

A Comparison of Chemical Composition and Yield of Essential Oils from Shoot System Parts of *Ocimum sanctum* Found in Semi-Arid Region of Uttar Pradesh

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Abstract

Ocimum sanctum (*O. sanctum*) Linn. synonym *Ocimum tenuiflorum* is an aromatic and medicinal plant used in whole world. The hydrodistillation essential oils (EO) of *O. sanctum* four varieties viz. CIM-Ayu, CIM-Angna, local Rama Tulsi and local Syama Tulsi was investigated using GC and GC/MS techniques on DB-(5% diphenyl-95% dimethyl polysiloxane) capillary columns. EO extracted from the leaves, stem and flower parts of *O. sanctum* plant. The *O. sanctum* plant found in semi-arid region of Uttar Pradesh (U.P.) chemical composition and EO yield no one research paper published yet. So, this investigation was carried out to determine the chemical composition and yield of EO of *O. sanctum* plant found in semi-arid region of U.P. The identified main constituents of EO were almost same in all varieties of *O. sanctum* plant dominated by eugenol, β -selinen, 4,10 (14)-muuroladien-8. β -ol, (R)-cembrenene, trans-Caryophyllene, camphene and sabinene. The other components were 1, 8-Anhydro-cis-. α -copaene-8-ol, β -elemene, (+)- β -costal and α -copaene. These compounds have biological importance showing through various citation literatures. In the fresh herb of shoot system parts (leaves, stems and flowers) of *O. sanctum*, EO highest yield in CIM-Ayu (0.5%) as compared to CIM-Angna (0.4%), local Syama Tulsi (0.3%) and local Rama Tulsi (0.2%).

Keywords: *Ocimum sanctum*; EO; U.P; Semi-arid region; Eugenol; Germacrene-D

Introduction

Ocimum sanctum (*O. sanctum*) is a medicinal [1] plant comprising of different species. It is found throughout the world from an ancient period and commonly cultivated in gardens and holy places in India. *O. sanctum* Linn. belonging to the family Lamiaceae commonly known as Tulsi in Hindi and holy Basil in English. *O. sanctum* is an aromatic herb, much branched soft hairy and 30 cm-75 cm high. Leaves elliptic-oblong, acute or obtuse, entire or serrate, pubescent on both sides, minutely gland-dotted; flowers are purplish or crimson, found in racemes, close whorled, broadly ellipsoid, slightly compressed, nearly smooth, pale brown or reddish, with the small black markings. *O. sanctum* has a very wide range of distribution, it covers mostly the entire Indian sub-continent, its presence has been reported in high altitude of Himalayan regions up to the 1800 m of height and reported in the far regions of Andaman and Nicobar Islands. *O. sanctum* grown under contract organic farming in the semi-arid region of central India in the district Hamirpur of Uttar Pradesh (U.P.). Hamirpur geographical status is 25°-95° N to 80°-15°E and an average elevation of 80 m [2]. It lies between latitude 25°N and 6° 7'N and longitude 79° 17'E and 80° 21'E temperature varies between 3°C to 46°C and annual rainfall is 750 mm to 1000 mm [2]. The soils found Kabar (Black cotton soil) with pH ranges between 7 to 8.5 and rich in organic fertilizer [2]. The organic matters considered as one of the important factors of soil fertility due to their beneficial effects on the physical, chemical and biological productivity of the soil. *O. sanctum* plant used in the treatment of bronchitis, bronchial asthma, malaria, diarrhea, dysentery, skin diseases, arthritis, painful eye diseases, chronic fever, insect bite etc. The extract of the *O. sanctum* shows radioprotective activity [3,4]. Due to genetic and environmental factors composition of essential oils (EO) varies which influence the genetic expression of plant [5]. Essential oils of *O. sanctum* plant have a diverse group of natural products that are important sources of aromatic and flavoring chemicals in food, pharmaceutical and industrial products [6]. But

there is no published research report found in the literature about the EO major constituents in different varieties of *O. sanctum* grown in semi-arid region of U.P. So, an attempt has been made to investigate the major components of EO found in *O. sanctum* grown in semi-arid region of U.P. In this paper, we compare the chemical composition and yield of EO from shoot system parts of *O. sanctum* plant found in semi-arid region of U.P. This paper shows essential oils high yield variety of *O. sanctum*.

Materials and Methods

Collection of plant material

The plant material collected during October 2014 from the local farmers of semi-arid region Hamirpur, a district of Uttar Pradesh. Since last 6-7 yrs, local farmers are organic growers of *O. sanctum* crop under contract farming with Organic India.

Isolation of essential oil

The fresh herb (leaves, stem and flowers) used for extraction after removal of all dust and foreign particles of *O. sanctum* plant. In each sample 500 g leaves were used. The sample was hydro-distilled in Clevenger apparatus for 6 h. The yield of EO was obtained 0.8% v/w.

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In the graduated tube yellow colored EO was collected. The collected EO was dried over an anhydrous sodium sulphate and stored in the dark at 4°C.

GC analysis

GC analysis was carried out on a Varian 3800 Gas Chromatograph fitted with a silicone DB-5 capillary column (30 m × 0.25 mm), film thickness 0.25 µm, nitrogen was used as a carrier gas, flow rate 1.0 mL/min., a split ratio of 1:40, temperature programmed 180°C-250°C at 4°C/min. Injector temperature and detector temperature were 250°C and 300°C respectively. Detector used was Flame ionization detector (FID). Injector volume for all samples was 0.1 µL. Total GC running time was 61 min.

GC-MS analysis

GC-MS analysis done on a Shimadzu QP-2000 instrument using ULBON HR-1 fused silica capillary column (50 m × 0.25 mm × 0.25 µm film thickness) at EI mode 70 eV and 250°C ion source temperature. Carrier gas was helium at a flow rate of 2 mL/min. The initial temperature was 100°C for 6 min. and then heated at a rate of 10°C/min to 250°C.

Results and Discussion

Identification of components

The EO components identification was done by comparison of retention indices of GC chromatograph of the peaks with those of compounds reported in literature [4] and computer matching of mass spectra with standards Wiley L-built libraries and Tutorial data of GC MS systems.

Discussion

By GC and GC-MS, the constituents of EO were identified. Retention time (RT) and percentage composition of each constituent are listed in Table 1. The hydro-distillation of the leaves, stem and flower parts of *O. sanctum* at full flowering stage in all four varieties total eleven components of essential oil were identified. In four varieties of *O. sanctum*, highest amount of Eugenol found in CIM-Angna (78.3%), local Syama Tulsi (62.7%), CIM-Ayu (42.9%) and local Rama Tulsi (23.4%) while β-Selinen is high amount in CIM-Ayu (29.1%), local Rama Tulsi (26.9%) and local Syama Tulsi (11.3%). In CIM-Angna, β-Selinen is in low amount (7.4%). The compound 4,10(14)-Muurooladien-8. β-ol is higher amount in local Rama Tulsi

(28.7%) as compared to local Syama Tulsi (18.6%), CIM-Ayu (17.8%) and CIM-Angna (9%). The percentage of compound 1, 8-Anhydro-cis-α-Copaene-8-ol in local Rama Tulsi is (1.6%), CIM-Angna (1.5%), CIM-Ayu (1.3%) and local Syama Tulsi (1%). (R)-Cembrenene compound from higher amount to lower found in CIM-Angna (9.3%), local Rama Tulsi (3.3%), CIM-Ayu (2.5%) and local Syama Tulsi (0.1%) respectively. The oil Component trans-Caryophyllene found in higher amount in only two varieties viz. CIM-Ayu (2.6%) and CIM-Angna (1.5%) while in local Rama Tulsi and local Syama Tulsi shows in very low amount 0.8%. The component β-Elemene found higher amount in local Syama Tulsi (1.6%), CIM-Ayu (1.4%) and CIM-Angna (1%) while in local Rama Tulsi have trace amount of this component i.e., 0.7%. Other compound (+)-β-Costal component is in higher amount in local Rama Tulsi (1.4%), CIM-Ayu (1%), CIM-Angna (1%) and trace amount in local Syama Tulsi. Camphene compound is detected more in CIM-Angna (2.2%), local Rama Tulsi (1.8%), CIM-Ayu (1.7%) and low in local Syama Tulsi (0.1%). CIM-Angna (6.7%) and CIM-Ayu (6.3%) having higher amount of Sabinene compound in comparison to local Rama Tulsi (0.4%) and local Syama Tulsi (0.2%). the α-Copaene component is found more amount in local Rama Tulsi (1.6%), CIM-Ayu (1.3%), CIM-Angna (1.2%) and less in local Syama Tulsi (0.5%). In trace amount many other constituents are also detected. Eugenol, β-Selinen, 4,10(14)-Muurooladien-8. β-ol, (R)-Cembrenene, trans-Caryophyllene, Camphene and Sabinene are major components identified in all four varieties of *O. sanctum* EO. Eugenol comprise the major fraction of the oil followed by β-Selinen and 4,10(14)-Muurooladien-8. β-ol. Whole plant of *Ocimum sanctum* contains eugenol which is an antibacterial component used for pharmacological work [7] and as a phenylpropanoid compound. This is also used in perfumes, flavorings as well as antiseptic and anesthetic [8]. The essential oil yielded as 0.5% in CIM-Ayu, 0.4% in CIM-Angna, 0.3% in local Rama Tulsi and 0.2% in local Syama Tulsi. This shows CIM-Ayu performs better in organic field of semi-arid region of Uttar Pradesh. Many results reported the chemical composition and yield of EO of *O. sanctum* [9-11] but *O. sanctum* plant grown under organic field of semi-arid region of Uttar Pradesh are being reported for the first time by this research paper.

Conclusion

The medicinal value of *O. sanctum* plant grown in organic condition proved through many published reports. The presence of EO constituents justifies the uses of the Tulsi herb in various forms like as spices in food industry, in aromatherapy or as a cosmetic additive

S. No.	Identified components	*RT	Peak area %			
			Varieties of <i>Ocimum sanctum</i>			
			CIM-Ayu	CIM-Angna	Local Rama Tulsi	Local Syama Tulsi
1	Eugenol	28.57	42.95	78.34	23.45	62.75
2	β-Selinen	30.11	29.12	7.4	26.97	11.3
3	4, 10(14)- Muurooladien-8. β-ol	31.46	17.77	9.06	28.73	18.58
4	1, 8-Anhydro-cis-α-Copaene-8-ol	32.81	1.27	1.5	1.63	1.05
5	(R)-Cembrenene	33.88	2.53	9.27	3.27	0.14
6	trans-Caryophyllene	34.44	2.61	1.52	0.85	0.78
7	β- Elemene	35.41	1.42	1.02	0.71	1.57
8	(+)-β-Costal	36.38	1.06	1.04	1.37	0.07
9	Camphene	37.9	1.66	2.18	1.83	0.13
10	Sabinene	38.22	6.3	6.66	0.38	0.22
11	α-Copaene	40.5	1.34	1.24	1.65	0.51

*Retention Time (RT) on DB-5 capillary column (30 m × 0.25 mm)

Table 1: Essential oils constituents found from shoot system parts of *O. sanctum* L.

and in cure of many diseases. The farmers can make good money by selling essential oils to various kinds of industries. Thus, *O. sanctum* is emerging as an economical crop for the farmers and traditional practitioners.

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