Acta Pharmaceutica Sciencia
52: 19-22 (2010)

Essential oil composition of *Majorana hortensis* (Moench) from subtropical India

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Abstract

Hydro-distilled essential oil of *Majorana hortensis*, grown in the lower region of Kumaon Himalaya was analysed by GC and GC-MS. Thirty-two constituents accounting 96.32 % of the oil were identified. The oil was mainly composed of monoterpenes and to a small extent sesquiterpenes. The major constituents of this oil were (*Z*)-sabinene hydrate (30.81 %), terpinen-4-ol (22.02 %), (*E*)-sabinene hydrate (9.16 %), sabinene (6.73 %) and *p*-cymene (5.15 %).

Key words: *Majorana hortensis*, lamiaceae, essential oil, GC-MS, (*Z*)-sabinene hydrate.

Introduction

Sweet marjoram (*Majorana hortensis* Moench.) is a perennial herb native to Cyprus and eastern Mediterranean countries (Ietswarrt 1980). The aerial parts of the plants are used for isolation of oil, which has a lot of uses in flavour, perfumery and pharmaceutical industry. In food industry, it is mainly used as a spice in sausages, but its use in baked goods, processed vegetables, condiments, soups, snack foods and gravies are also reported (Burdock 1995). The plant is also reported to possess anticancer (Hartweel 1969), antioxidant (Ei-Ghorab et al. 2004) and antifungal properties (Afifi and Dowidar 1976, Pruthi 1980). The essential oil composition of marjoram has been investigated by number of workers from different countries (Sarer et al. 1982, Nykanen 1986, Lawrence 1989, Komaitis et al. 1992, Baser et al. 1993, Vera and Chane-Ming 1999, Barazandeh 2001, Novak et al. 2002). A review of literature revealed that the marjoram has also been investigated from south India (Rao 2000) and mid hills of northern India (Mishra et al. 2004) however; there is no report from lower region of northern India. Therefore, aim of the present investigation was to fill the gap and explore the possibilities for commercial cultivation of *Majorana* in this region.

Materials and Methods

Plant Material and Essential oil Extraction: The fresh aerial part of *M. hortensis* were collected during flowering stage from experimental farm of Central Institute of Medicinal and Aromatic plants (CIMAP), Research Centre, Pantnagar, Uttarakhand, India in the month of March.

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The plant material was subjected to hydrodistillation in Clevenger's apparatus for 3 h to isolate essential oil. The essential oil was dried over anhydrous sodium sulphate and used for analysis.

GC and GC-MS analysis: The GC analyses of the oil sample was carried out on a Perkin-Elmer Auto XL gas chromatograph equipped with FID using PE-5 (50 m x 0.32 mm; 0.25 μm film coating) fused silica column. Hydrogen was the carrier gas at 1.0 ml/min. Temperature programming was done from 100^0-280^0C at 3^0C/min. The injector and detector temperatures were 220°C and 300°C. GC-MS recorded on a Perkin Elmer Auto System XL GC and Turbo Mass Spectrometer fitted with fused silica capillary column, PE-5 (50 m x 0.32 mm, film thickness 0.25 μm). The column temperature was programmed 100° - 280°C at 3°c/min, using helium as carrier gas at constant pressure of 10 psi. MS conditions were: EI mode 70 eV, ion source temperature 250°C.

Identification of compounds: The identification was done on the basis of retention time, Kovats Index, MS Library search (NIST and WILEY), n-alkane (C_9-C_{22}) hydrocarbons pattern (Nile, Italy) and by comparing mass spectra with the MS literature data (Adams 2001, Jennings and Shibamoto 1989). The relative amounts of individual components were calculated based on GC peak areas without using correction factors.

Results and Discussion

The hydro-distillation of aerial parts of *M. hortensis* produced a colorless essential oil with a yield of 0.35 % on fresh weight basis. Thirty-two compounds accounting for 96.32 % of the oil were identified. The identified compounds along with their relative percentages are given in the Table 1. The major components of this oil were (*Z*)-sabinene hydrate (31.81 %), terpinen-4-ol (22.02 %), (*E*)-sabinene hydrate (9.16 %), α-terpineol (3.56 %), *p*-cymene (5.15 %) and sabinene (6.73 %). Other important constituents of this oil were linalool (1.84 %), β-myrcene (1.77 %), (*Z*)-sabinene hydrate acetate (1.61%), β-caryophyllene (1.41 %), limonene (1.30 %) geraniol (1.13 %), α-terpinene (1.09 %) and α-terpinolene (0.85 %).

The comparison of essential oil composition from different countries is also presented in Table 1. The oils reported from Reunion Island, Iran, Germany, Egypt, mid hills of north India and south India contain lower concentration of (*Z*) and (*E*) sabinene hydrates compared to present oil. The oils of Reunion Island, mid hills of north India, South India, Egypt and Germany possessed terpinen-4-ol as a major constituent (38.40%, 30.55%, 24.25%, 20.19% and 19.7%, respectively). However, linalyl acetate (26.1%) and sabinene (12.0%) were the principle components of marjoram oil of Iran origin. The observed differences may be probably due to different environmental, genetic/chemotypic, isolation process and pedogenetic factors.

Conclusion

The compounds typical for marjoram, (*Z*)-sabinene hydrate and its acetate, responsible for the spicy and herby flavour (Nitz et al. 2002) are present in good amount in present oil. Therefore, marjoram oil of lower region of Uttarakhand could be a better option for flavour industry.

Table 1. Essential oil composition of Marjoram (*Majorana hortensis* Moench.) grown in lower region of Kumaon Himalaya, Uttarakhand

Compound*	RT (min)	KI	Area (%)						
			Our result	Reunion Island (Vera and Chane-Ming 1999)	Iran (Barazandeh 2001)	Germany (Novak et al. 2002)	Egypt (El-Ghorab et al. 2004)	South India (Rao 2000)	Mid hills (Mishra et al. 2004)
α-Thujene	6.482	927	0.31						
α-Pinene	6.752	935	0.56	0.61	0.80	0.70	10.23	0.38	0.53
Sabinene	7.664	974	6.73	4.94	12.0	7.8	-	7.07	4.81
β-Pinene	7.833	980	0.03						
δ-2-Carene	-	-	-	-	-	-	8.85	-	-
β-Myrcene	8.138	989	1.77						
α-Terpinene	8.822	1021	1.09	2.75	-	11.4	-	-	2.67
p-Cymene	9.050	1025	5.15	7.01	5.7	1.3	-	9.57	5.83
Limonene	9.203	1030	1.30						
β-Phellandrene	9.295	1032	0.72						
(*Z*)-β-Ocimene	9.373	1038	0.13						
γ-Terpinene	10.087	1062	3.43	6.89	8.8	18.4	14.13	4.44	6.37
(*E*)-Sabinene hydrate†	10.469	1068	9.16	3.49	3.1	3.9	5.25	5.89	3.63
α-Terpinolene	11.148	1090	0.85						
(*Z*)-Sabinene hydrate†	11.630	1095	30.81	14.95	8.7	8.6	-	23.6	16.86
Linalool	12.295	1098	0.13						
(*Z*)-Sabinene hydrate acetate	12.418	-	1.61						
Terpinen-4-ol	14.694	1177	22.02	38.4	-	19.7	20.39	24.25	30.55
α-Terpineol	15.106	1188	3.56	4.88	6.5	2.9	11.06	4.52	3.71
(*Z*)-Piperitol	15.339	1194	0.53						
(*E*)-Piperitol	15.734	1210	0.37						
Geraniol	17.254	1237	1.13						
Linalyl acetate	17.471	1257	0.25	0.30	26.1	3.4	-	-	2.41
Bornyl acetate	18.389	1285	0.41						
Terpinen-4-yl acetate	19.099	-	0.26						
Thymol	19.520	1313	0.19						
Eugenol	20.468	1362	0.37						
Geranyl acetate	22.673	1373	0.14						
β-Caryophyllene	25.250	1419	1.41						
α-Humulene	28.483	1462	0.61						
Spathulenol	31.969	1577	0.56						
Caryophyllene oxide	32.298	1584	0.30						
β-Eudesmol	34.320	1651	0.43						
Total identified (%)			96.32						

RT=Retention time; KI= Kovat's index on PE-5 culoumn (relative to *n*-alkane)
*Mode of identification: Kovat's index and Mass spectra
†cis/trans related to methyl vs. isopropyl groups

Acknowledgement

The authors are thankful to Director, CIMAP (CSIR) Lucknow, Uttar Pradesh for providing necessary facilities and encouragement.

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Received: 29.12.2009
Accepted: 19.02.2010