Journal of Spices and Aromatic Crops
Vol. 16 (1) : 38–41 (2007)

Indian Society for Spices

Essential oil composition of petiole of *Cinnamomum verum* Bercht. & Presl.

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Received 24 August 2006; Revised 23 December 2006; Accepted 20 February 2007

Abstract

Essential oil isolated from the petiole of *Cinnamomum verum* was analysed by gas chromatography and gas chromatography-mass spectrometry. Twenty five compounds accounting for 87.31% of the total essential oil were identified. (E)-Cinnamaldehyde (33.04%) followed by eugenol (17.32%), linalool (16.85%) and (E)-cinnamyl acetate (11.78%) were the main components of the essential oil. This is the first report on the composition of essential oil of petiole of *C. verum*.

Keywords: cinnamon, *Cinnamomum verum*, essential oil, petiole.

Cinnamon of trade is the dried inner stem bark of *Cinnamomum verum* Bercht. & Presl. which is widely used as spice. In addition, essential oils isolated from leaf and bark of *C. verum* are extensively used as flavouring agents. Different plant parts of *C. verum* were reported to yield essential oils of varying composition. *C. verum* leaves and bark on distillation yielded essential oils rich in eugenol (Mallavarapu *et al*. 1995; Rao *et al*. 2006) and cinnamaldehyde (Variyar & Bandyopadhyay 1989), respectively. A chemotype of *C. verum* yielding leaf and bark essential oils rich in benzyl benzoate was also reported from north-east India (Nath *et al*. 1996). In contrast to the stem bark essential oil, the root bark essential oil was reported to contain camphor as its main component (Wijesekera *et al*. 1974). The essential oil distilled from tender twigs on the other hand possessed linalool and (E)-cinnamyl acetate as major constituents (Kaul *et al*. 2003).

Pedicels of buds, flowers and fruits of *C. verum* produced essential oils rich in linalool, (E)-cinnamyl acetate and β-caryophyllene (Jayaprakasha *et al*. 1997; Kaul *et al*. 2003). Chemical composition of essential oil isolated from the petiole of *C. verum* has not been studied earlier; therefore, the present investigation was conducted to examine the composition of petiole essential oil of the species.

Mature leaves were harvested from 14-year-old trees grown in the Research Farm of the Central Institute of Medicinal and Aromatic Plants Resource Centre, Hyderabad. The experimental location experiences a semi-arid tropical climate. Freshly harvested leaves (1800 nos.) were divided into 3 replicates of 600 leaves each. The petioles of these leaves were cut using sharp scissors and their weights were recorded. The petioles (3 replicates of 600 each) were hydro-distilled separately for 6 h in a modified Clevenger glass apparatus for essential oil isolation. The

essential oil samples were dried over anhydrous sodium sulphate to make them moisture free, weighed and stored at 4^0C in air tight containers, prior to analysis by GC and GC-MS.

GC analyses of essential oil samples were performed on Varian Star 3400 CX gas chromatograph fitted with a flame ionization detector (FID), K x -P1150 Panasonic printer and an electronic integrator using Supelcowax 10 (30 m x 0.25 mm x 0.25 μm film thickness) polar capillary column. Nitrogen was employed as the carrier gas at a flow rate of 1 ml min^{-1} and 10 psi inlet pressure. The column temperature programming was: 80°C (2 min) @ 5°C min^{-1} to 150°C @ 7°C min^{-1} to 220°C (5 min). The injector and the detector were maintained at 200°C and 240°C, respectively. The samples (0.1 μl) were injected neat with 1: 50 split ratio.

GC-MS analyses of the essential oil samples were carried out using Hewlett-Packard 5850 gas chromatograph coupled to HP 5850 mass-selective detector (MSD) system. Helium was employed as the carrier gas at 1 ml min^{-1} flow rate. The temperature programme was the same as in GC analyses. Mass spectra were recorded over 40–400 amu range at 1 span per s^{-1} with 70 eV ionization energy, EI mode of ionization and ion source temperature was maintained at 250°C.

Essential oil constituents were identified by comparing retention times of the GC peaks with those of reference compounds run under identical conditions, by comparison of retention indices with literature data (Jennings & Shibamoto 1980; Davies 1990), by peak enrichment on co-injection of authentic samples and by comparing mass spectra of the peaks with published literature (Masada 1976; Jennings & Shibamoto 1980; Adams 1995). Kovats (1965) retention indices were calculated from the gas chromatograms by logarithmic interpolation between bracketing *n*-alkanes. The homologous series of *n*-alkanes C_8 to C_{23} of Poly Science Inc., Niles, USA, were used as standards. Peak areas and retention times were measured by the electronic integrator. The relative amounts of individual constituents were computed from peak areas without FID response factor correction.

The average fresh weight of the petiole was 0.025 g. The mean essential oil content of the petiole on fresh weight basis was 1.39% on weight/weight basis and 1.55% on volume/weight basis. Twenty five constituents accounting for 87.32% of the essential oil were identified and listed in Table 1 and the grouped components are shown in Table 2. Linalool, (E)-cinnamaldehyde, (E)-cinnamyl acetate and eugenol were the main components accounting for 78.99% of the total essential oil composition. Aliphatic alcohols, aromatic esters, aromatic aldehydes and phenols and phenolic ethers were the main grouped components of the essential oil.

The essential oil content of the petiole in the present investigation is comparable to the leaf essential oil concentration ranging from 1.2% to 1.9% reported earlier for the test location; however, the chemical composition of petiole essential oil differed from that of leaf essential oil rich in eugenol (Kaul *et al*. 1996, 1998; Rao *et al*. 2006). The linalool content (16.85%) of the petiole essential oil resembled the linalool concentration (15.2%) of tender twig essential oil (Kaul *et al*. 2003). The (E)-cinnamyl acetate percentage in petiole essential oil is less compared to its percentage in tender twigs, pedicels, flowers and fruits essential oils (Jayaprakasha *et al*. 1997; Kaul *et al*. 2003). The (E)-cinnamaldehyde content of petiole essential oil is higher compared to its concentration in tender twig essential oil (4.0%), but is less in comparison with its percentage (82.11%) in stem bark essential oil (Variyar & Bandyopadhyay 1989). Thus, the petiole essential oil is unique in its composition. Cinnamaldehyde is a minor constituent of *C. verum* leaf essential oil and its high concentration in petiole essential oil (up to 33.04%) warrants further detailed investigations to find whether the observed result is location specific or widely occurring. Investigations carried out by several

Table 1. Chemical composition of the essential oil of *Cinnamomum verum* petiole

Constituent	Retention time (min)	Peak area percentage	Method of identification
Camphene	2.01	0.09	a, b, c, d
β-Pinene	2.31	0.19	a, b, c
Sabinene	2.70	0.06	a, b, d
Myrcene	2.88	1.17	a, b, c
α-Terpinene	3.04	0.09	a, b
Limonene	3.28	0.41	a, b, d
1,8-Cineole	3.40	0.46	a, b, c, d
cis-β-Ocimene	3.89	0.03	a, b, c
trans-β-Ocimene	4.01	0.05	a, b, c, d
p-Cymene	4.32	0.92	a, b, c, d
Linalool	9.48	16.85	a, b, c, d
Linalyl acetate	9.93	2.25	a, b, c
Terpinen-4-ol	10.26	0.13	a, b, c
α-Terpineol	11.95	0.61	a, b, c, d
Piperitone	12.49	0.16	a, b, c
Geraniol	14.46	0.05	a, b, c, d
Safrole	16.44	0.01	a, b, d
(E)-Cinnamaldehyde	17.79	33.04	a, b, c, d
(Z)-Cinnamyl acetate	18.57	0.01	a, b, d
(E)-Cinnamyl acetate	19.20	11.78	a, b, d
Eugenol	19.31	17.32	a, b, c, d
Eugenyl acetate	20.43	1.29	a, b, d
(E)-Cinnamyl alcohol	21.47	0.09	a, b, d
Benzyl benzoate	29.59	0.22	a, b, c, d

a=retention time; b=retention index; c=co-injection with authentic substance; d=mass spectrum

Table 2. Grouped constituents of essential oil of *Cinnamomum verum* petiole

Grouped component	Percentage in essential oil
Monoterpenes	3.01
Aliphatic alcohols	16.90
Cyclic alcohols	0.74
Aromatic alcohols	0.09
Monoterpene esters	2.25
Aromatic esters	12.01
Aromatic aldehydes	33.04
Cyclic terpene ketones	0.16
Oxides	0.46
Phenols and phenolic ethers	18.62
Sesquiterpenes	0.03

researchers have clearly shown *C. verum* to be an interesting species producing essential oils of varying composition in its different parts. It would be interesting to investigate the biosynthetic pathways of essential oil components in different plant parts to plan future breeding programmes to breed varieties that can yield specific essential oil rich in desirable constituents. This is the first report on the composition of petiole essential oil of the species.

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