

CHEMICAL COMPOSITION AND ANTIMICROBIAL ACTIVITY OF THE ESSENTIAL OIL FROM FERONIA ELEPHANTUM CORREA

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ABSTRACT

Essential oil of the leaves of *Feronia elephantum* Correa (0.56%) was analysed by gas chromatography-mass spectrometry (GC-MS). About 99.4% of the oil components were identified. This represented eleven components. Estragole was the main component (76.0%), followed by *trans* and *cis*-anethole (13.5 and 2.1%, respectively).

The oil exhibited remarkable antimicrobial activity against *Candida albicans*, *Cryptococcus neoformans*, *Mycobacterium intracellulare*, *Aspergillus fumigatus*, *Trichophyton mentagrophytes* and *Saccharomyces cerevisiae*.

INTRODUCTION

Feronia elephantum Correa [= *F. limonia* (Linn.) Swingle] family Rutaceae is a common Indian tree known as wood-apple⁽¹⁾ and locally as Tuffah el Fil⁽²⁾. It belongs to the tribe *Citreae* and subtribe *Feroninae*⁽¹⁾. The plant is cultivated in Egypt as an ornamental tree. It is a spiny deciduous tree with hard-shelled fruits.

The plant is well-known for its medicinal importance^(3 & 4). The roots are prescribed in treatment of snake bites and the bark is used for biliousness. The leaves are aromatic and carminative, while the fruits are astringent, stomachic and stimulant.

The different parts of the plant have been investigated by several workers and they were reported to contain coumarins⁽⁵⁻⁸⁾, flavonoid glycosides⁽⁶⁾ and sterols^(6 & 9).

Concerning the essential oil, Bhati and Deshapande⁽¹⁰⁾ studied the oil of the leaves of Feronia elephantum. They identified estragole and confirmed its structure by chemical reactions. Gildemeister⁽¹¹⁾ reported that the oil obtained from the leaves of Indian plants contains estragole as the main constituent (90%). Macleod and Pieris⁽¹²⁾ identified ethyl butanoate, acetone, butanoic acid, methyl butanoate, hexanoic acid and ethyl-3-hydroxybutanoate as main constituents of the aroma volatiles of the fruits of F. elephantum.

A botanical study of the leaf, stem and bark of the plant was also carried out⁽¹³⁾.

Reviewing the current literature, it was found that analysis of the oil obtained from the leaves of Feronia elephantum^(10 & 11) is inadequate. This stimulated the authors to carry out the present study.

EXPERIMENTAL

Plant material:

The fresh leaves were obtained from trees growing at the Zoo Garden, Giza, Egypt. They were collected in April 1990 at 9 a.m. to get the optimum yield of the oil.

The plant was kindly identified by Prof. M.N. El-Hadidy, Faculty of Science, Cairo University. Herbarium specimens are kept at the Department of Pharmacognosy, Faculty of Pharmacy, Cairo University.

Preparation and analysis of the essential oil:

The oil was prepared by hydrodistillation of the fresh leaves⁽¹⁴⁾. The volatile oil was separated, dried and submitted for analysis.

The GC-MS analysis was carried out using previously reported⁽¹⁵⁾ conditions. Splitless injection of 0.1 μ l ethanolic solution of the oil (3.03 mg/ml) was used. The components of the oil were identified by comparing their retention times and mass fragmentation patterns with those of the available references and/or with the published data⁽¹⁶⁾. Results of GC-MS analysis are summarised in Table 1.

Screening for the antimicrobial activity:

The antimicrobial activity of the essential oil was performed adopting the reported micro-organisms and technique⁽¹⁷⁾. Results are recorded in Table 2.

RESULTS AND DISCUSSION

The yield of the essential oil of the fresh leaves of *F. elephantum* Correa growing in Egypt reached up to 0.56%. It is almost colourless with anise-like odour with specific gravity and refractive index 1.0114 and 1.52544 respectively.

Eleven components, which represented about 99.4% of the total composition of the oil, were identified (Table 1). Estragole is the major constituent (76.0%) followed by *trans* and *cis*-anethole (13.5 and 2.1% respectively), which are responsible for the anise odour of the oil.

In addition, the oil obtained from the Egyptian plants contained limonene (3.3%), β -caryophyllene (1.4%), p-anisaldehyde (1.0%), β -pinene

(0.9%), methyl eugenol (0.5%), linalol (0.3%), carvacrol (0.3%) and α -humulene (0.2%).

The relatively high content of estragole is in agreement with that previously reported⁽¹¹⁾ for the oil obtained from the plants of Indian origin (90%). The slight decrease in the estragole content in the Egyptian samples is attributed to environmental conditions.

The aroma volatiles of the fruits of this plant previously reported⁽¹²⁾ are completely different from those identified in the essential oil of the leaves in this work.

This is the first report for the identification of the above constituents, other than estragole, in the essential oil obtained from the leaves of this species.

The oil showed an appreciable inhibitory activity against Candida albicans, Aspergillus fumigatus, Trichophyton mentagrophytes, Saccharomyces cerevisiae, Cryptococcus neoformans and Mycobacterium intracellulare.

It showed no activity against the other tested micro-organisms viz.: Bacillus subtilis, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa and Aspergillus flavus.

The relatively high antifungal activity of the oil recommended its use in the treatment of meningitis and pneumonia caused by C. neoformans⁽¹⁸⁾ as well as in diarrhea and diaper rash caused by C. albicans^(19 & 20). Its activity against M. intracellulare suggested the utilization of the oil for treatment of systemic infection caused by this organism⁽²⁰⁾.

Table (1): Chemical composition of the essential oil of Feronia elephantum Correa.

Component*	RR _t **	M ⁺	B.P.	Percentage
β-Pinene	0.48	136	41	0.9
Limonene	0.60	152	67	3.3
Linalol	0.76	154	43	0.3
Estragole	1.00	148	148	76.0
Unidentified	1.03	148	41	0.1
Unidentified	1.06	148	43	0.2
p-Anisaldehyde	1.12	136	135	1.0
cis-Anethole	1.15	148	148	2.1
trans-Anethole	1.24	148	148	13.5
Carvacrol	1.31	150	135	0.3
Methyl eugenol	1.57	178	178	0.5
Unidentified	1.63	111	43	0.1
β-Caryophyllene	1.67	204	41	1.4
α-Humulene	1.76	204	93	0.2
Unidentified	1.93	196	41	0.2

* = Components were identified on the bases of their mass spectral data and retention times.

** = Retention times relative to estragole.

M⁺ = Molecular ion peak. B.P. = Base peak.

Table (2): Antimicrobial activity of essential oil of Feronia elephantum Correa.

Microorganisms	Essential oil	Amphotricin B	Rifamycin
<u>Candida albicans</u> (24/48 h).	++/+	+++/>+++	--
<u>Aspergillus fumigatus</u> (48/72 h).	++/+	+++/>+++	--
<u>Trichophyton mentagrophytes</u> (48/72 h).	+++/>+++	+++/>+++	--
<u>Saccharomyces cerevisiae</u> (48/72 h).	++/+	+++/>+++	--
<u>Cryptococcus neoformans</u> (48/72 h).	++/+	+++/>+++	--
<u>Mycobacterium intracellulare</u> (48/96 h).	+++/>+++	---	+++/>+++

+ = Definite inhibitory activity 1-2 mm; ++ = 3-6 mm; +++ = 7-12 mm.

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دراسة الزيت الطيار لنبات فورنيا إيفانتم كوريا

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يعتبر نبات فورنيا إيفانتم كوريا المعروف باسم تفاح الفيل أحد النباتات ذات الأهمية فى الطب الشعبى الهندى لما له من فوائد فى علاج الدوسنتاريا والصفراء ولدغ الحشرات. فى هذا البحث تم تحضير الزيت الطيار ونسبته ٥٦.٠٪ وقد تم تحليله باستعمال كروماتوجرافيا الغاز المتصلة بمطياف الكتلة .

وأمكن التعرف على ١١ مركباً تمثل ٩٩.٤٪ من التركيب الكلى للزيت ومن المركبات الاساسية التى تم التعرف عليها الاستراجول ونسبته ٧٦٪ وترانس ، سيس - أنيشول ونسبتهما ١٣.٥٪ ، ٢.١٪ على التوالى .

وقد وجد أن الزيت الطيار ذو تأثير فعال ضد بعض الميكروبات مثل كانديدا البيكانس ، كريتوكوكس نيوفورمانس ، ميكوباكترىم إنتراسليولار ، أسبيرجيلس فيوميجاتس وسكاروميس سرفيسيا .