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

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ABSTRACT

Leaf and stem volatile oils were obtained differently from *Hypoestes phyllostachya* 'Rosea' [HR] [Acanthaceae] in 0.36% and 0.13% respectively. Fourteen main volatiles were identified in the stem part which had appreciable amount of sesquiterpenes with the most abundant compounds being 3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylethenyl)-2(1H) naphthalenone (38.01%), 1-ethenyl-1-methyl-2(1-methylethenyl)-4-(1-methylethylidene) cyclohexane (14.26%) and tetramethylcyclopropylidene methylbenzene(7.38%). Twenty-five compounds were identified in the leaf oil of HR which also contained appreciable amount of sesquiterpenes. The most abundant compounds were 3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylethenyl)-2(1H)naphthalenone(23.3%), and1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene) cyclohexane(20.73%), which were the same as in the stem parts. The two most abundant compounds are common to both leaf and stem essential oils. They could be taken as taxonomic compounds for identifying HR, as well as being commercial sources of the naphthalenone and cyclohexane derivatives. The oils were characterised by the presence of derivatives of azulenes and naphthalenes. The known ubiquitous monoterpenes were absent in both leaf and stem essential oils. We report the volatile composition of *Hypoestes phyllostachya* 'Rosea' which is scarce in literature.

KEYWORDS

Hypoestes phyllostachya 'Rosea';
Acanthaceae;
Naphthalenones;
Cyclohexanes;
Taxonomic compounds;
Hydrodistillation.

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 4ft, 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[1-3]. 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*, they include hypoestoxide, fusicoserpenol, dolabeserpenic acid, dihypoestoxide, roseatoxide, roseanolone and roseadione[4-11].

Acanthaceae earlier taken as a single taxon, are the third [3rd] largest tropical family of dicotyledonous plants of about 2,500 species in 250 genera. They are mostly herbs and shrubs with general and divers, local and medicinal values, ornamental and mechanical uses[12,13]. Data on the chemical compositions of plants in Acanthaceae including their volatile constituents and the causative agent(s) in each plant are not adequate in literature[14]. This study is a continuation of our research into the chemical constituents of the poorly and rarely studied species of the Nigerian flora.

EXPERIMENTAL

Plant Collection and Isolation of the Volatile Oils

Fresh shrubs of *Hypoestes phyllostachya* 'Rosea' were collected in 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 were hydrodistilled in an all glass Clevenger-type apparatus, over very little distilled hexane (0.3ml), which was removed afterwards. The distillation time was about 3hours in each case.

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 (30x0.25mm, 0.25µm film thickness). Helium was used as carrier gas at a flow rate of 1ml/min. The GC oven temperature was programmed at 60°C (held for 2mins), heated to 250°C at 4°C/min, with final hold time of 20min. Injector and detector temperatures were fixed at 200°C and 250°C 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 70eV with a mass range of m/z 50-500. Same operations and temperature programming were used as for GC. Relative percentage amounts of the separated compounds were calculated from FID chromatograms as seen in tables 1 and 2.

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[15], Adams Library[16], Mass Finder 3.1 Library[17] and in-house "Başer Library of Essential Oil Constituents" built up by genuine compounds and components of known oils.

RESULTS

TABLE 1 : Essential Oil Composition of Leaf of Nigerian *Hypoestes phyllostachya* 'rosea'

Peak No[a]	RT (mins)[b]	% TIC[c]	Compound Identified
1	10.73	0.80	1-octenol
2	25.05	0.53	Ylangene
3	25.90	0.38	7-methylene-2,4,4-trimethyl-2-vinylbicyclo[4.3.0]nonane
4	26.84	1.64	caryophyllene
5	27.24	1.64	2,6-dimethyl-6-(4-methyl-3-pentenyl)-bicyclo[3.1.1]hept-2-ene
6	27.95	3.99	1,5,9,9-tetramethyl-z,z,z-1,4,7-cycloundecatriene
7	28.81	3.17	1-methyl-5-methylene-8-(1-methyethyl)-[s-(E,E)]-1,6-cyclodecatriene
8	29.05	2.38	1,2,3,4,5,6,7,8-octahydro-1,4-dimethyl-7-(1-methylethylidene),(1S-cid)-azulene
9	29.53	2.24	1,2,3,4,5,6,7,8,8a-octahydro-1,4-dimethyl-7-(1-methylethenyl)-[1S-(1α,7α,8aβ)]-azulene
10	29.81	0.90	1,2,4a,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-naphthalene
11	30.04	0.78	1,2,4a,5,8,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl),[1S-(1α,4aβ,8aα)]-naphthalene
12	30.27	2.22	3,5-dimethyl-acetate,phenol
13	30.66	2.04	1,2,3,4,5,6,7,8,8a-octahydro-1,8a-dimethyl-7-(1-methylethenyl)-[1R-(1α,7β,8a)]-naphthalene
14	30.99	4.53	4-ethenyl-1αα,4-trimethyl-3-(1-methylethenyl)-[1R-(1α,3α,4β)]-cyclohexanemethanol
15	31.18	20.73	1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene)-cyclohexane
16	31.32	11.29	decahydro-1,1,7-trimethyl-4-methylene-[1aR(1aα,4aβ,7α,7aβ,7bα)]-1H-cycloprop[e]azulene
17	32.68	2.03	Decahydro-1,1,7-trimethyl-4-methylene-[1aR(1aα,4aα,7α,7aβ,7bα)]-1H-cycloprop[e]azulene
18	34.40	2.39	1a,2,3,5,6,7,7a,7b-octahydro-1,1,4,7-tetramethyl-[1aR-(1aα,7α,7aβ,7bα]-1H-cycloprop[e]azulene
19	34.72	3.39	1,2,3,4,4a,5,6,8a-octahydro-4a,8-dimethyl-2-(1-methylethylidene)-(4aR-trans)-naphthalene
20	36.32	23.30	3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylethenyl)-2(1H)naphthalenone
21	40.62	1.77	α-farrnesene
22	42.76	3.78	(E,E)-7,11,15-trimethyl-3-methylene-hexadeca-1,6,10,14-tetraene
23	43.39	2.12	1-(3-methylbutyl)-2,3,6-trimethylbenzene
24	44.78	1.30	3-methoxy-8α,9β-estra-1,3,5-(10)-trien-17-one
25	47.11	0.66	2,3,4,5,6,7,-hexahydro-1-(2-hydroxy-2-methylpropyl)-1H-2-indenol

[a]According to the pattern of elution from the GC[Fig 1]
[b]Rentention time in minutes; [c]Total ion concentration in %.

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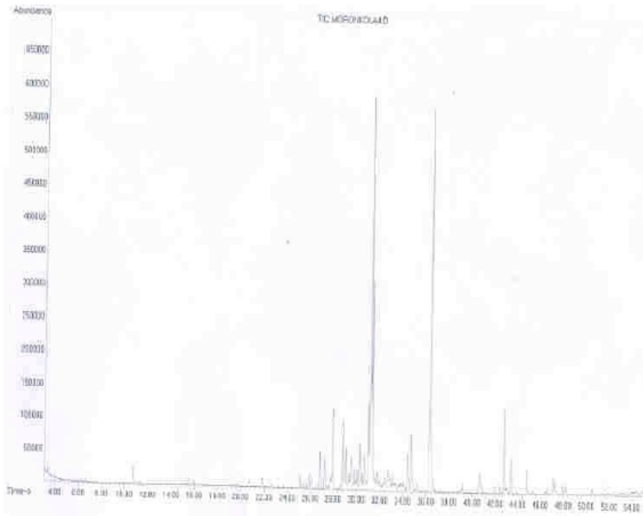

Figure 1 : Gas chromatogram of the leaf essential oil of *Hypoestes phyllostachya* 'rosea' (Acanthaceae), using column fitted with DB-5 (30x0.25mm, 0.25μm film thickness).

TABLE 2 : Essential Oil Composition of Stem part of Nigerian *Hypoestes phyllostachya* 'rosea'

Peak No[a]	RT (mins)[b]	% TIC[c]	Compound Identified
1	26.83	2.12	Caryophyllene
2	27.26	3.25	2,6-dimethyl-6-(4-methyl-3-pentenyl)-bicyclo[3.1.1]hept-2-ene
3	27.94	3.23	1,5,9,9-tetramethyl-z,z,z-1,4,7-cycloundecatriene
4	30.04	1.73	1,2,3,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl),(1S-cis)-naphthalene
5	31.14	14.26	1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene)-cyclohexane
6	31.29	7.26	6-ethenyl-6-methyl-1-(1-methylethyl)-3-(1-methylethylidene)-(S)-cyclohexene
7	32.69	6.90	1,2,3,4,4a,5,6,8a-octahydro-7-methyl-4-methylene-1-(1-methylethyl)-(1α,4aβ,8aα)]-naphthalene
8	34.39	4.38	1a,2,3,5,6,7,7a,7b-octahydro-1,1,4,7-tetramethyl-[1aR-(1aα,7α,7aβ,7bα]-1H-cycloprop[e]azulene
9	34.72	4.96	1a,2,3,4,4a,5,6,7b-octahydro-1,1,4,7-tetramethyl-[1aR-(1aα,4α,4aβ,7bα]-1H-cycloprop[e]azulene
10	36.31	38.01	3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylethenyl)-2(1H)naphthalenone
11	43.40	2.39	2-isopropoxyphenyl,4-ethylbenzoate
12	44.78	7.38	[(tetramethylcyclopropylidene)methyl]-benzene
13	47.29	2.47	Estrolactone
14	47.90	1.66	Retinol

[a]According to the pattern of elution from the GC[Fig 2]
[b] Rentention time in minutes; [c]Total ion concentration in %

DISCUSSION

We obtained essential oils from the stem and leaf parts of *Hypoestes phyllostachya 'Rosea'* in respectively 0.36% and 0.13% yields with characteristic smells. The leaf oil is light yellow with hard woody-leafy odour. Stem oil has woody slightly pungent smell. Twenty-five and fourteen compounds make-up the leaf and stem essential oils[tables 1, 2] respectively. GC analyses reveal that the oils were characterized by high content of the following classes of compounds: aromatics, hydrocarbons, azulenes, alcohols, alicyclics, sesquiterpenes, ketones and esters[table 3]. Sesquiterpenes of appreciable amount was found in both the leaf and stem oils while the ubiquitous monoterpene was absent in both. The two most abundant compounds 3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylethenyl)-2(1H)naphthalenone, and 1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene) cyclohexane, are common to both leaf and stem oils.

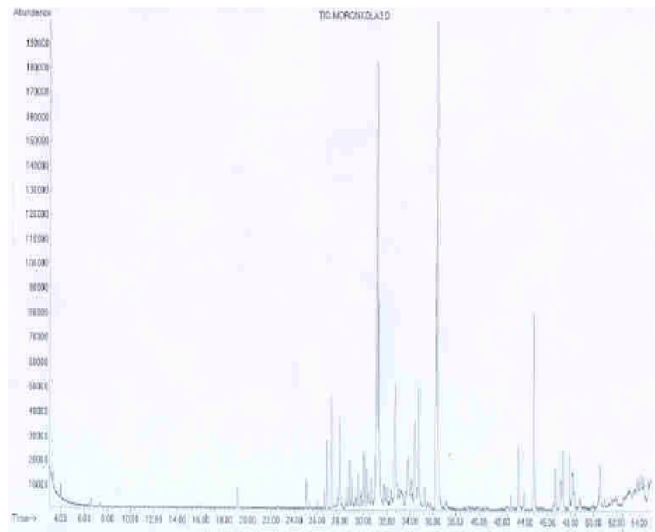

Figure 2 : Gas chromatogram of the stem essential oil of *Hypoestes phyllostachya* 'rosea'(Acanthaceae),using column fitted with DB-5 (30x0.25mm, 0.25μm film thickness).

TABLE 3 : Comparisons between the Chemical Compositions of the Leaf and Stem Essential Oils of *Hypoestes phyllostachya* 'Rosea'.

Class of Organic compound	Amount in the essential oils of [%] Leaf	Stem
Aromatics[naphthalene and benzene derivatives]	32.53	56.41
Unsaturated hydrocarbons	31.67	24.75
Azulenes	20.33	9.34
Alcohols	7.41	1.66
Alicyclics	1.64	3.25
Sesquiterpenes	3.94	2.12
Ketones	1.30	Nil
Esters	Nil	2.39

The two most abundant compounds 3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylethenyl)-2(1H)naphthalenone, and 1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene) cyclohexane, are common to both leaf and stem oils. They could be taken as taxonomic compounds for identifying *Hypoestes phyllostachya* 'Rosea' as well as being commercial sources of the naphthalenone and cyclohexane derivatives. This report is the first to provide and compare the chemical composition of the volatile oils of the leaf and stem of *Hypoestes phyllostachya* 'Rosea'.

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