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Qualitative analysis of essential oil of *Rosmarinus officinalis* L. cultivated in Uttaranchal Hills, India

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Abstract

Gas chromatography and gas chromatography and mass spectroscopy analysis of essential oil hydrodistilled from fresh aerial part of rosemary (*Rosmarinus officinalis*) cultivated in Uttaranchal, India, resolved into 33 compounds representing 96.29% of the essential oil according to their chromatographic retention indices and mass spectra. The major compounds of the oil were, camphor (26.40%), 1, 8-cineole (23.40%), α-pinene (9.94%), camphene (5.83%), myrcene (4.86%), bornyl acetate (3.97%), verbenone (3.32%), limonene (3.08%), borneol (2.05%) and α-terpineol (2.68%).

Keywords: essential oil composition, rosemary, *Rosmarinus officinalis*.

Rosmarinus officinalis L. (Family: Lamiaceae), a dense aromatic shrub with dark green lavender like leaves, is a native of the Mediterranean region. Though rosemary was introduced into India in the Nilgiri Hills several decades ago, it has not well established as a cultivated crop. The chemical composition of rosemary oil from different countries has been a subject of extensive study (Fournier *et al.* 1989; Chalchat *et al.* 1993; Pino *et al.* 1998; Perez-Alonso *et al.* 1995; Tomei *et al.* 1995; Porte *et al.* 2000; Abdelaziz *et al.* 2000; Diab *et al.* 2002; Serrano*et al.* 2002; Mauhssen & Rached 2003). Chemical composition of essential oil as a function of geographical region has been reported earlier (Solinas *et al.* 1996; Moretti *et al.* 1998; Kandeel & Peter 2001; Mastro *et al.* 2004; Munnu & Singh 2004). The objective of the present study was to examine the yield and quality of essential oil of rosemary introduced and being cultivated in the hilly terrain of Uttaranchal, India.

Plant material: The plant material was cultivated at Central Institute of Medicinal and Aromatic Plants, Resource Centre, Purara, Bageshwar (1,500–1,560 m MSL altitude, 79° 51′38″E longitude and 29°38′45″ N latitude) of Uttaranchal State in western Himalayas with a sub-tropical climate.

Extraction of oil: Fresh aerial part (100 g) from 5 month-old rosemary plants were harvested and hydrodistilled using Clevenger type apparatus for 4 h.

GC analysis: The essential oil was analysed

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on Perkin Elmer Auto XL GC using a PE-5 column (50 m x 0.32 mm x 0.25 m film) with temperature programme from 100°C to 280°C @ 3°C/min, initial hold time 2 min, hydrogen at 10 psi inlet pressure; injector 220°C, detector FID 300°C. Data was processed on Turbochrome Navigator software.

GC-MS analysis: GC-MS analysis of essential oil was performed on Perkin Elmer Turbomass system using identical column and temperature programme and Helium as a carrier at 10 psi. Identification of compounds was carried out based on Wiley and NIST libraries search.

The yield of rosemary oil distilled from fresh parts of plants ranged between 1.5% to 2.0% on fresh weight (v/w) basis. The percentage yield of the rosemary oil was at par with the earlier observations made by various researchers in different parts of the world. However, the yield of rosemary oil from Rio de Janerio (Brazil) was as high as 2.5% which is high in comparison with other values found in literature (Porte *et al.* 2000) and as low as 0.3% from the USSR. GC and GC-MS analysis resulted in the identification of 33 compounds, accounting for 96.29% of the oil (Table 1). The major compounds of the oil were camphor (26.40%), 1, 8-cineole (23.40%), α-pinene (9.94%), camphene (5.83%), myrcene (4.86%), bornyl acetate (3.97%), verbenone (3.32%), limonene (3.08%), borneol (2.05%) and a-terpineol (2.68%). The chemical composition of the oil was characterized by high amounts of camphor, 1, 8-cineole, myrcene, and a-pinene similar to those found in the oils from South India, Brazil, Hungary, Turkey and Spain (Soliman *et al.* 1994; Perez-Alonso 1995; Domokos *et al.* 1997; Mallavarapu *et al.* 2000; Porte *et al.* 2000). It has been reported in literature (Boelens 1985) that generally 2–3 types of rosemary oils exist namely, (a) with high cineole and high camphor content from France, Greece, Tunisia and Italy, (b) with low cineole content from Spain, Yugoslavia and some parts of Italy, and (c) with high a-pinene and verbnone content from Algeria and Corsica (Boutekedjiret *et al.* 1998). From the present analysis it is evident that the quality of rosemary oil of the plants under investigation is similar to that of a type having high cineole and camphor contents.

Table 1. Chemical composition of rosemary oil from Uttaranchal, India

Compound	RT (min)	Area %
cis-3-Hexanol	4.90	0.08
α-Thujene	6.50	0.14
α-Pinene	6.77	9.94
Camphene	7.20	5.83
1, Octan-3-ol	7.46	0.44
Sabinene	7.67	0.26
Myrcene	7.90	4.86
α-Phellandrene	8.50	0.79
α-Terpinene	8.83	0.13
P-Cymene	9.05	0.91
Limonene	9.22	3.08
β-Phellandrene	9.30	1.65
1, 8-Cineole	9.41	23.40
γ-Terpinene	10.09	0.51
cis-Sabinene-hydrate	10.46	0.53
Terpinolene	11.15	0.42
Linalool	11.25	1.24
trans-Sabinene hydrate	11.75	0.11
Filifolone	11.96	0.06
Chrysanthenone	12.42	0.14
Camphor	13.60	26.40
Borneor	14.32	2.05
Terpinene-4-ol	14.65	1.46
α-Terpineol	15.11	2.68
Myrtenol	15.44	0.43
Verbenone	16.07	3.32
p-Mentha-1,8-dien-3-one	18.55	0.14
Bornyl acetate	19.06	3.97
Eugenol	22.05	0.17
Methyl eugenol	23.77	0.16
β-Caryophyllene	25.26	0.40
α-Humulene	26.73	0.39
Caryophyllene oxide	32.31	0.16
Total		96.29

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