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COMPOSITION OF ESSENTIAL OILS FROM THE RHIZOMES OF THREE *Alpinia* SPECIES GROWN IN THAILAND

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The genus *Alpinia* is an herbaceous plant belonging to the family Zingiberaceae and comprising more than 230 species. It has medicinal properties especially useful in conditions such as flatulence, dyspepsia, vomiting, and stomach sickness [1, 2]. Products of *Alpinia* rhizome have also been used as biological agents, for example, antibacterial [3], antifungal [4], anticlastogenic [5], antimutagenic [6], and as antioxidant agents [7]. The essential oil of *Alpinia* is useful in the treatment of respiratory illnesses and has been used as a flavoring agent for beverages in some European countries. Chemical studies of some main species of *Alpinia* have been widely reported [8–12], while a few studies have been conducted on the chemical compositions of some less common species [13–14]. In this study, the composition of essential oil obtained from rhizome of the rare *A. malaccensis*, which grows wild in areas of Northern Thailand, was investigated in comparison with those of the common species, *A. galanga* and *A. officinarum*, which are cultivated extensively.

The essential oils extracted by SDE from rhizome parts of *A. galanga*, *A. officinarum*, and *A. malaccensis* appeared as pale yellow viscous liquids with percentage yields of 0.5, 0.1, and 0.2 (w/w), respectively. GC×GC profiles of rhizome oils from common species, *A. galanga* and *A. officinarum*, were almost the same, while those for a wild *Alpnia*, *A. malaccensis,* were different. The volatile constituents in the monoterpene region of all essential oil profiles are similar, thus are the characteristic of *Alpinia* rhizome oil. The overall GC×GC profile of volatile constituents of *A. galanga* oil was similar to that obtained from oil of *A. officinarum,* which revealed the similar genotype of both plants. These profiles of the common *Alpinia* were rather different from that of *A. malaccensis*.

GC-MS analysis of the three *Alpinia* essential oils confirmed the regions of monoterpenes and sesquiterpenes as well as their derivatives. Overall, 71 volatile components were identified among the three *Alpinia* essential oils. The structural assignments of these volatiles, their relative percentages, and retention indices are summarized in Table 1. Individually, *A. galanga* essential oil yielded 60 identified components. The dominant components were 1,8-cineole (21.6%), chavicol (17.7%), and α-bisabolene (15.6%). Fifty-three components were identified in the essential oil of *A. officinarum*; the major component was α-bisabolene (10.6%) followed by α-*trans*-bergamotene (7.9%), and β-sesquiphellandrene (6.9%). Forty-one constituents were investigated in *A. malaccensis*, with 1,8-cineole (11.9%) as the major component followed by linalool (9%), and fenchyl acetate (8.6%). According to the GC×GC profiles, at least 122, 117, and 145 volatile components were detected in *A. galanga*, *A. officinarum*, and *A. malaccensis* essential oils, of which the extents of the identified components were 49, 45, and 28%, respectively. Comparison of the oil compositions of these *Alpinia* species by GC-MS showed that the high proportion of oxygenated monoterpenes was typical both in the *A. galanga* oil (72%) and *A. malaccensis* oil (45%), whereas sesquiterpene hydrocarbons dominated in *A. officinarum* essential oil (47%). Although most of the identified components were similar in all the essential oils, the quantity of some of these components in each essential oil was significantly different.

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TABLE 1. Essential Oil Composition of *Alpinia* ssp.

Component	RI	Content, %			Component	RI	Content, %		
		1	2	3			1	2	3
β-Myrcene	991	Tr.	Tr.	Tr.	Geranyl acetate	1385	0.1	1.3	
α-Terpinene	1016	0.1			*β*-Elememe	1390	0.2	Tr.	
p-Cymene	1024	0.2	Tr.	0.4	*N*-Methyl-3,5-dihydroxyaniline*	1401	0.3	0.2	
Limonene	1027	0.6	Tr.	1.1	*o*-Methyleugenol	1406	0.9	3.0	
1,8-Cineole	1030	21.6	1.8	11.9	1-Caryophyllene	1416	1.9	5.2	1.6
γ-Terpinene	1057	0.1	Tr.		*α*-Santalene	1418	Tr.	0.3	
Isoterpinolene	1088	0.1	Tr.	0.1	*trans*-*α*-Bergamotene	1434	0.3	7.9	
Linalool	1101	0.1	0.1	9.0	*α*-Humulene	1450	1.3	1.8	0.4
endo-Fenchol	1113	Tr.		0.2	*α*-neo-Clovene	1454	Tr.	0.2	0.2
trans-*p*-Mentha-2,8-dien-1-ol	1121	0.1	Tr.	0.1	*trans*-*β*-Farnesene	1457	0.9	1.6	
Campholenal	1126	Tr.		0.2	*trans*-Cadina-1(6),4-diene	1475	Tr.	0.8	
Pinocarveol	1137	Tr.	0.1	0.8	*γ*-Muurolene	1478		0.7	
Camphor	1143			1.2	2-Isopropenyl-4a,8-dimethyl-1,2,3,4,4a,5,6,7-octahydronaphthalene*	1480	0.6	0.7	Tr.
Camphene hydrate	1146			0.2					
Pinocarvone	1161			0.3	*γ*-Himachalene	1481	0.2	0.9	
Borneol	1164	Tr.		1.1	*ar*-Curcumene	1482	0.1	0.7	1.3
p-Mentha-1,5-dien-8-ol	1166	0.4	0.5	0.2	*β*-Selinene	1490	Tr.		3.5
δ-Terpineol	1176	1.3	2.7	0.7	*δ*-Selinene	1492	Tr.	1.6	
p-Cymen-8-ol	1185	0.1	0.2	Tr.	Zingiberene	1494	Tr.	0.6	
Cryptone	1186			1.4	*β*-Bisabolene	1502	0.5	1.7	
α-Terpineol	1190	2.0	2.0	2.6	*α*-Bisabolene	1508	15.6	10.6	
Myrtenol	1196	Tr.		1.1	*δ*-Amorphene	1511	1.0	1.1	0.9
Methyl chavicol	1199	0.1	Tr.		*δ*-Cadinene	1520		Tr.	0.3
Verbenone	1210	Tr.		0.4	*β*-Sesquiphellandrene	1523	0.9	6.9	
Fenchyl acetate	1219	0.1	0.1	8.6	Eugenol acetate	1529	0.5		
Cumin aldehyde	1239	Tr.		0.2	*trans*-*γ*-Bisabolene	1531	Tr.	4.3	
Carvone	1244	Tr.		0.1	Silphiperfol-5-en-3-one B	1553	Tr.	0.5	
Chavicol	1256	17.7	1.3	Tr.	*trans*-Nerolidol	1564	0.1	0.7	5.7
Endobornyl acetate	1285	0.1	0.4	4.4	Spathulenol	1575	Tr.		0.9
exo-2-Hydroxycineole acetate	1342	15.0			(–)-Caryophyllene oxide	1579	0.4	1.2	2.4
4-(2-Propenyl) phenol acetate	1346	6.5			*trans*-Isolongifolanone	1624	0.2	1.3	2.5
α-Terpinyl acetate	1349			0.2	*α*-Cadinol	1652	0.2	1.2	2.3
Eugenol	1358		0.5		*epi*-*α*-Bisabolol	1684	0.1	1.1	
cis-Carvyl acetate	1363		0.1		*trans*-*α*-Bergamotol	1691	0.1	1.1	
exo-2-Hydroxycineole acetate	1364	0.3	0.1		Eudesm-7(11)-en-4-ol,acetate	1840	Tr.	1.1	
α-Copaene	1374		0.1	0.6	Farnesyl acetate	1843		1.1	

1 – *A. galanga*; 2 – *A. officinarum*; 3 – *A. malaccensis*.
*Tentative of identification; RI: retention index; Tr.: trace amount <0.05%.

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