Journal of Essential Oil Research

ISSN: 1041-2905 (Print) 2163-8152 (Online) Journal homepage: https://www.tandfonline.com/loi/tjeo20

Volatile constituents of essential oils isolated from *Alpinia galanga* Willd. (L.) and *A. officinarum* Hance rhizomes from North East India

Archana P. Raina, S.K. Verma & Z. Abraham

To cite this article: Archana P. Raina, S.K. Verma & Z. Abraham (2014) Volatile constituents of essential oils isolated from *Alpinia galanga* Willd. (L.) and *A. officinarum* Hance rhizomes from North East India, Journal of Essential Oil Research, 26:1, 24-28, DOI: 10.1080/10412905.2013.822430

To link to this article: https://doi.org/10.1080/10412905.2013.822430

Journal of Essential Oil Research, 2014
Vol. 26, No. 1, 24–28, http://dx.doi.org/10.1080/10412905.2013.822430

Taylor & Francis
Taylor & Francis Group

Volatile constituents of essential oils isolated from *Alpinia galanga* Willd. (L.) and *A. officinarum* Hance rhizomes from North East India

Archana P. Raina[a]*, S.K. Verma[b] and Z. Abraham[c]

[a]*Germplasm Evaluation Division, National Bureau of Plant Genetic Resources, New Delhi, India;* [b]*National Bureau of Plant Genetic Resources Regional Station, Shillong, India;* [c]*National Bureau of Plant Genetic Resources Regional Station, Kerala Agricultural University, Thrissur, India*

(*Received 12 September 2012; final form 26 June 2013*)

Chemical profiles of essential oils isolated from the rhizomes of two *Alpinia* species, *Alpinia galanga* (L.) Willd. and *Alpinia officinarum* Hance from North East India, were analyzed by gas chromatography-flame ionization detection and gas chromatography–mass spectrometry. Major compounds identified in the oils of *A. galanga* and *A. officinarum* were 1,8-cineole (63.4 and 44.2%), α-terpineol (2.8 and 6.3%), α-pinene (1.9 and 2.0%), β-pinene (0.8 and 5.7%), and terpinen-4-ol (2.8 and 4.5%), respectively. Some additional compounds identified in *A. officinarum* oil were camphor (4.0%) and α-fenchyl acetate (8.9%), while chavicol (0.9%), (*E*)-β-farnesene (8.4%), β-sesquiphellandrene (2.6%), β-bisabolene (0.3%), and eugenol acetate (3.3%) were present in *A. galanga* oil. 1,8-Cineole is an important aromatic chemical reported to possess expectorant, antiseptic, and anesthetic properties and is used widely in pharmaceutical preparations. Therefore, there is a promising possibility to utilize these plant species for industrial purpose.

Keywords: *Alpinia galanga*; *Alpinia officinarum*; greater galangal; lesser galangal; Zingiberaceae; essential oil; composition; 1,8-cineole; α-fenchyl acetate

Introduction

Alpinia is a large, widespread genus in the family Zingiberaceae with 230 species occurring throughout tropical and subtropical Asia (1). *Alpinia galanga* Willd. (greater galangal) and *Alpinia officinarum* Hance (lesser galangal) are the important species belonging to this genus. These are aromatic, rhizomatous herbs distributed in various regions of India and throughout Southeast Asian countries like Sri Lanka, Thailand, and Malaysia (2). The dry rhizomes of *A. galanga* are used in flavoring foods, meat dishes, and curries in Malaysia (3). The rhizomes are used in many traditional medicines for the treatment of rheumatism, bronchial catarrh, asthma, and in reducing pain. It is used to stimulate digestion, purify blood, improve voice, and to treat inflammation (4). It also yields an essential oil of commercial importance used for preparation of perfumes, pharmaceuticals, room sprays, lotion, and cosmetic products.

A survey of the literature showed reports of *A. galanga* oil composition by many researchers from several countries (3, 5–10), but there is very little information available from North East India. The essential oil composition of *A. galanga* was reported to possess compositional differences, suggesting the existence of chemotypes in this species. The oil from Indonesia was made up predominantly of monoterpenoids with pinenes (18.6%) and 1,8-cineole (47.3%), while the Malaysian oil was characterized by sesquiterpenoids with (*E*)-β-farnesene (18.2%) and β-bisabolene (16.2%) as the major components (6, 7, 11). Studies showed that *A. galanga* from Southern India contained 1,8-cineole (33.0–30.2%), camphor (5.0–14.0%), α-terpineol (2.3–9.3%), α-fenchyl acetate (1.1–12.7%), and (*E*)-methyl cinnamate (2.6–5.3%) as the main component in its rhizome oil (8). Chemical diversity among four *Alpinia* species grown in Northern India was studied and monoterpenoids 1,8-cineole, α-terpineol, (*E*)-ethyl cinnamate, camphor, terpinen-4-ol, and α-and β-pinenes were reported as the major constituents in rhizome oil of *A. galanga* from Northern India (12). *A. galanga* from North East India showed 1,8-cineole as the major compound (67.5%) and other compounds were β-sesquiphellandrene (9.4%), β-pinene (2.3%), and terpinen-4-ol (2.1%) (13). Chemical components of the rhizomes, flowers, and leaves of *A. galanga* have also been recently reviewed (10).

A. officinarum Hance (lesser galangal) is also a well-known pungent and aromatic plant which is cultivated in Vietnam and Southern China for its spices and medicinal purposes. It has been used in both Ayurvedic and Chinese medicine against a variety of diseases and is considered as a stimulant, carminative,

*Corresponding author. Email: aprraina@yahoo.co.in

Table 1. Essential oil composition (% of total)* of the rhizome oils of *A. galanga* and *A. officinarum*.

Compound	RI**	KI***	*A. galanga*	*A. officinarum*	Methods of identification
α-Thujene	931	930	0.1	tr	MS, RI
α-Pinene	939	939	1.9	2.0	MS, RI, Co
Camphene	954	954	0.1	3.2	MS, RI, Co
β-Pinene	980	979	0.8	5.7	MS, RI, Co
Myrcene	992	990	0.4	0.9	MS, RI, Co
p-Cymene	1026	1024	0.7	0.1	MS, RI, Co
Limonene	1027	1029	0.1	–	MS, RI, Co
1,8-Cineole	1031	1031	63.4	44.2	MS, RI, Co
γ-Terpinene	1063	1059	0.4	0.2	MS, RI, Co
Terpinolene	1082	1088	0.1	–	MS, RI
Fenchone	1083	1086	0.2	0.6	MS, RI
Linalool	1100	1096	0.3	0.2	MS, RI, Co
Camphor	1149	1146	–	4.0	MS, RI, Co
Borneol	1170	1169	1.1	1.1	MS, RI
Terpinen-4-ol	1177	1177	2.8	4.5	MS, RI, Co
α-Terpineol	1192	1188	2.8	6.3	MS, RI, Co
α-Fenchyl acetate	1220	1220	–	8.9	MS, RI, Co
Chavicol	1253	1250	0.9	–	MS, RI
Bornyl acetate	1290	1285	0.6	0.8	MS, RI, Co
Eugenol	1361	1359	0.6	0.2	MS, RI, Co
(*E*)-Methyl cinnamate	1379	1378	0.2	1.9	MS, RI
Geranyl acetate	1381	1381	0.5	–	MS, RI
Methyl eugenol	1406	1403	0.6	2.9	MS, RI, Co
β-Caryophyllene	1419	1408	0.5	4.3	MS, RI, Co
(*E*)-β-Farnesene	1457	1442	8.4	–	MS, RI
β-Bisabolene	1509	1505	0.3	–	MS, RI
β-Sesquiphellandrene	1523	1522	2.6	–	MS, RI
Eugenol acetate	1529	1522	3.3	–	MS, RI
(*E*)-Nerolidol	1566	1563	0.5	0.2	MS, RI
Caryophyllene oxide	1583	1583	0.9	0.2	MS, RI, Co
Monoterpene hydrocarbons			4.6	12.1	
Oxygenated monoterpenes			71.8	70.6	
Sesquiterpene hydrocarbons			11.7	4.3	
Oxygenated sesquiterpenes			1.4	0.4	
Phenyl propanoids			5.6	5.0	
Total (%) identified			95.1	92.4	

Notes: *Data indicates relative area percentage, **RI = Retention indices on HP-5MS column, ***KI = Kovats index (Literature values), MS = Mass spectrum, Co = Co-chromatography with authentic sample.

and stomachic. The rhizome oil of *A. officinarum* has been very less studied and reported (14). Thus, the present study compares the chemical composition of rhizome oils of *A. galanga* and *A. officinarum* growing in North East India.

Experimental

Plant material

A. galanga and *A. officinarum* collected from Imphal district of Manipur from North East India were multiplied at National Bureau of Plant Genetic Resources Regional Station, Shillong, Meghalaya, India. The fresh rhizomes were washed, cut into small pieces, and dried. They were then subjected to hydrodistillation in a Clevenger-type apparatus for 4 hours. The oil obtained was separated and dried over anhydrous sodium sulfate. The essential oil content in the rhizomes was 0.27 (*A. galanga)* and 0.21% (*A. officinarum*) and was stored at 4°C for further studies.

Gas chromatography–flame ionization detection analyses

Gas chromatography–flame ionization detection (GC–FID) analyses of the volatile oil samples were performed using Agilent GC model 7890A equipped with flame ionization detector and a HP-5MS capillary column (30 m × 0.25 mm i.d.; film thickness 0.25 μm). Helium was used as carrier gas at the flow rate of 1 mL/min. The oven temperature was programmed from 60 to 240°C at 3°C/min. Detector temperature was maintained at 250°C. The sample (0.1 μl) was injected neat in split ratio (1:40) at 220°C. Percentages of the

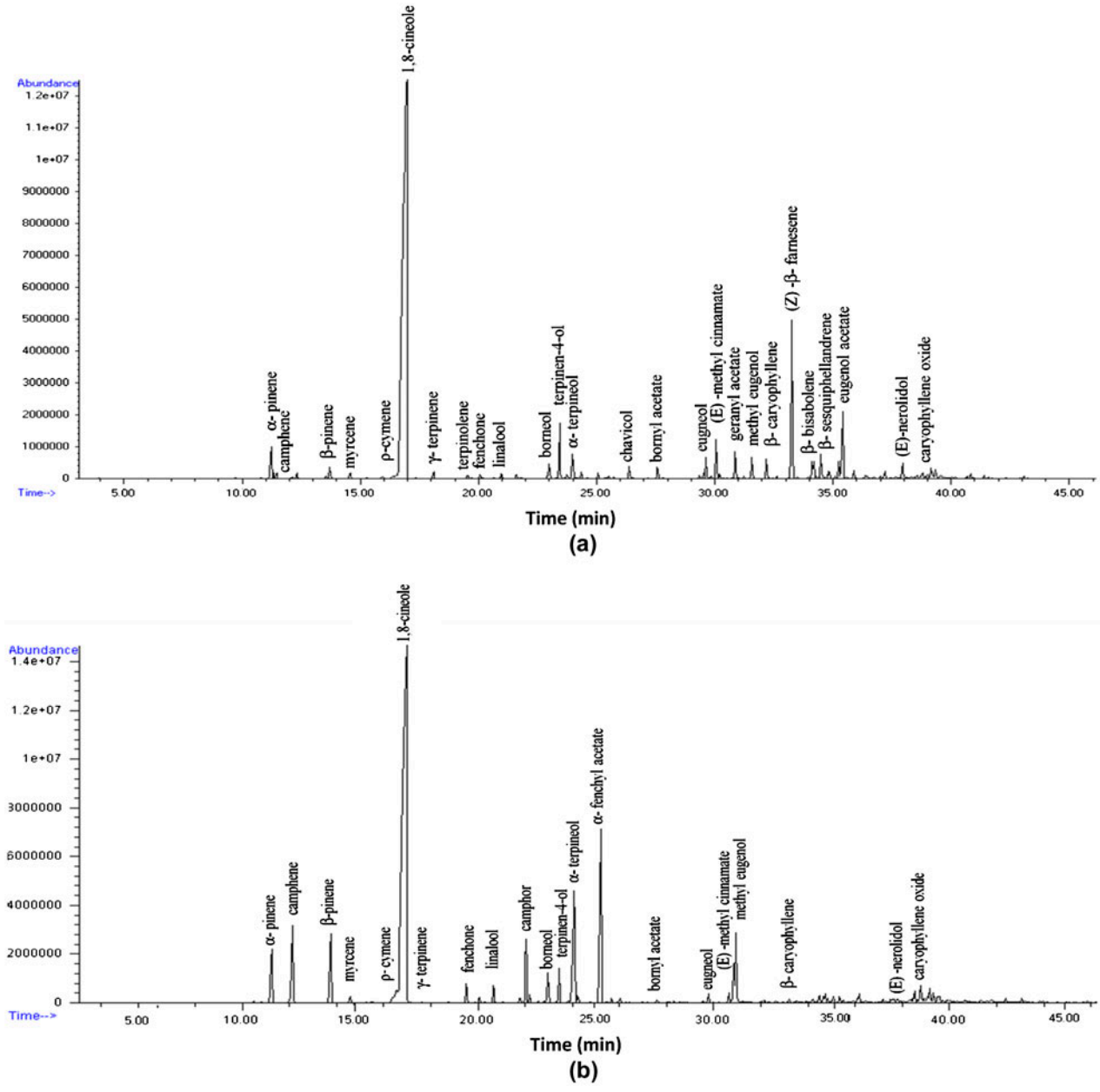

Figure 1. Essential oil chromatograms of *A. galanga* (a) and *A. officinarum* (b).

individual components in each of the oil were obtained from the GC–FID peak area% reports.

Gas chromatography–mass spectrometry analyses

Gas chromatography–mass spectrometry analyses of volatile oils were carried out on a Agilent 6890A gas chromatograph fitted with an HP-5MS capillary column (30 m × 0.25 mm i.d.; film thickness 0.25 µm) coupled with a model 5975 C mass detector. Temperature programming was done as mentioned above. Helium was used as the carrier gas at 1 mL/min flow rate. Mass spectra were recorded over 40–400 amu range at 1 scan/s with ionization energy of 70 eV and ion source temperature at 230°C. The split ratio used was 1:40. The constituents of the oils were identified by comparing the retention indices of the peaks with those reported in literature, matching mass spectral data of the peaks with the data of their authentic standards, or the data of the NIST library or literature values (15).

Results and discussion

The rhizomes of *A. galanga* and *A. officinarum* were found to yield 0.27% and 0.21% essential oil (v/w on

dry weight basis), respectively. Twenty-nine compounds accounting 95.1% of the rhizomes oil were identified in *A. galanga* oil and are presented in Table 1. Major components present in *A. galanga* rhizome oil were 1,8-cineole (63.4%), α-terpineol (2.8%), α-pinene (1.9%), terpinen-4-ol (2.8%), (*E*)-β-farnesene (8.4%), β-sesquiphellandrene (2.6%), β-bisabolene (0.3%), eugenol acetate (3.3%), chavicol (0.9%), γ-terpinene (0.4%), eugenol (0.6%), geranyl acetate (0.5%), caryophyllene oxide (0.9%), methyl eugenol (0.6%), and (*E*)-nerolidol (0.5%). Present oil composition of *A. galanga* differed from earlier reports from India as α-fenchyl acetate and chavicyl acetate were not detected, (13) whereas low β-sesquiphellandrene and high (*E*)-β-farnesene contents were noted (12). The occurrence of 1,8-cineole as major component in the rhizome oil of *A. galanga* in the present investigation is in agreement with the earlier findings (8, 12, 13). In contrast, (*E*)-methyl cinnamate (45%), α-terpineol (19.1%), (*E*)-β-farnesene (18.2%), and myrcene (94.5%) rich five chemotypes of this species are reported earlier. 1,8-cineole, the most abundant component in *A. galanga* rhizome oil, was found in much greater quantity than that reported in the oil of similar species either from India or abroad (3, 6, 7, 11), but its composition is quite different from the chemotypes of *A. galanga* of Sri Lankan and Indian origin (5, 10). The compositional and quantitative differences between the rhizome galangal oils reported in this study with those reported previously may suggest the existence of intraspecific chemical differences among the natural population of *A. galanga.*

Chemical analysis of *A. officinarum* rhizome oil showed 22 compounds, constituting 92.4% of total oil (Table 1). The main compounds identified were 1,8 cineole (44.2%), α-fenchyl acetate (8.9%), β-pinene (5.7%), camphor (4.0%), α-terpineol (6.3%), terpinen-4-ol (4.49%), β-caryophyllene (4.3%), methyl eugenol (2.9%), α-pinene (2.0%), camphene (3.2%), and (*E*)-methyl cinnamate (1.9%). The most common major compounds identified in both oils were 1,8-cineole (63.4 and 44.2%), α-terpineol (2.8 and 6.3%), α-pinene (1.91 and 1.99%), β-pinene (0.8 and 5.7%), and terpinen-4-ol (2.8 and 4.5%) in the oils of *A. galanga* and *A. officinarum,* respectively (Figure 1). Compounds namely chavicol (0.87%), (*E*)-β-farnescene (8.36%), β-sesquiphellandrene (2.6%), β-bisabolene (0.3%), and eugenol acetate (3.3%) were found only in *A. galanga* oil, while α-fenchyl acetate (8.9%) and camphor (4.0%) were present only in *A. officinarum* oil. Results of the present study showed that the rhizome oil of *A. galanga* contained a much higher amount of 1,8-cineole compared to that of *A. officinarum*. Rhizome oils of both the species were found rich in oxygenated monoterpenes (71%). However, their chemical compositions were found to be quite different and unique at the species level.

The analyzed rhizome oils of *Alpinia* species were found to possess qualitative similarities among their main compounds, but have considerable variations in quantitative levels of the individual components. Our studies concluded that both these *Alpinia* species are 1,8-cineole rich, which is an important aroma chemical reported to possess expectorant, antiseptic, and anesthetic properties and is used widely in pharmaceutical preparations. Therefore, there is a promising possibility to utilize these plant species for industrial purposes.

Acknowledgement

The authors are grateful to Director, NBPGR, New Delhi, for his keen interest and encouragement.

References

1. Anonymous. *The Wealth of India: Raw Materials*. Vol. I, pp. 198–199, CSIR, New Delhi (1985).
2. R.N. Chopra, S.L. Nayar and I.C. Chopra, Glossary *of Indian Medicinal Plants*. Council of Scientific and Industrial Research, New Delhi (1986).
3. L. Herman De Pooter, N.O. Muhammad, A.C. Brigitte and M.S. Niceas, *The essential oil of greater galanga (*Alpinia galanga*) from Malaysia.* Phytochemistry, **24**, 93–96 (1985).
4. K.R. Kirtikar and B.D. Basu. *Indian Medicinal Plants*, IInd Edits, Vol. IV, pp. 2445–2446, M/s. Bishen Singh Mahendra Pal Singh, New Delhi (1935).
5. D.J. Charles, J.E. Simon and N.K. Singh, *The essential oil of* Alpinia galanga *Willd.* J. Essent. Oil Res., **4**, 81–82 (1992).
6. C.J.J. Scheffer, A. Gani and A. Baerheim-Svendsen, *Monoterpenes in the essential rhizome oil of* Alpinia galanga *L.* Willd. Sci. Pharm., **49**, 337–346 (1981).
7. H. Mori, K. Kubota and A. Kobayashi, *Potent aroma components of rhizomes from* Alpinia galanga *Willd L.* Nippon Shokuhin Kagaku Kogaku Kaishi, **42**, 989–995 (1995).
8. G.R. Mallavarapu, L. Rao, S. Ramesh, B.P. Dimri, B.R. Rajeswara Rao, P.N. Kaul and A.K. Bhattacharya, *Composition of the volatile oils of* Alpinia galanga *rhizomes and leaves from India.* J. Essent. Oil Res., **14**, 397–399 (2002).
9. V.K. Raina, S.K. Srivastava and K.V. Syamasundur, *The essential oil of greater galangal (*Alpinia galanga *L. Willd) from the lower Himalayan region of India.* Flav. Fragn. J., **17**, 358–360 (2002).
10. B.M. Lawrence, *Galangal Oil.* Prog. Essential Oils. Perf. and Flav., **30**, 66–72 (2005).
11. I.B. Jantan, F.B. Ahmad and A.S. Ahmad, *Constituents of the rhizome and seed oils of greater galanga* Alpinia galanga *(L.) Willd from Malaysia.* J. Essent. Oil Res., **16**, 174–176 (2004).
12. R.C. Padalia, R.S. Verma, V. Sundaresan and C.S. Chanotiya, *Chemical diversity in the genus* Alpinia *(Zingiberaceae): Comparative of four* Alpinia *species grown is Northern India.* Chem. Biodivers., **7**, 2076–2087 (2010).

13. M. Dutta and S.C. Nath. *Essential oil components of the rhizome of* Alpinia galanga *Willd native to North East India*. In: *Bioprospecting of Commercially Important Plants*; Proc. Nat. Symp., ISAB-JC, Edits., R.C. Borah, A. Talukdar, J.C.S. Kataky, B.G. Unni, M.K. Modi and P. Deka, pp. 213–216, Indian Society of Agricultural Biochemists, Jorhat (2003).
14. B.M. Lawrence, J.W. Hogg and S.J. Terhune, *Essential oils and their constituents. Part 2. The oil of* Alpinia officinarium *Hance.* Perfum. Essent. Oil Rec., **60**, 88–96 (1969).
15. R.P. Adams. *Identification of Essential Oils by Ion Trap Mass Spectroscopy*. Academic Press, San Deigo, CA (1990).