NOTE

(E)-METHYL CINNAMATE: THE MAJOR COMPONENT OF ESSENTIAL OILS OF *ALPINIA MALACCENSIS* VAR. *NOBILIS*

M. A. Nor Azah*, Y. Y. Sam, J. Mailina & L. S. L. Chua**

Forest Research Institute Malaysia, 52109 Kepong, Selangor Darul Ehsan, Malaysia

Alpinia malaccensis var. *nobilis* (Turner 1995) is a large ginger between 2 and 4 m tall. The tall leafy stems arise from stout rhizomes just below the ground, growing close together forming big clump. Each stem bears up to eight pairs of large linear leaves with shortly pointed apex and narrowly cuneate base, the largest can measure up to 90 by 20 cm; upper surface of leaves glabrous except the midrib, underneath is covered with short velvety hairs; petiole to 8 cm long. The inflorescence is held erect at the terminal of the stem, bearing the largest flower among all the *Alpinia* species in Peninsular Malaysia. Newly emerge inflorescence is enclosed entirely by two large sheaths until the rachis breaks open from the sheaths. The rachis can reach up to 47 cm, bearing single flower in each cincinnus except for a few with two flowers at the lower part. Young buds are covered with white hairy calyx with red tip. The most conspicuous part of the flower is the large and broadly ovate lip which is bright yellow in colour with red patches at the base and extends to edges of lip in red lines. Fully open flowers emit a slight foul-like rotten meat odour. The fruits are almost spherical, hairy, maturing into orange colour, capsule smell of *Piper sarmentosum* when crushed.

Alpinia malaccensis has a wide distribution, extending from north-east India to Indochina, southwards to Peninsular Malaysia and Java, but the plant found in the Peninsular Malaysia is a local endemic variety—*A. malaccensis* var. *nobilis* (Holttum 1950). This local variety is a rather rare plant, but once located, it normally grows in large clumps near streams or rivers in lowland forest. It has been recorded from the states of Terengganu, Pahang and Selangor. *Alpinia malaccensis* var. *nobili*s was first collected for *ex situ* germplasm conservation project. It also poses ornamental potential as the plant can be planted in open areas and it requires minimal maintenance. Other attractive features of the plant are its large size, green glossy leaves and the young inflorescence protected by large sheaths, which resembles the young inflorescence of banana. Since the chemical composition of this species, *A. malaccensis* var. *nobilis,* has not been reported before, the essential oil constituents were thus examined.

The samples were collected from Sungai Loh, Terengganu and the herbarium specimen (FRI 44399) was deposited at the Forest Research Institute Malaysia. Fresh leaves, rhizomes and stems were cut into small pieces and individually subjected to water distillation in Clevenger-type apparatus for eight hours. Water distillation of the various plant parts (leaf 400 g; rhizome 600 g; stem 1300 g) gave the following yields (calculated on a dry weight basis): leaf (0.6%); rhizome (1.0%) and stem (0.4%). Gas chromatography (GC) analysis was performed using a Shimadzu GC 14A capillary chromatograph equipped with a FID detector using a ZB1 (30 m × 0.25 mm; 0.25 μm film thickness) capillary column. Neat

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**Nor Azah Mohd. Ali. E-mail: norazah@frim.gov.my*
***Mailina Jamil*

samples were injected in split mode, using pressured controlled helium as carrier gas at a linear velocity of 50 cm s^{-1}. Injector and detector temperatures were maintained at 250 °C. The oven temperatures were programmed at 60 °C (10 min) to 230 °C at 3 °C min^{-1} for 1 min. Temperature program linear retention indices of the compounds were also determined relative to n-alkanes (Kovats 1965). GC/MS analyses were carried out on a Hewlett Packard GC/MSD 5890 series, EI electron impact ion source, 70 EV using a DB1 (30 m × 0.25 mm, 0.25 μm film thickness) with similar condition as described in GC programs.

Identification of the chemical components listed in Table 1 was based on the comparison of their mass spectral data with the existing Wiley library, comparison of calculated retention indices with literature values (Jennings & Shibamoto 1980) and co-chromatography of some of the chemical constituents with authentic components on the ZB1 capillary column.

Table 1 Percentage composition of the essential oils of *Alpinia malaccensis* var. *nobilis*

Compound	RI	Leaf (%)	Rhizome (%)	Stem (%)	Method of identification
α-thujene	920	–	0.1	0.1	MS
α-pinene	929	–	1.1	3.3	RI, CO, MS
benzaldehyde	930	0.1	–	–	RI, MS
camphene	941	–	0.4	0.1	RI, CO, MS
β-pinene	967	0.1	1.6	6.0	RI, CO, MS
myrcene	982	0.1	0.3	0.8	RI, CO, MS
α-phellandrene	995	0.1	1.9	6.3	RI, CO, MS
δ-3-carene	999	0.1	0.3	0.8	MS
p-cymene	1011	1.5	1.6	3.5	RI, CO, MS
1,8-cineole	1020	1.8	1.5	3.0	RI, CO, MS
limonene	1022	0.6	1.0	2.1	RI, MS
(E)-β-ocimene	1044	–	–	0.1	MS
γ-terpinene	1051	0.3	–	0.1	MS
terpinolene	1078	–	0.1	–	RI, MS
linalool	1088	0.1	0.1	0.3	RI, MS
camphor	1112	–	0.6	–	RI, MS
terpinen-4-ol	1161	0.6	0.3	0.2	RI, CO, MS
α-terpineol	1174	0.8	0.3	0.7	RI, CO, MS
Z-citral	1214	–	–	0.2	RI, MS
geraniol	1241	0.2	–	0.2	RI, MS
endobornyl acetate	1265	–	0.1	–	RI, MS
(E)-methyl cinnamate	1380	88.0	85.7	64.4	RI, CO, MS
β-caryophyllene	1405	–	0.2	–	RI, MS
β-bisabolene	1498	0.1	0.1	0.3	MS

Percentages were calculated based on results obtained from gas chromatography on column ZB1. RI = retention index, tentative identification for all compounds, except for CO; MS = mass fragmentation; RI = retention index; CO = co-chromatography with authentic sample

The results showed that *A. malaccensis* var. *nobilis* was a promising source of (*E*)-methyl cinnamate contributing 88.0, 85.7 and 64.4% of the leaf, rhizome and stem oils respectively (Table 1). The remainder of the components were present in smaller amounts with the majority being monoterpenoids. These included 1,8-cineole (1.8%), *p*-cymene (1.5%), α-terpineol (0.8%), limonene (0.6%) and terpinen-4-ol (0.6%) in the leaf oil, while the stem oil contained α-phellandrene (6.3%), β-pinene (6.0%), *p*-cymene (3.5%), α-pinene (3.3%), 1,8-cineole (3.0%) and limonene (2.1%). Similar chemical components present in lesser amounts were detected in the rhizome oil. The components were α-phellandrene (1.9%), β-pinene (1.6%), *p*-cymene (1.6%), 1,8-cineole (1.5%), α-pinene (1.1%) and limonene (1.0%). The rhizome oil could also be distinguished from the others by the presence of camphor (0.6%), which were absent in the other oils. The distribution of chemical components in different parts of *A. malaccensis* var. *nobilis* may be used as a taxonomic tool for species identification. However, chemical composition of the essential oils within the same species may vary depending on the locality and season of collection.

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