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SHORT COMMUNICATION

Essential oil composition of allspice [*Pimenta dioica* (L.) Merill.] leaf from the Western Ghats, India

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ABSTRACT

The chemical composition of essential oils from the fresh leaf of *Pimenta dioica* (L.) Merill. growing in the Western Ghats, India was investigated for the first time. Hydro-distillation method was used to extract the essential oil, which was then evaluated using gas chromatography and mass spectrometry (GC-MS). The yields of essential oil for fresh leaf were 0.6% (v/w). The predominant constituents of the essential oil (EO) of fresh leaf were oxygenated phenylpropenes (75.70 %). The major constituents of fresh leaf EOs were eugenol (67.67%), β-myrcene (10.40%), p-chavicol (8.03%), and D-limonene (4.55%). The earlier reported values of eugenol (54.00%), β-myrcene (16.00%), and chavicol (12.50%). As prominent constituents in the EO of *P. dioica* leaf, these biologically active compounds offer a novel potential source for phenylpropene and monoterpenes, which can be employed in culinary, fragrance, and medical applications.

Keywords: allspice, D-limonene, essential oil, eugenol, *Pimenta dioica*, β-myrcene.

INTRODUCTION

Allspice [*Pimenta dioica* (L.) Merill.] is a plant native to the West Indies and Central America that belongs to the Myrtaceae family. This plant is a medium-sized evergreen tree that is linked to the bay and clove trees (Padmakumari et al., 2011). The flavours of *P. dioica* are similar to a combination of cinnamon, clove, and nutmeg. The essential oil of the plant is extracted mostly through hydrodistillation (Padmakumari et al., 2011; Amma et al., 2013; Stewart et al., 2016; Sarathambal et al., 2021).

The EO yield of *P. dioica* air-dried leaf varied between 1.0 - 2.0% (Amma et al., 2013; De Soysa et al., 2016; Stewart et al., 2016). The essential oil of *P. dioica* berries is primarily composed of limonene, 1,8 cineole, α-terpinol, β-caryophyllene, β-selinene, and

methyl eugenol (Padmakumari et al., 2011; Chaudhari et al., 2020). The primary constituents of eugenol, methyl eugenol, and β-caryophyllene in Jamaican *P. dioica* leaf oil (Tucker and Maciarello, 1991; Jirovetz et al., 2007). Guatemala-grown *P. dioica* leaf essential oil contains significant eugenol constituents (71.4%), β-myrcene (10%), and chavicol (3.1%) (Mérida-Reyes et al., 2020). However, India grew *P. dioica* leaf EO contains predominant constituents of eugenol (54%), β-myrcene (16.0%), and chavicol (12.5%) (Sarathambal et al., 2021). EO of the *P. dioica* exhibited antioxidant, antibacterial, and antifungal activities (De Soysa et al., 2016; Mérida-Reyes et al., 2020; Sarathambal et al., 2021).

Several studies have been carried out on the EOs of the plant from several regions of the world (Tucker and Maciarello, 1991; Jirovetz et al., 2007; Mérida-Reyes et al., 2020; Sarathambal et al., 2021). As part of continuing interest and our knowledge, this study was the first report of EO compositions from the leaf of *P. dioica* growing in the Western Ghats, India. Therefore, this study aimed to investigate the essential oil yield and composition of fresh *P. dioica* leaf essential oil and compare the results to those from other regions.

MATERIALS AND METHODS

Plant material and extraction of essential oil

The leaf of *Pimenta dioica* was collected from the cardamom research station, pampadumpara, Idukki, in June 2020. The plant was grown in black forest loam-loamy soil with pH of 5.2 to 5.8. The latitude and longitude of the collection area are 9° 45' (N) and 77° 10' (E); the Altitude is 1100 metres above mean sea level with a mean annual rainfall of 1737.5 mm. Voucher specimen [(CRS/KAU/PD/19-06-2020)] is preserved in our laboratory for future reference.

The leaves of *Pimenta dioica* (100 g) were ground well in a blender, and a finely grounded sample was placed in a 500 ml distillation flask. The essential oil was extracted by the Hydro distillation method using the Clevenger apparatus for 3 hrs or until the entire volatile oil was liberated from the sample (Murugan et al., 2019). The essential oil was carefully collected and dried over anhydrous sodium sulphate and stored in a sealed glass vial for GC-MS analysis (Ashokkumar et al., 2021a). The essential oil yield was estimated by volume and weight using the following equations: Essential oil (%, v/w) = volume of oil collected (ml) / weight of the sample (g) x 100 (Ashokkumar et al., 2021b).

Analysis of essential oil

Gas chromatography (GC) and mass spectrometer (MS) were used to analyse essential oil (GC-MS - QP2020 NX SHIMADZU). The GC had a Rxi®-5 Sil MS (20 m, 0.18 mm ID) fused silica capillary column with a 0.18-m film. The injection was split (1:20) and the helium flow rate was 1 ml/min (Ashokkumar et al., 2021a). The oven was set to 70°C for 15 minutes, then gradually elevated to 200°C and eventually 280°C. (10 min hold). Detector and injector temperatures were 280°C. Electron energy was 70 eV, ion source temperature was 260°C, and transmission line temperature was 280°C. Data was obtained at full scan mode with a 3-minute solvent delay. Mass spectra from NIST, Wiley, and literature were compared to identify essential oil components (Adams, 2007).

RESULTS AND DISCUSSION

Essential oil extraction

In the present study, fresh leaf of *P. dioica* was used to determine EO yield using hydro distillation. The average oil yield of three separate analyses was 0.6% (v/w) in fresh leaves (Table 1). The oil yield of the leaf (0.6%) was lower than the Guatemala-grown *P. dioica* leaf (1.02%) (Mérida-Reyes et al., 2020). The lower level of oil content observed might be due to changes in soil type, location, origin, extraction methods, and environmental conditions (Ashokkumar et al., 2020; Ashokkumar et al., 2021c; Ashokkumar et al., 2021d).

GC-MS analysis

The obtained oils were analysed by GC-MS, which resulted in the identification of 17 total compounds, comprising 97 % of the fresh leaf of *P. dioica* (Table 1). The fresh leaf oil was characterized by a high concentration of oxygenated phenylpropenes followed by monoterpene hydrocarbons and sesquiterpene hydrocarbons. The major constituents of fresh leaf EOs were eugenol (67.67%), β-myrcene (10.40%), p-chavicol (8.03%), and D-limonene (4.55%). The earlier reported values of eugenol (54.00%), β-myrcene (16.00%), and chavicol (12.50%), leaf oil corroborate our findings (Sarathambal et al., 2021). GC-MS chromatogram showed major essential oil constituents of the fresh leaf of *P. dioica.*

Table 1. Profiling chemical constituents of essential oil from fresh leaf of *P. dioica*

Sl. No.	Compound name	RT[a]	RI[b]	RI[c]	Area %
					Fresh leaf
1	α -pinene	8.47	932	933	0.3
2	β-myrcene	9.89	988	990	10.4
3	α-phellandrene	10.40	1002	1002	1.34
4	(+)-4-Carene	10.68	1020	1028	0.21
5	p-cymene	10.89	1026	1030	0.43
6	D-limonene	11.04	1030	1030	4.55
7	γ -terpinene	11.8	1054	1059	0.1
8	linalool	12.88	1087	1095	0.92
9	Terpinen-4-ol	15.14	1137	1184	0.45
10	Decanal	15.65	1204	1199	0.52
11	p-Chavicol	17.00	1205	1203	8.03
12	Eugenol	19.50	1356	1359	67.67
13	Copaene	20.08	1374	1376	0.32
14	Humulene	21.95	1452	1454	0.15
15	Caryophyllene	21.18	1464	1466	0.26
16	γ-muurolene	22.40	1478	1480	1.25
17	α-cadinol	26.19	1580	1603	0.12
	Oil yield (%)				0.6
	Monoterpene hydrocarbons				17.33
	Oxygenated monoterpenes				1.89
	Total monoterpene				19.22
	Sesquiterpene hydrocarbons				1.98
	Oxygenated sesquiterpene				0.12
	Total sesquiterpene				2.10
	Oxygenated phenylpropene				75.70
	Total constituents (%)				97.02

(-), not detected; [a]RT, Retention time; [b]RI = Retention index (experimental) on Rxi®-5 Sil MS column; [c]RI= Retention index in literature; Monoterpene hydrocarbons, 1-7; Oxygenated monoterpenes, 8-10; Sesquiterpene hydrocarbon, 13-16; Oxygenated sesquiterpene, 17; Oxygenated phenylpropenes, 11, & 12.

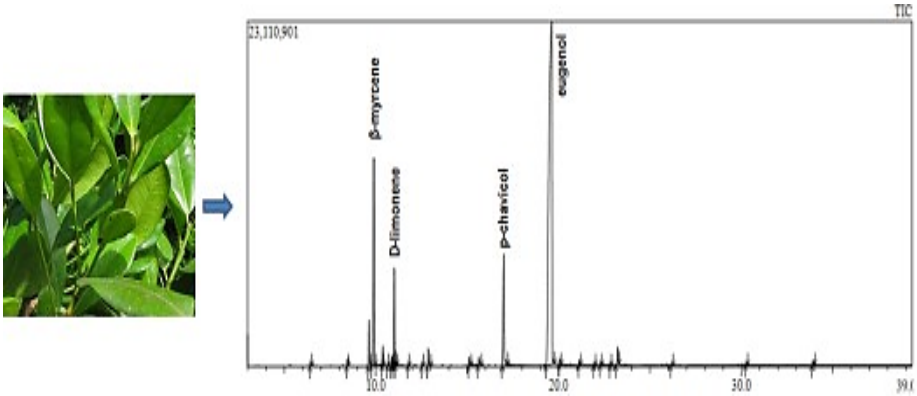

Figure 1. Major essential oil constituents of fresh leaf of *P. dioica*

CONCLUSION

For the first time, chemical constituents of EO of fresh *P. dioica* leaf was conducted. GC-MS chemo profiling revealed that twenty-two phytochemical constituents accounted for about 97 % of both EOs. The EO of the fresh leaf has a high concentration of phenylpropene. *P. dioica* leaf EOs contain eugenol, β-myrcene, p-chavicol, and D-limonene as major constituents. *P. dioica* leaf EO's main constituents can be used in the fragrance, culinary, and pharmaceutical industries.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by authors.

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