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Essential Oil Composition of *Rosmarinus officinalis* L. from Kashmir (India)

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Abstract

Rosmarinus officinalis, commonly known as rosemary, is a woody, perennial herb with fragrant, evergreen, needle-like leaves and white, pink, purple, or blue flowers. The aerial parts of *R. officinalis* L. (rosemary) on steam distillation yielded an essential oil with characteristic refreshing woody odour. Thirty eight compounds were characterized. Major compounds of the oil identified were α-pinene (16.33), 1, 8-cineole (14.33), camphor (22.01), camphene (9.28), β-pinene (5.97), β-phellandrene (5.19), bornyl acetate (4.59), myrcene (4.31), borneol (3.35), terpinen-4-ol (1.11), α-terpineol (1.03), verbenone (1.39), γ-terpinene (1.04), linalool (1.16) and β-caryophyllene (2.88%).

Keywords: *Essential Oil; Rosmarinus officinalis; Rosemary*

Introduction

Rosmarinus officinalis also known as 'Rosemary' is a common household plant. *R. officinalis* belongs to the family Lamiaceae and is grown in many parts of the world. Its name is derived from the Latin word "*ros*" meaning dew and "*marinus*" meaning sea which together means 'dew of the sea'. It has been named as "The Herb of the Year" in 2001 by the International Herb Association. Rosemary is also being regarded as 'The herb of faithfulness' as Elizabethan sweethearts carried a twig of rosemary as its sign. Nowadays, the market demand of the plant is growing, as the plant is being used in several commercially available products. Rosemary was introduced to Britain by the Romans and it is still loved today particularly by the Italians and the British, who use it in their cooking. In ancient Greece and Rome, it was believed that this plant strengthens the memory, hence it is also being known as 'The Herb of Remembrance and fidelity' [1]. It was introduced in India by the Europeans as a garden plant due to its pleasant fragrant scented leaves [2]. *R. officinalis* contains pine like leaves, which are the main crux of all the medicinal and the other benefits derived from its oil. Its leaves are leathery, strongly re curved, and have fringed margins with prominent midrib. Leaves are about 1.0 - 2.5 cm long and about 4 cm in width. Leaves are green from the upper surface but appear to be grey from the lower surface due to numerous trichomes [1]. *R. officinalis* has been used for both medicinal and culinary purposes due to its aromatic properties and health benefits [3].

In view of its essential oil and medicinal properties it has become a household plant in many parts of the World. The plant is being cultivated in Spain, Greece, Italy, France, Algeria and Morocco. In traditional medicine it is used as an analgesic, anti-rheumatic, carminative, cholagogue, diuretic and expectorant. Freeze dried rosemary leaves are used as culinary herb in seasoning for soups, meat, fish and poultry. The oil extracted finds use in food products and cosmetics such as soaps, creams, deodorants, hair tonics and shampoos. The oil has tonic stimulant properties and has substantial use in aromatherapy. The leaves possess antioxidant properties due to presence of rosmarinic acid, carnosol, carnosic acid and caffeic acid [4,5]. Ethanolic extract of the leaves have shown anti-diabetic activity in addition to antioxidant properties [6]. Recently antioxidant properties were attributed to rosemary oil and has been reported to possess anti-mycotoxigenic characteristics and could be used as a food preservative against toxigenic fungal infections [7-9].

Rosmarinic acid (RA) which is one of the major bioactive compounds of *Rosmarinus officinalis* has been found to exhibit multiple biological and pharmacological activities, including antioxidant, anti-allergic and anti-inflammatory effects [10]. Recently, our research group reported the synthesis of a new series of amide analogs of rosmarinic acid as effective antioxidants [10]. In this paper we report the chemical profile of the volatile oil by GC and GC-MS cultivated in the temperate region of Kashmir Valley.

Materials and Methods

Plant material

The plant of *Rosmarinus officinalis* was collected from IIIM Srinagar (Kashmir, India) and authenticated by Mr. Akhtar Hussain (Plant Taxonomist, University of Kashmir). The essential oil was obtained by hydrodistillation for 3 hours, using a modified Clevenger-type apparatus. The oil sample had characteristic fresh woody rosemary odour (Yield 1.08% on fresh weight basis). The oil was dried over anhydrous Na_2SO_4 and was placed at low temperature. Oil content (month wise) was also estimated by hydrodistillation using Clevenger apparatus.

GC and GC-MS Analysis

The analysis of the oil was carried out on a gas chromatograph Perkin Elmer- Autosystem XL with head space analyzer and FID, using a fused-silica capillary column (30 m X 0.32 mm i.d.; 0.25 µm film thickness) coated with 5% diphenyl and 95% polysiloxane (RTx-5). Oven temperature programmed from 60° - 220°C at 5°C per minute. Injector temperature 250°C and detector temperature 270°C. Carrier gas nitrogen at 8 psi, split ratio 1:80. Retention indices (RI) of the sample components and authentic compounds were determined on the basis of homologous n-alkane hydrocarbons under the same conditions and co-injection with standard compounds involving peak enrichment. GC-MS data obtained on Varian Mass Spectrometer-4000 using VF-5 column (60 m X 0.32 mm i.d.; 0.25 µm film thickness). Column temperature programmed 60 to 250°C at 5°C per minute. Helium was used as carrier gas at 10 psi. The identification was accomplished by comparison of the mass spectra with those reported in the NIST and WILEY libraries and those of published in literature [11]. Identification of the components was done by comparison of their linear RI with those from Mass Finder library.

Results and Discussion

Rosmarinus officinalis L. found in Mediterranean region was introduced in India several years back in Niligiris. Later on CIMAP introduced the plant for trial cultivation at its field station in Bangalore [12]. The oil sample had following physical properties, colour: colourless to light yellow, specific gravity: 0.893, refractive index: 1.467, optical rotation: - 5° at 18°C having fresh woody rosemary odour. Based on the seasonal variation in the oil content, it was found that the optimum stage of harvest is from the month of August to October. Quality profile of the essential oil was evaluated by GC and GC-MS. Thirty eight compounds were identified (Table 1).

Compound	Retention Index	Percentage
Tricyclene	920	0.04
α-thujene	924	0.28
α - pinene	932	16.33
Camphene	948	9.28
1-octen-3-ol	954	0.21
Sabinene	973	0.11
β-pinene	976	5.97
Verbenene	981	0.07
Myrcene	986	4.31
∝ α -phellandrene	1001	0.98
Δ^3-Carene	1006	0.01
α -Terpinene	1012	0.51
Limonene	1019	0.95
β-phellandrene	1023	5.19
1, 8-cineole	1028	14.33
(*E*)-β- ocimene	1039	0.01
γ-terpinene	1050	1.04
1-octanol	1064	0.15
(*Z*)-Sabinene hydrate	1076	0.65
Linalool	1087	1.16
1-oct-3-en-yn-acetate	1091	0.02
α -Campholenal	1107	0.01
Chrysanthenone	1109	0.17
Camphor	1122	22.01
Borneol	1150	3.35
Terpinen-4-ol	1162	1.11
α -terpineol	1177	1.03
Myrtenol	1186	0.03
α -Campholenol	1191	0.01
Verbenone	1205	1.39
Bornyl acetate	1270	4.59
Methyl eugenol	1368	0.11
(*E*)-β-caryophyllene	1420	2.88
∝ − α -humelene	1453	0.76
Germacrene –D	1471	0.01
Caryophyllene oxide	1566	0.12

Table 1: *Composition of essential oil of Rosmarinus officinalis L.*

The major constituents of *R. officinalis* L. oil identified are α-pinene (16.33), 1, 8-cineole (14.33), camphor (22.01), camphene (9.28), β-pinene (5.97), β-phellandrene (5.19), bornyl acetate (4.59), myrcene (4.31), borneol (3.35), (E)-β-caryophyllene (2.88), verbenone (1.39), linalool (1.16), terpinen-4-ol (1.11), α-terpineol (1.02) and γ-terpinene (1.04%). Rosemary oil has been the subject of various chemical and biological studies over the years [7,8,12-14]. The major constituents reported are mostly monoterpenes, like α-pinene, 1,8-cineole and camphor with variable amounts of camphene, myrcene, limonene, borneol, verbenone, bornyl acetate etc. Further variation in the chemical composition of essential oil depends upon number of factors such as environmental conditions, location, elevation, harvesting period, storage conditions etc. It is quite evident from the present studies that the composition of the oil produced in Kashmir is similar to that reported from Greece, France, Spain and USA. Rosemary oil finds application in soap, cosmetic, flavour industries but now maximum of the oil is destined for aromatherapy in view of its therapeutic potential [16]. The rosemary oil could be used as an essential ingredient in aromatherapy as it is one of the major complimentary therapies in which essential oils are used as the major therapeutic agents to treat several diseases and disorders.

Conclusion

Essential oil analysis of *R. officinalis* lead to the identification of 38 constituents. The essential oil was dominated by α-pinene (16.33), 1, 8-cineole (14.33), camphor (22.01), camphene (9.28), β-pinene (5.97), β-phellandrene (5.19), bornyl acetate (4.59), myrcene (4.31) and borneol (3.35). Based on the known antioxidant properties and the pleasant woody smell of the essential of *R. officinalis*, it is having tremendous scope in perfumery and aromatherapy industries. Further studies are warranted to check the toxicological parameters of the essential oil to make it a suitable candidate in the said industries.

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