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Studies on chemical composition of essential oil of wild *Cymbopogon martinii* (Roxb.) from Karnataka

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Abstract

The wild *Cymbopogon martinii* collected from Devarayana Durga Hill was subjected to study the chemical composition of the essential oils. The Hydro-distillation method was used to extract the Essential oil from the leaf and was subjected to GC/MS analysis. The Essential oil yield obtained from hydro-distillation method was 0.5% v/w and a total of 65 Compounds were identified. Out of 65 compound Geraniol (20.31%) was found as the major component whereas Geranyl acetate was found to be second highest constituent which was 15.19%, followed by Nerol (15.18%), Camphene (9.31%), Borneol (8.05%), D-limonene (6.05%), Cubenol (6.88%) and Linalool (5.14%).

Keywords: wild *Cymbopogon martinii*, essential oil extraction, GC-MS analysis, geraniol, geranyl acetate

Introduction

The Essential oils are concentrated, a volatile hydrophobic liquid containing aroma compounds produced from aromatic plants as secondary metabolites, which are commonly known as volatile or ethereal oils present in a specialized structure like oil cells or glandular trichome. The variation in the Essential oil composition is affected by environmental conditions and the process of extraction. The essential oils are a mixture of a wide variety of terpenoid compounds like Geraniol, Citral, Citronellol and citronellal are important aroma compounds present majorly in different species of Cymbopogon. Chemically, the essential oils are composed of terpenoids and aromatic polypropanoids synthesized via the mevalonic acid pathway for terpenes and the shikimic acid pathway for aromatic polypropanoids. In Cymbopogon, the essential oil composition varies significantly across the species by qualitative and quantitative variation. (Padalia *et al*., 2011) [9]. The Essential oil of lemongrass, palmarosa and citronella has immense commercial values in flavors, fragrances, cosmetics, perfumery, soaps, detergents, toiletry, tobacco products and pharmaceuticals (Ganjewala *et al*., 2009) [4].

Cymbopogon is one of the essential oil yielding aromatic crops belongs to the family of Poaceae. It comprises about 140 species worldwide; in contrast, 45 species were reported to occur in India. The different species of the genus Cymbopogon occur abundantly in tropics and subtropics regions of Asia, Africa and America, with a distribution ranging from mountains and grassland to arid zones (Bor, 1960; Soenarko,1997; Rao, 1997) [3, 13, 16] Cymbopogon species display wide variation in morphological attributes and essential oil composition at inter and intraspecific level.

Cymbopogon martini Roxb. belongs to the family Graminae is a tall, perennial and sweet-scented grass commonly known as palmarosa, yields an essential oil rich in Geraniol. of two varieties, namely 'Motia' and 'Sofia' exists, which are morphologically almost indistinguishable but show distinct chemotypes characteristics in terms of essential oil composition (Guenther, 1950; Sangwan, 2003) [5, 15]. It is used mainly as a source of high-quality Geraniol, which is used in high-grade perfumes and cosmetics. (Akhila, 2010) [1]. The characteristic odor of palmarosa oil is due to its high content of total alcohol, mainly Geraniol and a small but varying amount of esters associated with Geraniol. Moreover, the commercial palmarosa oil, which is rich in Geraniol, is distilled from a variety 'motia', whereas the essential oil produced from the variety 'Sofia' is known as ginger-grass oil. The main producer of palmarosa oil is India, Brazil and Madagascar. In India, the oil is produced in the states of Madhya Pradesh, Maharashtra, Tamilnadu, Karnataka and Andhra Pradesh. (Raina, 2003) [14]. The palmarosa oil is extensively used in soaps, and it imparts a rose-like prominent and lasting odor. This oil is also employed in the flavoring of tobacco and other mouth fresheners. It is valued in the perfumery industry as a source of high-grade geraniol ex palmarosa. However, the oil of ginger-grass is used in low-cost perfume formulations and scenting of soaps and cosmetics (Khanuja *et al*., 2005; Rajeswara *et al*., 2009) [6, 12]. Further, the essential oil produced from the variety 'motia' is predominantly composed of Geraniol with a small amount of geranyl acetate (Padalia *et al*., 2011; Raina *et al*., 2003) [9, 14]. The essential oil of the *C. martinii* was studied earlier by GC-FTIR revealed the presence of Geraniol (65%) and geranyl acetate (20%) as higher in composition (Prashar *et al*., 2003) [11]. Similarly, the essential oil composition of the leaf (53.41%) and flower (69.63%) of *C. martinii* showed the presence of Geraniol as Primary compound and Piperitone (6.0%) in flower and Nerol (24.76%) and α-pinene (4.32%) in leaf essential oils have also been identified (Nirmal *et al*., 2007) [8].

The commercial usage of these essential oils produced from the wild aromatic grasses and their cultivars are the interesting topics that lead to the study of the variation in chemical composition present in collected wild *Cymbopogon martinii*

Materials and Methods

Plant material

The fresh plant materials of wild *Cymbopogon martinii* were collected from Devarayana Durga hill, Tumkur district, Karnataka, in the month of July 2019 and duly identified. The collection site was located at an altitude of 13.37N and a longitude of 77.12E and it experiences a hot climate with low rainfall throughout the year. The plant was authenticated by the Regional Ayurveda research institute for metabolic disorders(RARIMD) with an authentication number RRCB1-1052. The collected plant sample was subjected to Essential oil extraction and analysis.

Essential oil extraction:

The fresh plant leaves were collected from the experimental sites are washed under tap water followed by dist. Water to remove dust particles and dry at ambient temperature for two days in the laboratory. The dried leaves were cut into small pieces. The dried plant leaves are used for the extraction of essential oils. The plant materials were subjected to hydro-distillation using a Clevenger-type apparatus for 3 hours. The oil was dried over anhydrous sodium sulfate and was stored in sealed vials under a refrigerator until analysis. The amount of essential oil concentration was calculated by using the formula given below

$$\text{Essential oil concentration (\%)} = \frac{\text{Amount of essential oil recovered (g)}}{\text{Amount of crop biomass distilled (g)} \times 100}$$

Gas Chromatography and Mass Spectrometry

GC-MS analysis of the essential oil was carried out on an Acquisition – General, Shimadzu GC-MS, Model Number: QP2010S Equipped with Electron Ionization using a column Rxi-5Sil MS, 60 m length × 250 µm thickness. Temperature programming was done Initial 40 ºC hold for 2 mins Ramp at 5 ºC to 280 °C Ramp at 20 °C to 300 °C holds for 2 mins; Flow Rate: 1ml/min; Carrier gas helium**.**

Identification of compounds

Essential oil constituents were identified by comparing retention times of the chromatogram peaks with those of reference compounds run under identical conditions. Interpretation of the mass spectrum was conducted using the database of National Institute Standard and Technology (NIST 11) and WILEY 18 library.

Result and Discussion

Gas Chromatography-Mass Spectrometry analysis

The Essential oils were obtained from the Hydro-distillation method by using fresh leaves of palmarosa herbs from Devarayana Durga Hill, which gave oil in 0.5% v/w yields

The essential oil content in the fresh aerial-parts of *C. martinii* was collected from the wild ecotype region. The chemical composition of the extracted essential oil was analyzed by GC–MS techniques. Altogether, Sixty-five constituents. The GC-MS analysis revealed the presence of major compounds like Geraniol, Geranyl acetate, Nerol, Camphene, Borneol, D-limonene, Cubenol, Linalool, Citral and α-pinene. The essential oil showed the highest percentage of Geraniol (20.31%).

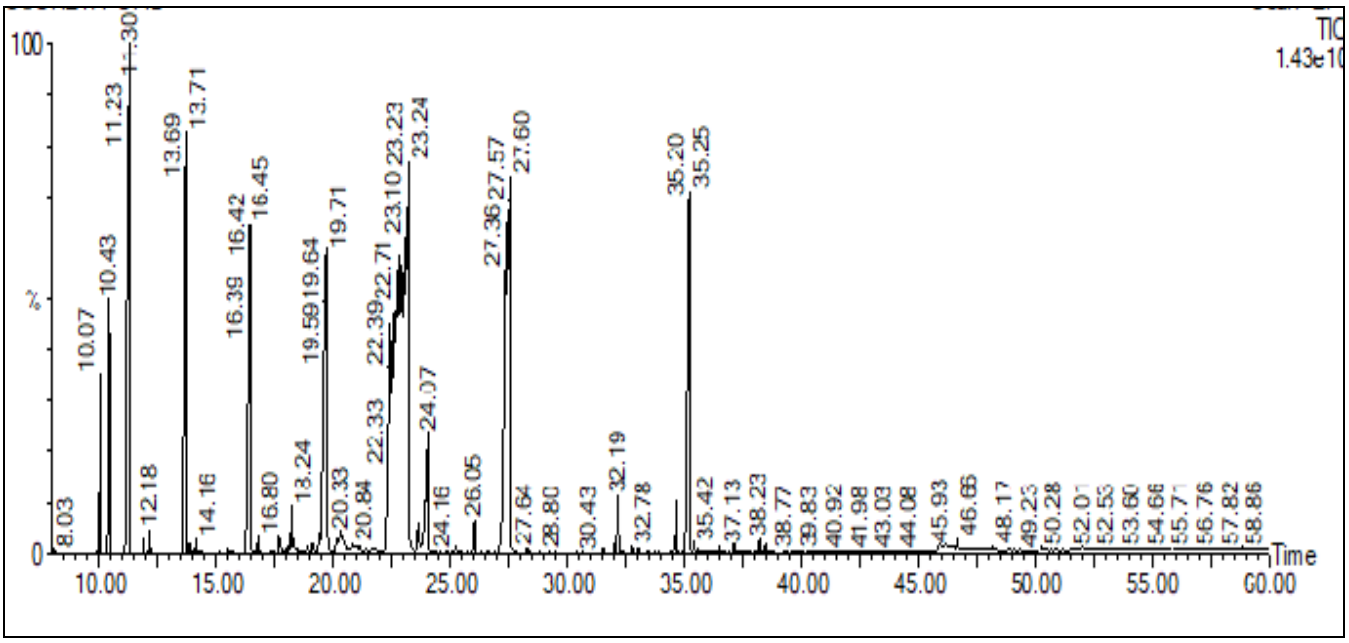

Fig 1: Gas Chromatogram of *C. martinii* Essential oil

Table 1: Fingerprint of the Compounds present in the Essential oil

Sl. No	Compound Name	Area %	Molecular Weight g/mol
1	Cyclohexane (1- methyl propyl)	0.014	140.27
2	1,8 octadienol	0.017	126.2
3	α-pinene	3.42	136.23
4	Camphene	9.310	136.24
5	β-Phellandrene	0.142	136.23
6	β-pinene	0.186	136.23
7	D-limonene	6.050	136.238
8	β-ocimene	0.046	136.23
9	m- cymene	0.112	134.21
10	P- menthane-1,8-diol	0.026	172.27
11	Cyclohex-2-en-1-ol	0.019	196.33
12	Isopulegol	0.043	154.25
13	Linalool oxide	0.077	170.25
14	Terpinolene	0.011	136.23
15	Linalool	5.149	154.25
16	Cis-piperitol	0.098	154.25
17	Cis para-2-menthane-1-ol	0.044	172.26
18	Cis-verbenol	0.332	152.23
19	Camphonelic aldehyde	0.027	152.23
20	Limonene dioxide	0.069	168.23
21	Citronellal	0.392	154.25
22	Carveol	0.257	152.23
23	Camphene hydrate	0.071	154.25
24	Borneol	8.055	154.25
25	Camphor	0.175	152.23
26	α-Terpineol	0.207	154.25
27	Perillyl alcohol	0.641	152.237
28	Cis-myrtanol	0.286	154.25
29	β-Pinene oxide	0.045	152.23
30	Geraniol	20.316	154.253
31	Nerol	15.180	154.25
32	Citral	2.129	152.23
33	Citronellyl propionate	0.121	212.33
34	Transversinal	0.011	152.23
35	2-carene	0.385	136.23
36	Decalinol	0.011	138.25
37	Geranyl acetate	15.192	196.29
38	α-elemol	0.091	222.37
39	3,6-nonadien-1-ol	0.024	140.22
40	α-bisabolol	0.025	284.7
41	γ-cadinene	0.07	204.35
42	Bornyl acetate	0.364	196.29
43	Patchoulene	0.061	204.35
44	Vitamin – A	0.013	286.45
45	Aromadendrene	0.075	204.35
46	Caryophyllene oxide	0.511	220.35
47	Cubenol	6.881	222.37
48	β-selinene	0.155	204.35
49	α-Cadinol	0.040	222.37
50	Caryophyllene	0.15	204.36
51	Cedrane	0.073	206.37
52	Iso- longifolol	0.024	204.35
53	Aristolene	0.012	204.35
54	Methyl linolenate	0.017	294.5
55	Oleic acid	0.027	282.47
56	Linoleic acid	0.024	280.44
57	Geranyl geraniol	0.014	290.48
58	Oleyl alcohol	0.189	268.478
59	Propyl linoleate	0.146	324.5
60	Palmitoaldehyde	0.038	240.42
61	1, 3 octadecanal(Z)	0.013	268.48
62	Linoleoyl chloride	0.035	284.9
63	Trielaidin	0.010	885.4
64	Trans- limonene oxide	0.027	152.23
65	Stigma sterol	0.055	412.69

Conclusion

Essential oils of Cymbopogon species that are diverse in chemical composition possess many important and potential bioactivities of great pharmaceutical and medicinal significance. Some of the novel bioactivities of Cymbopogon essential oils and constituents include anti-inflammatory, anticancer, antioxidant and insect repellence. In addition, they have a number of other activities of ecological and industrial significance. Demand for a wide variety of wild species is increasing with growth in human needs, numbers and commercial trade. (Lambert *et al*., 1997) [7]. cultivated plants are sometimes considered qualitatively inferior when compared with wild plants. Scientific studies partly support this. Medicinal properties in plants are mainly due to the presence of secondary metabolites which the plants need in their natural environments under particular conditions of stress and competition and which perhaps would not be expressed under experimental conditions. (Palevitch 1991; Uniyal *et al*., 2000) [10, 18].

Essential-oil–based products or natural aroma chemicals are in higher demand in the cosmetic, food, perfume, and pharmaceutical industries, and more than 250 types of essential oils, at a value of 1.2 billion USD, are traded annually on the international market (Akhtar *et al*., 2014; Swamy and Sinniah, 2016) [2, 17]. The main goal of studying wild plants is to conservation option is sustainable harvest from wild populations, for a variety of reasons. cultivation is a conservation option because the constant drain of material from their populations is much higher than the annual sustained yield. If the demand for these species can be met from cultivated sources the pressure on the wild populations will be relieved, it provides an incentive to protect and maintain wild populations and their habitats and the genetic diversity of Medicinal and Aromatic Plant populations. Thus studying wild plants gives an idea of conservation, their genetic diversity and their secondary metabolites present in the plants in their natural habitats which can be further used for human well-being.

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