their retention times (RT) and mass spectra to those obtained from the authentic samples and/or the MS library.

The percentage composition of the essential oils was computed from 6C peak areas ignoring the correction factors. Qualitative analysis was based on a comparison between retention times and mass spectra and the respective data in the literature (Adams, 2001).

RESULTS AND DISCUSSION

Chemical composition of the essential oil of *Thymus vulgaris* are given in Table 1 in order of the retention times and Kovats indices of the constituents. The essential oil isolated by hydrodistillation from the aerial parts of *Thymus vulgaris* was found to be a pale yellow liquid, obtained in yield of 1,57% (v/w) based on dry weight. Thirty compounds were identified in the essential oil of *T.vulgaris*, representing 100 % of the oil, the major of which were: thymol (46.2%), γ-terpinene (14.1%), *p*-cymene (9.9%), linalool (4.0%), myrcene (3.5%), α- pinene (3.0%) and α-thujene (2.8%).

The essential oil from *T.vulgaris* contained α-pinene, α-thujene, myrcene, *p*-cymene, α-terpinene and limonene - the most important monoterpenes hydrocarbons. Monoterpenic hydrocarbons were rich in oil content. The amounts of oxygenated compounds such as 1,8-cineole, linalool, terpinen-4-ol in sample oil were found to be low.

Table 1. Composition of the essential oils of *Thymus vulgaris* L collected at Gülnar (Mersin), Turkey.

RT	RI	Components	Concentrations (%)
8.363	931	α- thujene	2.84
8.584	939	α-pinene	2.97
10.159	980	β-pinene	0.71
10.371	988	octan-1-en-3-ol	0.48
10.823	991	myrcene	3.45
11.237	1005	α-phellandrene	0.42
11.716	1018	α -terpinene	2.69
12.048	1026	*p*-cymene	9.91
12.177	1031	limonene	1.23
12.232	1033	1,8-cineole	1.96
13.365	1062	γ-terpinene	14.08
13.54	1068	cis-sabinen hydrate	0.19
14.296	1088	terpinolene	0.13
14.784	1096	linalool	3.99
17.290	1177	terpinene-4-ol	0.25
19.141	1235	thymol methyl ether	1.78
21.196	1290	thymol	46.21
21.334	1298	carvacrol	2.44
22.605	1352	terpinyl acetate	0.68
22.771	1356	eugenol	0.1
23.664	1386	β-bourbonene	0.09
23.830	1391	β-elemene	0.14
24.051	1401	methyl eugenol	0.21
24.641	1418	β-caryophyllene	1.64
24.880	1430	β-copaene	0.16
25.534	1454	α-humulene	0.17
26.271	1480	germacrene D	0.4
26.935	1509	β-bisabolene	0.33
27.331	1520	δ-cadinene	0.14
28.897	1581	caryophyllene oxide	0.21

Thymus sp oil was the subject of several studies conducted in the past (Tümen et al.1998; Barazandeh, 2004; Couladis *et al*., 2004; Ligia *et al*., 1999; Moldao-Martins *et al*., 1999; Asfaw *et al*., 2000; Figueiredo *et al*., 2001; Hedhili *et al*., 2001; Baser *et al*., 2001; Kalvandi *et al*., 2004; Zambonelli *et al*., 2004; Baranauskiene *et al*., 2003; Guillen and Manzanos, 1998; Tumen *et al*., 1994; Miguel *et al*., 2004). It was previously reported (Baranauskiene *et al*., 2003) that the oil of *T.vulgaris* contained thymol (44.1-58.1%), *p*-cymene (9.1-18.5%), γ-terpinene (6.9-18.9%) and carvacrol (2.4-4.2%). Zambonelli *et al*.(2004) found thymol (22-38%), γ-terpinene and p-cymene. Guillen and Manzanos (1998) reported the presence of 1,8-cineole and linalool. *Thy-*

mus capitatus is very rich in carvacrol and *p*-cymene (Hedhili et al., 2001), *T.migricus* and *T.fedtschenkoi* var. *hadelii* in carvacrol, thymol and linalool (Baser *et al*., 2001), *T.cilicicus* in α-pinene (16.7%), 1,8-cineole (10.4%) and *cis*-verbenol (8.2%) (Tumen *et al*., 1994), *T.aznavourii* in α-*pinene* (11.1%), (E)-β-farnesene (16.1%), germacrene D (Tumen et al., 1998), *T.zygis* subsp.sylvestris in thymol (21.0%), geranyl acetate (17.0%) and geraniol (13%) (Moldao-Martins *et al*., 1999), *T.lotocephallus* in 1,8-cineole (11.0-19%), linalyl acetate (6.14%) and linalool (4-12%) (Figueiredo *et al*., 2001); *T.eriocalyx* in thymol (42.8-43.1%), linalool (4.0-11.1%), γ-terpinene (6.0-6.3%), 1,8-cineole (5.6-3.3%), borneol (3.4-4.9%) and α-terpineol (1.8-7.1%) (Kalvandi *et al*., 2004). Comparison between these results and the results of other reports showed differences, probably due to the plant varieties or sites, as well as the time of harvesting. Differences observed may be due to the different environmental and genetic factors, different chemotypes and the nutritional status of the plants or any other factors that can influence the oil composition.

References

Adams R., 2001. *Essential oil comporents by Quadrupole GC/MS.* Allured Publishing Corp., Carol Stream, IL, USA.

Asfaw,N., oresund,H.J., Skattebol,L., Tonnesen,F., Aasen,A.J., 2000. Volatile oil constituents of two *Thymus* species from Ethiopia Flavour and Fragr. J.15(2):123-125.

Baranauskiene,R., Venskutonis,P.R., Viskelis,P., Dambrauskiene,E., 2003. Influence of nitrogen fertilizers on the yield and composition of thyme (*Thymus vulgaris*). Journal of Agriculture and Food Chemistry 51(26): 7751-7758.

Barazandeh, M.M.., 2004. Essential oil composition of *Thymus fallax* Fisch et C.A. Mey. From Iran. J.Esent. Oil Res. 16(2):101-102.

Barnes,J., Anderson,L.A., Phillipson,J.D., 2002. Herbal Medicines. A Guide for Healtheare Profe Second Edition, London:Pharmaceutical Pres.

Başer,K.H.C., Demirci,B., Kırımer,N., Satil,F., Tumen,G., 2001. The essential oils of *Thymus migricus* and *T.fedtschenkoi* var. *handeli* from Turkey. Flavour and Fragrance J.17(1):41-45.

Baytop T., 1984. *Treatment with plants in Turkey*. Publ. nº 3255. Istanbul University. Istanbul. Turkey .

Couladis,., Tzakou,O., Kujundzis,S., Sokovic,M., Mimica-Dukic,N., 2004. Chemical analyses and antifungal activity of *Thymus striatus*. Phytatherapy Research 18(1): 40-42.

Davis,P.H.(1982). Flora of Turkey and the East Aegean Islands. Vol.7, 320-354 pp, University Pres, Edinburgh.

Figueiredo,A.C., Miguel,M.G., Duarte,A.M.F., Barraso,J.G., Pedro,L.G., 2001. Essential oil composition of *Thymus lotocephallus* G. Lopez & R.Morles, collected during flowering and vegetative phases. Flavour Fragr. J.16(6):417-421.

Guillen,M.D., Manzanos,M.J., 1998. Composition of the extract in dichloromethane of the aerial parts of a Spanish wild growing plant *Thymus vulgaris* L. Flavour Fragrance J. 13(4): 259-262.

Hedhili,L., Romdhane,M., Abderrabba,A., Planche,H., herif,I., 2001. Variability in esential oil composition of Tunisian *Thymus capitatus* (L.) Hoffmanns. Et Link. Flavour and Fragrance J. 17(1):26-28.

Jellin,J.M., Batz,F., Hitchens,K., 2000. Natural Medicines Comprehensive database. Third Edition. California: Therapeutic Research Faculty.

Kalvandi,R., Sefidkon,F., Atri,M., Mirza,M., 2004.Analysis of the essential oil of hymus eriocalyx from Iran. Flavour and Fragrance .19(4):341-343.

Lueng,A.Y., Foster,S., 1996. Encyclopedia of Common Natural Ingredients Used in Food, Drug, Cosmetics. Second Edition. New York,NY:Wiley & Sons.

Miguel,G., Simoes,M., Figueiredo,A.C., Barroso,J.G., Pedro,L.G.,Carvalho,L., 2004. Composition and antioxidant activities of the essential oils of *Thymus caespititius*, *Thymus camphoratus* and *Thymus mastichina*. Food hemistry 86:183-188.

Moldao-Martins,M., Bernardo-Gil,M.G., Beirao Da Costa,M.L., Rouzet,M., 1999. Seasonal variation in yield and composition of *Thymus zygis* L. subsp. *sylvestris* essential oil. Flavour Fragrance J. 14(3):177-182.

Salgueiro,L.R., Cunha,A.P., Tomas,X., Canigueral,S., Adzet,T., Vila,R., 1999. The essential oil of *Thymus villosus* L.ssp. *villosus* and its chemical Polymorphism. Flavour and Fragrance J.12(2):117-122.

Tümen,G., Baser, K.H.C, Demirci,B., Ermin,N., 1998. The essential oils of Satureja coerulea Janka and *Thymus aznavourii* Velen. Flavour and Fragrance J. 13(1):65-67.

Tumen,G., Koyuncu,M., Kırımer,N., Baser,K.H.C., 1994. Composition of the essential oil of *Tymus cilicicus* Boiss. & Bal. J.Essent. Oil Res. 6:97-98.

Venskutanis,R., Poll,L., Larsen,M., 1998. Influence of drying and irradiation on the composition of volatile compounds of thyme (*Thymus vulgaris* L.). Flavour and Fragrance J.11(2):123-128.

World Health Organization (WHO), 1999. Monographs on Selected Medicinal Plants. WHO, Geneva.

Zambonelli,A., D'Aulerio,A.Z., Severi,A., Benvenuti,S., Maggi,L., Bianchi,A., 2004. Chemical composition and fungicidal activity of commercial essential oils of Thymus vulgaris L.. J.Essent. Oil Res. 16(1):69-74.