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Full Length Research Paper

Compositions and comparison of the leaf and stem essential oils from Nigerian *Hypoestes phyllostachya* 'rosea' p. Beau. [acanthaceae]

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Leaf and stem volatile oils were obtained differently from *Hypoestes phyllostachya* 'Rosea' (Acanthaceae) in 0.36 and 0.13% yields, respectively. GC-MS analyses revealed 38 compounds are responsible for 99.86% of the leaf oil, and 26 compounds make-up 99.89% of the stem oil. Identified compounds were 26 in leaf, which make-up 93.43% of it; 21 identified in stem, which represent 90.45% of it. Leaf oil is dominated by sesquiterpenoids (69.37%), while stem oil contain mostly sesquiterpene hydrocarbons (87.25%). Most abundant compounds in leaf oil are: β-elemenone (20.04%), 8-cendren-13-ol (19.35%), 5-cendranone (10.60%), guaiol (4.43%), geranyl tinglate (4.30%) and germacrene B (4.21%). Prominent compounds in stem oil are: viridiflorene (31.28%), allo-aromadendrene (14.65%), acoradiene (6.99%), γ-gurjunene (4.15%) and valencene (3.97%). The known ubiquitous monoterpenes are not in both leaf and stem essential oils. We report 20 other compounds in leaf oil, and 16 other compounds in stem oil as composition of *Hypoestes phyllostachya* 'Rosea' which is scarce in literature.

Key words: *Hypoestes phyllostachya 'Rosea'*, acanthaceae, essential oils, gas chromatography-mass spectroscopy [GC-MS], sesquiterpenoids.

INTRODUCTION

The broad-leafed evergreen Acanthaceae, *Hypoestes phyllostachya* 'Rosea', is a tropical sub shrub commonly referred to as 'polka dot plant', 'freckle face', and 'morning glory lobelia'. It is grown as an indoor houseplant and as accent plant in dish gardens to add colour in partially shaded areas. The sizes are between 8" to 4 ft, with bushy and coloured shape. They are native to Madagascar, but found in most parts of the world especially West Africa; they are indigenous to Nigeria. The flowers are tiny lilac in racemes. Some of the ethno-medical uses of *Hypoestes* rosea were stated by Gill (1992). This colourful foliage plant is ideal for desk bowls and as under plant in feature beds. Naturally occurring diterpenes most of which are cell-permeable, with anti-inflammatory, antifungal and anticancer activities have been reported in the genus *Hypoestes* and they include hyoestoxide, fusicoserpenol, dolabeserpenic acid, dihypoestoxide, roseatoxide, roseanolone and roseadione (Ojo-Amaize et al., 2001, 2002, 2007; Rasoamiaranjanahary et al., 2003a, b; Adesomoju et al., 1983a, b; Okogun et al., 1982).

Acanthaceae earlier taken as a single taxon, are the third largest tropical family of dicotyledonous plants of about 2,500 species in 250 genera. They are mostly herbs and shrubs with diverse, local and medicinal values, ornamental and mechanical uses (UH Botany, 2008; BoDD, 2008). Data on their chemical compositions including their volatile constituents and the causative agent(s) in each plant are not adequate in literature. This study is a continuation of our research into the chemical constituents of the poorly and rarely studied species of the Nigerian flora.

MATERIALS AND METHODS

Plant collection and isolation of the volatile oils

Fresh shrubs (1.5 kg) of *H. phyllostachya* 'Rosea' were collected in

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January 2008, from University of Ibadan nursery and other parts of Ibadan, Nigeria. The plant was authenticated by Dr. A. A. Ayodele of the University Herbarium, Department of Botany and Microbiology, University of Ibadan, Nigeria where a voucher specimen was deposited.

The plant was separated into leaf and stem parts. Weighed amounts of each (500 g of leaf and 900 g of stem) were hydrodistilled in an all glass Clevenger-type apparatus, over very little distilled hexane (0.3 ml), which was removed afterwards. The distillation time was 3 h in each case. 1.8 g of leaf and 1.2 g of stem essential oils with characteristic odours (light yellow oil with hard woody leafy odour, and colourless oil with woody slightly pungent smell respectively) were procured from the samples.

Gas chromatography (GC)

The volatile oil samples were subjected to GC analyses on an Agilent model 6890 gas chromatograph fitted with a flame ionization detector (FID) and DB-5 (30 x 0.25 mm, 0.25 µm film thickness). Helium was used as carrier gas at a flow rate of 1 ml/min. The GC oven temperature was programmed at 60℃ (held for 2 min), heated to 250℃ at 4℃/min, with final hold time of 20 min. Injector and detector temperatures were fixed at 200℃ and 250℃ respectively.

Gas chromatography/mass spectrometry (GC/MS)

The GC-MS analyses were performed on an Agilent model 6890 GC-MSD system with split/splitless automated injection interfaced to a 5973 mass selective detector operated at 70 eV with a mass range of m/z 50-500. Same operations and temperature programmings were used as for GC. Relative percentage amounts of the separated compounds were calculated from FID chromatograms.

Identification of components

Identification of the essential oil components were based on their retention indices (determined with a reference to a homologous series of n-alkanes) and by comparison of their mass spectral fragmentation patterns in computer matching against in-built data and commercials such as NIST database/ Chemstation data system, Wiley GC/MS Library (Massada, 1976), Adams Library (Adams, 1995), Mass Finder 3.1 Library (Joulain and Koenig, 1998) and in-house "Başer Library of Essential Oil Constituents" built up by genuine compounds and components of known oils.

RESULTS AND DISCUSSION

Essential oils (1.8, 1.2 g) from the leaf (500 g) and stem (900 g) of *H. phyllostachya 'Rosea'* were obtained in 0.36 and 0.13% yields respectively. The leaf oil is light yellow with hard woody-leafy odour. Stem oil which is colourless has woody slightly pungent smell. Lower yield observed for stem oil may be due to more fibres in stem than leaves. GC analyses revealed that thirty-eight (38) and twenty-six (26) compounds make-up 99.86% of the leaf and 99.89% of the stem essential oils respectively. 26 compounds were identified in leaf, which make-up 93.43% of it; 21 identified in stem, which represent 90.45% of it (Table 1). Most abundant compounds in leaf oil are: β-elemenone (20.04%), 8-cendren-13-ol(19.35%), 5-cendranone (10.60%), guaiol (4.43%), geranyl tinglate (4.30%) and germacrene B (4.21%). Prominent compounds in stem oil are: viridiflorene (31.28%), allo-aromadendrene (14.65%), acoradiene (6.99%), γ-gurjunene (4.15%) and valencene (3.97%). Leaf oil is dominated by sesquiterpenoids (69.37%), while stem oil contain mostly sesquiterpene hydrocarbons (87.25%).The oils were characterized by high content of the following classes of compounds: sesquiterpenes, sesquiterpenoids, aromatics, hydrocarbons, alcohols, ketones, aldehydes, esters and ethers (Table 2). The known monoterpenes are not in both leaf and stem essential oils. We report 20 other compounds in leaf oil, and 16 other compounds in stem oil as composition of *H. phyllostachya* 'Rosea' which is scarce in literature.

The unidentified components have patterns of fragmentation showing some of them are isomers. The leaf oil especially seem to have four sets of isomers among its unidentified compounds i.e. peak numbers [(22, 23, 24); (30 and 31); (33, 34, 35, 36); (37 and 38)]. Most of them occur in low amount, but for the fourth most abundant compound in stem oil (6.52%), with fragmentation pattern similar to that of cupaene/ α-muurolene. Results also indicate that this highly medicinal *H. phyllostachya* 'Rosea' is a commercial source for sesquiterpenoids. This report is the first to provide and compare the chemical composition of the volatile oils of the leaf and stem of *H. phyllostachya* 'Rosea'.

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Table 1. Essential oil composition of Leaf and Stem of Nigerian *Hypoestes phyllostachya* 'rosea'.

Plant Part	Peak No [a]	RI [b]	% Composition[c]	Compound Identified	MS[d]
LEAF	1	685	1.12	1-octenol	57,43,72,85,99.
	2	2041	0.80	β-cubebene	161,105,204,119,91,107,133,79.
	3	2061	0.80	β-elemene	93,81,67,107,79,68,147,161,121,189.
	4	2416	2.08	α-caryophyllene	133,93,91,79,41,105,69,120,161,148,189, 204
	5	2425	1.60	γ-curcumene	93,119,121,91,107,105,41,79,77,69,161,1 33,189,55,147,204
	6	2443	4.21	Germacrene B	93,121,80,147,92,91,79,107,41,67,53,204, 161,189.
	7	2778	3.51	γ-cadinene	161,105,91,119,81,204,120,79,77,41,133.
	8	2784	2.14	δ-cadinene	161,204,105,119,91,189,107,133,93,147,7 7,41,67,55,205.
	9	2796	1.76	Trans-β-farnesene	93,107,189,108,105,91,204,79,121,41,119 ,161,133,147,67,55.
	10	2803	1.28	γ-elemene	161,91,105,119,79,204,93,133,121,132,41 ,81,55,189,67,147.
	11	2808	1.04	Cis-3-hexenyl benzoate	161,204,119,134,105,91,93,162,189,41,77 ,55,147,67.
	12	2814	2.35	Cis-isoelemicin	122,107,91,105,121,93,41,79,133,161,189 ,149,55,67,204,205.
	13	2824	1.84	Spathulenol	161,204,122,107,121,93,91,105,41,189,20 5.
	14	2832	4.43	Guaiol	93,161,59,121,107,81,67,189,41,135,79,2 04,53,149.
	15	2837	20.04	β-elemenone	121,93,107,105,91,119,161,67,204,79,133 ,189,41,147,53.
	16	3139	10.60	5-cendranone	204,121,107,105,161,91,133,189,119,93,1 47,81,67,41,55,206.
	17	3175	1.12	γ-eudesmol	151,161,204,105,95,79,81,67,43,119,55,1 33,189,111.
	18	3220	1.92	τ-cadinol	135,107,161,93,59,105,189,91,204,119,79 ,81,41,149.
	19	3229	2.81	Torreyol	122,204,107,161,189,67,109,105,43,147,1 33,81,91,55,175,222.
	20	3271	19.35	8-cendren-13-ol	218,68,175,105,123,91,67,96,161,203,147 ,133,79,41,53,185,219.
	21	3384	0.96	[z]-α-trans-bergamotol	69,41,93,91,119,107,81,161,133,55,147,2 03,187.
	22	3418 RT=41.91	0.32	Ui isomers?	68,93,107,67,121,79,41,81,53,133,149,14 7,257.
	23	3419 RT=41.93	0.08	Ui isomers?	93,81,107,67,68,79,121,133,149,203,55,1 89,41,257,161,175,272.
	24	3429 RT=42.34	0.48	Ui isomers?	69,41,93,81,95,187,107,121,149,55,175,1 33,229,159,272.
	25	3439	4.30	Geranyl tinglate	69,93,41,91,119,120,77,161,107,132,147, 55.
	26	3747	1.84	Cis-nuciferol	133,134,119,91,107,105,79,41.
	27	4031	0.16	[8s,14] cendrane-diol	149,213,119,41,57,185,171,199,133,157.
	28	5131	1.28	Abietal	172,284,241,171,145,91,105,159,199,213, 128,185,115,41,77,227,55,69,269,285.

Table 1. Continues.

	29	5149 RT=45.31	1.60	Ui	71,43,81,57,123,85,95.
	30	5196 RT=46.64	0.40	Ui isomers?	227,270,133,145,55,41,91,105,119,161,81,69,255.
	31	5212 RT=47.10	0.96	Ui isomers?	69,119,134,41,81,133,135,93,107,55,149,177,159,255.
	32	5385	0.09	Neo-abietol	134,119,69,41,135,81,133,93,149,105,55,255,161,187,288.
	33	5392 RT=47.29	0.72	Ui isomers?	286,119,135,133,145,93,107,41,55,79,159,243,69,215,271,187,173,287.
	34	5392 RT=47.30	0.10	Ui isomers?	286,91,119,135,55,105,41,149,243,271,287.
	35	5413 RT=47.89	0.48	Ui isomers?	145,286,119,160,91,159,135,41,105,173,287.
	36	5414 RT=47.91	0.09	Ui isomers?	286,145,215,119,105,91,135,187,159,41,173,55,81,243,271,287.
	37	5422 RT=48.13	0.56	ui isomers?	121,107,119,135,273,41,81,149,94,69,55,288,245,205,159,177.
	38	5422 RT=48.14	0.64	ui isomers?	121,273,135,81,119,41,97,288,107,149,245,55,69,205,177.
STEM	1	2416	2.26	Caryophyllene	133,91,93,41,79,69,105,107,120,161,147,189,55,175,204.
	2	2426	3.78	Thujopsene	119,93,91,41,107,69,79,55,133,161,189,204,147.
	3	2442	3.02	Aromadendrene	93,121,80,91,92,147,107,79,41,67,204,53,133,161,189.
	4	2464	1.51	α-guaiene	161,91,105,79,119,133,69,41,204.
	5	2481	1.22	α-tr;himachalene	93,107,105,204,91,119,41,79,69,108,161,189,135,147,55.
	6	2493	1.89	α-cadinene	161,204,119,134,105,91,189,41,93,77,55.
	7	2499	1.32	α-patchoulene	122,107,91,105,93,121,41,79,149,133,161,189,55,67,204.
	8	2516	1.79	Cis-β-farnesene	93,121,161,59,107,67,41,81,105,43,79,119,189,135,147,204,53.
	9	2521	14.65	Allo-aromadendrene	121,93,107,105,91,119,161,204,67,133,79,81,189,41,53,147.
	10	2524	6.99	Acoradiene	204,121,107,161,105,93,91,133,119,189,81,147,41,67,55.
	11	2557	4.15	γ-gurjunene	161,151,95,109,204,105,93,107,119,41,81,67,189,179,55,135.
	12	2584	1.70	γ-muurolene	161,119,105,204,93,79,95,43,121,41,162,189,133.
	13	2599	2.83	6-methyl γ-ionone	135,107,161,93,105,189,204,59,119,91,81,79,108,43,67.
	14	2607	3.97	Valencene	122,204,107,161,189,43,109,105,121,119,67,81,91,147,55,133,175.
	15	2645	31.28	Viridiflorene	68,175,105,96,123,161,91,67,203,121,147,133,77,41.

Table 1. Contd.

16	2801	0.47	α-selinene	69,41,93,133,120,91,77,119,109,55,147.
17	2817	2.07	α-longipinene	133,134,91,105,79,41,119.
18	2829 RT=43.89	0.56	ui[e]	284,241,256,269,213,149,91,187,133,145, 57,105,159,141,41,119,227,77,285.
19	2850/ 3178 RT=44.78	6.52	Ui Cuparene? α-muurolene?	172,284,145,171,91,241,131,157,185,213, 143,105,199,115,41,79,32,227,269,55,69,256,165.
20	3225 RT=46.66	1.32	Ui	270,227,133,91,105,81,41,145,121,55,67,159,255,175,185,215,271,203.
21	3236 RT=47.11	1.00	Ui	119,134,133,135,41,69,149,81,43,93,91,55,121,107.
22	3237 RT=47.13	0.04	Ui	134,119,133,149,135,43,69,93,55,91,121,41,81,107,255,159.
23	3241	2.07	Cis γ-bisabolene	119,145,135,91,41,55,93,105,77.
24	3256	1.89	1S-cis-calamenene	160,145,105,159,119.
25	3262	1.22	Tran-γ-bisabolene	135,41,107,105,121,91.
26	3599	0.37	8-cendren-13-ol	159,119,105,149,91,133,55,95,41,44,81,93,57,43,69,97,109,135,145,161.

[a]According to the pattern of elution from the GC; [b] Retention Index; [c] Percentage composition; [d] base peak 1st stated, and other most prominent ions [m/e] values; [e] un-identified compound but MS is provided.

Table 2. Comparisons between the class of organic compounds of the leaf and stem essential oils of *Hypoestes phyllostachya* 'Rosea'.

Class of Organic compound	Amount in the essential oils (%)	
	Leaf	Stem
Sesquiterpenes	18.18	87.25
Sesquiterpenoids	69.37	0.37
Aromatics	3.39	1.89
Alcohols	35.64	0.37
Esters	5.34	Nil
Ketones	30.64	2.83
Aldehydes	1.28	Nil
Ethers	2.35	Nil

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