Original Article

Comparative study of essential oil composition of *Buddleja asiatica* and *Buddleja davidii* aerial parts

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Aerial parts of the plants, *Buddleja asiatica* Lour. and *Buddleja davidii* Franchet. were studied with a focus on essential oil composition by using gas chromatography and gas chromatography-mass spectrometry techniques. A total of 15 and 17 components were identified representing 83.46% and 86.83% of the total oil of *B. asiatica* and *B. davidii* respectively. The major constituents in *B. asiatica* oil were *n*-tridecane (55.87%), 5-methylundecane (10.62%), *n*-dodecane (2.84%) and *n*-hexadecanol (2.76%), while *B. davidii* essential oil was found to contain *n*-dodecane (55.15%), 5-methylundecane (13.67%), *iso*-acorone (4.32%) and *n*-undecane (2.64%) as major components. Both the essential oils were found to contain hydrocarbons as major compounds. The major component detected in *B. asiatica* essential oil was found as minor component in *B. davidii* essential oil and vice versa. The plants can be further studied for their biological activities and to identify various chemotypes.

Key words: *Buddleja asiatica*, *Buddleja davidii*, essential oil, gas chromatography-mass spectrometry

INTRODUCTION

The genus *Buddleja* comprises approximately 100 species, most of which are shrubs and a few being trees.[1] Previous studies on this genus have resulted in the isolation of a variety of compounds including terpenoids, flavonoids, iridoids, phenylethanoids and saponins.[2] The plant has been used medicinally in different regions in the past and present. It has been used for skin complaints[3] and as an abortifacient.[4] Roots and leaves of the plant are employed to treat head tumour and malaria.[5,6] *Buddleja asiatica* Lour., commonly known as Butterfly Bush, has been reported to contain dihydrobuddledin-A, buddledone-B, ursolic acid, 2-phenylethyl-β-D-glucoside, 7-deoxy-8-epiloganic acid and scutellarin-7-O-β-D-glucopyranoside; most of the isolated compounds showed good antimicrobial activity.[7] The juice of the plant is applied as a wash to treat skin diseases.[8] The leaves have a hypotensive effect on cats and dogs, probably due to α-adrenoreceptor blocking activity.[9] It is also reported that the essential oil from the leaves has *in vitro* antifungal, antibacterial and antihelmintic activity.[10]

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Buddleja davidii Franchet. is a medium-sized shrub indigenous to China and Japan, but cultivated and naturalised in many parts of the world.[1] Yoshida *et al*. obtained five sesquiterpenes from the roots of *B. davidii*.[11,12] These were named as buddledins A, B, C, D and E. Houghton reported the presence of coniferaldehyde and revealed lignan type of compounds in the stem of this species.[13] The powdered leafy stems of this plant are recommended for use as an ingredient of a poultice to stimulate wound healing, to treat skin ulcers and to heal the lesions associated with leprosy.[1]

Earlier, Garg and Dengre have reported the essential oil composition of *B. asiatica* leaves, which has β-caryophyllene oxide (21.7%), citronellol (16.7%) and β-caryophyllene (15.8%) as major components,[10] but the present study of *B. asiatica* oil is completely different from the previous one. This difference in chemical composition may be due to the variations in soil condition and other climatic factors.[14-16] The main aim of the study was to analyse the comparative essential oil composition of two *Buddleja* species, which has not been reported so far.

MATERIALS AND METHODS

Plant Material

The fresh aerial parts of *B. asiatica* Lour. were collected from Jeolikote, Nainital, in the month of February 2009, while those of *B. davidii* Franchet. were collected in the month of September 2009 from Nainital, Uttarakhand,

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India. The plants' identification was confirmed by Prof. Y.P.S Pangtey, Department of Botany, Kumaun University, Nainital, and the voucher specimens of both the plant species have been deposited in the Department of Chemistry, D.S.B. Campus, Kumaun University, Nainital.

Extraction of Essential Oil

The fresh aerial parts (5 kg of each plant) were chopped and steam-distilled separately using copper still fitted with spiral glass condensers. The distillates were saturated with NaCl and extracted with *n*-hexane. This was separated using a separating funnel and the solvent was finally evaporated under reduced pressure. Anhydrous Na_2SO_4 was then added to dry the organic phase. The percentage content was calculated on the basis of dry weight of plant materials. The oil yields were 0.01% and 0.03 % (w/w) for *B. asiatica* (B1) and *B. davidii* (B2), respectively. The oils were stored in separate screw-capped vials, under refrigeration until needed.

Gas Chromatography and Gas Chromatography/Mass Spectrometry

The oils were analysed using a Nucon 5765 GC (30 m×0.32 mm, FID) with split ratio 1:48, N_2 flow of 4 kg/cm^2. Gas chromatography (GC)/mass spectrometry (MS) analysis was performed using a thermoquest (Vienna, Austria) trace GC-2000 interfaced with Finnigen MAT Polaries-Q ion trap mass spectrometer fitted with RTX-5MS (Restek Corporation, Pennsylvania, USA) fused silica capillary column (30×0.25 mm, 0.25 μm film coating). The oven temperature was programmed from 60–210°C at 3°C/min, using helium as carrier gas at 1 mL/min. The injector temperature was 210°C, injection volume was 0.1 μL prepared in hexane, split ratio 1:40. Mass spectra were taken at 70 eV Electron Impact (EI) with mass scan range of *m*/*z* 40-450 amu with mass scan time 4 s. The Kovat retention indices were calculated for all volatile constituents using a homologous series of *n*-alkanes C9-C22.

RESULTS AND DISCUSSION

A comparative study of the essential oils of the two plants showed higher yield for *B. davidii* (0.03%) than *B. asiatica* (0.01%). The oil samples were analysed by GC and GC-MS and the constituents were identified on the basis of the retention index, library mass search database (NIST and WILEY) and Adams.[17] A total of 15 and 17 components were identified representing 83.46% and 86.83% of the total oil of *B. asiatica* (B1) and *B. davidii* (B2), respectively [Table 1]. The major constituents in *B. asiatica* oil were *n*-tridecane (55.87%), 5- methylundecane (10.62%), *n*-dodecane (2.84%) and *n*-hexadecanol (2.76%), while *B. davidii* essential oil was found to contain *n*-dodecane (55.15%), 5- methylundecane (13.67%), *iso*-acorone (4.32%) and *n*-undecane (2.64%) as major components.

Table 1: Essential oil composition of *Buddleja asiatica* and *Buddleja davidii* aerial parts

Compounds	K.I.	Oil %		Mode of identification
		B1	B2	
2,2,5-trimethyl-3,4-hexanedione	800	0.96		a,b
4-propyl-6-heptadien-4-ol	880	1.17		a,b
n-undecane	1110	1.50	2.64	a,b
Terpineol <*cis*-β>	1140	0.23	1.02	a,b
5-methylundecane	1160	10.62	13.67	a,b
4-methylundecane	1170	0.86	0.40	a,b
n-dodecane	1205	2.84	55.15	a,b
6-methyldodecane	1220	0.98	2.38	a,b
n-tridecane	1300	55.87	1.36	a,b
2,3-dimethylnonane	1340		0.50	a,b
Bis (1,1-dimethylethyl) diazene	1350	0.83		a,b
3-methyltridecane	1355	0.39	0.54	a,b
n-tetradecane	1400	0.66	0.71	a,b
2,3,5,8-tetramethyldecane	1680	1.79	0.40	a,b
<*iso*-> acorone	1815		4.32	a,b
n-hexadecanol	1865	2.76	0.77	a,b
Cyclohexadecanolide	1930		0.61	a,b
n-eicosane	1990	0.86	0.93	a,b
n-octadecanol	2065	1.37	0.80	a,b
Trans-totarol	2300		0.63	a,b
Total		83.46	86.83	

B1 – *B. asiatica*; B2 – *B. davidii.* a – Mass spectra, b – Retention index

Interestingly, the major component detected in *B. asiatica* essential oil was found as minor component in *B. davidii* essential oil and vice versa. Furthermore, among the major constituents identified in *B. davidii* essential oil, *iso*-acorone (sesquiterpenoid) was found absent in *B. asiatica* oil, while 5-methylundecane was present as one of the major components in both the oils.

As evident from available literature, no record is available on the composition of *B. davidii* essential oil and the results of previous studies[10] revealed a wide variation in essential oil constituents of *B. asiatica,* which could be ascribed to climatic and regional variations.[14-16] Therefore, the present investigation could be quite helpful for further studies on these two essential oils and also to identify chemotypes of both the plant species.

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