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HIGH-LEVEL 1,8-CINEOLE IN THE *Alpinia officinarum* ESSENTIAL OIL FROM HAINAN ISLAND OF CHINA

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Alpinia officinarum Hance (also called galanga, galangal, galingale or galangale) is a pungent and aromatic dried rhizome, which has been used as an aromatic stomachic, analgesic, and antiemetic in Asia [1]. Few studies on the oil in the rhizome of *A. officinarum* (small galanga) have been reported. Previous studies showed that 1,8-cineole was the major constituent of the essential oil from small galangal (8.2–50%) and greater galangal (39.4%) [2–7]. The volatile constituents of the dried rhizome of *A. officinarum* Hance, growing in Dingan County in Hainan Island, of which the major constituent is 1,8-cineole (also called eucalyptol > 70%), is reported for the first time by GC and GC-MS. The essential oil was analyzed using the retention time locked method (www. Agilent.com/chem), and 30 compounds (92.2%) were identified by comparing their RI with those reported from the literature and mass spectrometric data using Flavor. LIB and NIST08.LIB. Twelve of the 30 compounds identified were detected for the first time. These are 3-methyl-2-hexanone, (–)-myrtenol, valeric anhydride, neoclovene, α-humulene, eremophilene, α-selinene, α-calacorene, dendrasaline, nerolidol, cadala-1(10),3,8-triene, and caryophyllene oxide, as listed in Table 1. It is notable that the oil is rich in 1,8-cineole (72.7%). In addition, 1,8-cineole was also the main component of the essential oil from fresh (50.0%) and dried (8.2%) rhizome of galangal in Hanoi, Vietnam [5].

TABLE 1. Volatile Compounds Identified in the Dried Rhizome of Small Galangal in Hainan Island

Compound	RI	%	Ref.	Compound	RI	%	Ref.
3-Methyl-2-hexanone	843	0.2	[9]	α-Humulene	1457	0.4	[10]
α-Pinene	919	0.3	[5]	Germacrene	1479	0.2	[5]
Camphene	937	0.4	[10]	Eremophilene	1490	0.7	[18]
β-Pinene	974	0.8	[11]	α-Selinene	1499	0.5	[19]
1,8-Cineole	1044	72.7	[12]	α-Farnesene	1516	0.8	[5]
Camphor	1146	1.5	[13]	α-Calacorene*	1546	0.3	
Isoborneol	1147	Tr.	[14]	Dendrasaline	1557	0.2	[20]
4-Terpineol	1159	0.2	[5]	Germacrene B	1559	0.2	[21]
α-Terpeneol	1170	0.4	[5]	Cadala-1(10),3,8-triene	1564	0.1	[22]
Piperitol	1182	1.3	[5]	Nerolidol	1568	0.1	[23]
trans-Carveol	1204	6.4	[5]	Caryophyllene oxide	1587	1.1	[10]
Myrtenol*	1206	Tr.		α-Cadinol	1618	0.4	[14]
Valeric anhydride*	1282	0.2		Monoterpene hydrocarbons		1.5	
Cycloisosativene	1366	0.1	[15]	Oxygen-containing monoterpenes		82.6	
β-Elemene	1392	0.2	[5]	Sesquiterpene hydrocarbons		5.6	
Caryophyllene	1421	1.2	[16]	Oxygen-containing sesquiterpenes		1.8	
α-Bergamotene	1439	1.1	[5]	Total identified		92.2	
Neoclovene	1451	0.2	[17]				

RI: relative to C_8-C_{24} *n*-alkanes on HP-5 column. Methods of identification: MS, by comparison of the mass spectrum with NIST08.LIB and Flavor. LIB (www. Agilent.com/chem). Tr.: trace quantities (< 0.1%). %: percentage of content (v/w) of each consitituent in total volatiles. *Tentative identification based upon mass spectrum and RI only restored by NIST.LIB.

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The hydrocarbons in the oil were α-pinene (0.3%), camphene (0.4%), and β-pinene (0.8%) as the monoterpene, and caryophyllene (1.2%), α-bergamotene (1.1%), and α-farnesene (0.8%) as the major sesquiterpene. Lawrence et al. [1] and Ly et al. [5] also reported that the compounds mentioned above were the major components in the fresh rihizome [1, 5]. The ratio of hydrocarbons to oxygenated constituents for the dried sample is obviously higher than that for fresh rhizome in spite of the reduction of monoterpene hydrocarbons [1]. An important reason may be that eucalyptol, as the major oxygenated compound, showed a significant decrease in concentration during drying of the rhizome [5].

There are many processed foodstuffs to which aromatic plants containing different levels of 1,8-cineole and/or their essential oils may be added as flavorings [8]. So, the essential oil from these plants, of which the major constituent is eucalyptol (> 70%), may be suggested as a new exciting potential source of food additives.

A. officinarum rhizomes in underground dormancy for four years (approx.) were collected from Dingan County of Hainan Island in November 2010. The air-dried rhizome was subjected to steam distillation for 3 h using a Clevenger apparatus to produce the essential oil in a yield of (1.1%, w/w) based on the dry weight.

The GC analysis was carried out using an Agilent GC-7890A equipped with FID using a HP-5 column (30 m × 0.25 mm; 0.25 μm film thicknesses). The program was started by a column temperature set at 60°C, increased to 240°C at 3°C/min and held for 10 min. Aliquot of oil (1 μL) was injected into the column using a 25:1 split injection, whose temperature was initialized at 250°C.

The GC/MS analyses were performed on an Agilent 7890A gas chromatograph equipped with a split/splitless inlet in combination with Agilent 5975C MSD. Separation was done on a 30 m × 0.25 mm; 0.25 μm HP-5MS column (β = 250) with He as the carrier gas. The mass spectrometer was operated in the 70 eV EI mode with scanning from 40 to 400 amu.

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