Chemical Composition of the Essential Oil of *Elephantopus scaber* from Southern China

Li Wang[a], Shuguang Jian[b], Peng Nan[a,c], and Yang Zhong[a,*]

[a] Ministry of Education Key Laboratory for Biodiversity Science and Ecological Engineering, and Institute of Biodiversity Science, School of Life Sciences, Fudan University, Shanghai 200433, China. Fax: 86-21-65642468.
E-mail: yangzhong@fudan.edu.cn

[b] South China Botanical Garden, The Chinese Academy of Sciences, Guangzhou 510650, China

[c] Shanghai Center for Bioinformation Technology, Shanghai 200235, China

* Author for correspondence and reprint requests

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The essential oil of *Elephantopus scaber*, a famous medicinal herb from Yangjiang County in Southern China was analyzed for the first time using GC-MS. The major constituents were hexadecanoic acid (42.3%), isopropyl dimethyl tetrahydronaphthalenol (14.1%), β-sesquiphellandrene (8.3%), octadecadienoic acid (5.5%), and phytol (5.2%).

Key words: Elephantopus scaber, Essential Oil, GC-MS

Introduction

The genus *Elephantopus* consists of approximately 30 species distributed in the Neotropics and the Old World, and its lectotype species, *E. scaber*, occurs in all tropical regions (Cabrera and Klein, 1980; Chen, 1985; Cao and But, 1999). In Southern China, Hong Kong and Taiwan, the whole plant of *E. scaber*, a perennial herb (10–50 cm in height), is well known as a folk medicine widely used in the treatment of nephritis, edema, dampness, pain in the chest, fever and cough of pneumonia, scabies, and arthralgia due to wounding (Peer and Metzger, 1980; Hsu, 1986; Tsai and Lin, 1999). In Brazil, the infusion and the decoction of the whole plant are used to stimulate diuresis, reduce fever, and eliminate bladder stones (Cabrera and Klein, 1980; Poli *et al.*, 1992). It has also been popular as a medicinal herb in many countries of Southeast Asia, Latin America and Africa for a long time (Hammer and Johns, 1993; Cao *et al.*, 1997).

Since the 1970's, a number of chemical constituents and pharmacological evaluations of *E. scaber* have been reported. For example, Kurokawa *et al.* (1970) and Govindachari *et al.* (1972) reported elephantopin, deoxyelephantopin, and isodeoxyelephantopin in this species; De Silva *et al.* (1982) found that both alcohol and chloroform extracts of *E. scaber* contain cytotoxic germacranolide-type sesquiterpene lactones; Poli *et al.* (1992) tested the aqueous and hydroalcoholic extracts of whole plants for acute toxicity, analgesic, antipyretic, anti-inflammatory, cardiovascular, diuretic, and constipating activities; Hammer and Johns (1993) reported that the plant extract of *E. scaber* was subjected to bioassays; Lin *et al.* (1995) and Tsai and Lin (1999) evaluated the hepatoprotective and anti-inflammatory effects of the Taiwanese folk medicine "Teng-Khia-U", derived from three plant species including *E. scaber*, and But *et al.* (1997) described the isolation and structure characterization of three germacranolide sesquiterpene lactones from *E. scaber.* However, the chemical composition of the essential oil of this important medicinal plant has not been reported yet. In the present study, the chemical constituents of the essential oil of *E. scaber* from Southern China were analyzed for the first time using GC-MS.

Materials and Methods

Plant materials

The whole plant of *E. scaber* used in this study was collected from Dong-An-Ling, Yangjiang county, Guangdong Province of Southern China (22° 01′ N, 112° 03′ E) in October 2003. The voucher specimens were deposited at the MOE Laboratory for Biodiversity Science and Ecological Engineering, School of Life Sciences, Fudan University.

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Extraction of essential oil

The dry whole plants (50 g) of *E. scaber* were subjected to steam distillation for 3 h using a Clevenger-type apparatus. The essential oils were collected and then stored with anhydrous sodium sulfate in Eppendorf tubes at 4 °C. A part of the crude essential oils was submitted to analysis using GC-MS.

GC-MS analysis

The GC-MS analysis was performed on a combined GC-MS instrument (Finnigan Voyager, San Jose, CA, USA) using a HP-5 fused silica gel capillary column (30 m length, 0.25 mm diameter, 0.25 μm film thickness). A 1 μl-aliquot of oil was injected into the column using a 10:1 split injection, whose temperature was set at 250 °C. The GC program was initiated by a column temperature set at 60 °C for 2 min, increased to 250 °C at a rate of 10 °C/min, held for 10 min. Helium was used as the carrier gas (1.0 ml/min). The mass spectrometer was operated in the 70 eV EI mode with scanning from 41 to 450 amu at 0.5 s, and mass source was set at 200 °C. The compounds were identified by matching their mass spectral fragmentation patterns with those stored in the spectrometer database using the National Institute of Standards and Technology Mass Spectral database (NIST-MS, 1998).

Results and Discussion

The steamdistillation of the whole plant of *E. scaber* yielded a clear and yellowish essential oil. It was about 0.05% v/w. The chemical constituents identified by GC-MS in the essential oil are listed in Table I. A total of 21 compounds (about 93.3% of the oil) were identified. The major constituents were hexadecanoic acid (42.3%), isopropyl dimethyl tetrahydronaphthalenol (14.1%), β-sesquiphellandrene (8.3%), octadecadienoic acid (5.5%), and phytol (5.2%). Of these major constituents, hexadecanoic acid, octadecadienoic acid, and phytol are relatively common for essential oils of higher plants.

As an important sesquiterpene compound, β-sesquiphellandrene has been isolated from a number of medicinal plants, such as *Curcuma xanthorrhiza* (Uehara *et al.*, 1992), *Solanum tuberosum* (Szafranek *et al.*, 1998), *Citrus aurantiifolia* and *C. latifolia* (Feger *et al.*, 2000), *Centaurea pseudoscabiosa* (Flamini *et al.*, 2002), *Pimpinella junoniae* (Velasco-Negueruela *et al.*, 2003), and *Lycopersicon hirsutum* f. *typicum* (Antonious and Kochhar, 2003). Furthermore, Denyer *et al.* (1994) investigated the dried rhizomes of Indonesian ginger (*Zingiber officinale*) for its antirhinoviral activity in a plaque reduction test, and found that β-sesquiphellandrene was the most active of several sesquiterpenes with antirhinoviral activity. On the other hand, isopropyl dimethyl tetrahydronaphthalenol is one of the tetrahydronaphthalenol analogues, which have been shown to have hypocholesterolemic effect and antioxidant activity (Pearce *et al.*, 1994). Our study suggests that *E. scaber* may be a potential resource of β-sesquiphellandrene and tetrahydronaphthalenol for antirhinoviral and antioxidant uses.

Table I. Chemical constituents of the essential oil identified from *E. scaber* from Southern China.

Compound	Content (%)
Cyclosativene	0.9
Copaene	0.2
Isopropyl dimethyl hexahydronaphthalene	4.2
Zingiberene	0.2
Trimethyl dimethylenedecahydronaphthalene	1.8
Caryophyllene	0.8
Dimethyl-6-(4-methyl-3-pentenyl)-2-norpinene	0.8
β-Sesquiphellandrene	8.3
β-Caryophyllene	0.8
Isocaryophyllene	1.4
α-Santalol	0.4
Ledol	1.2
α-Bisabolol	1.7
Caryophyllene oxide	1.3
Cadinol	0.7
β-Bisabolol	2.2
Isopropyl dimethyl tetrahydronaphthalenol	14.1
Hexahydrofarnesyl acetone	0.3
Hexadecanoic acid	42.3
Phytol	5.2
Octadecadienoic acid	5.5

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