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Essential oil composition of *Artemisia abyssinica* from three habitats in Yemen

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Abstract

The essential oils from the aerial parts of *Artemisia abyssinica*, collected from three different locations in Yemen, were obtained by hydrodistillation and analyzed by gas chromatography – mass spectrometry. The essential oil from Taiz was dominated by davanone (49.4%) and camphor (29.6%), while samples from Sana'a and Alhodiadah had camphor as the major component (42.1% and 42.5%, respectively) with slightly lower concentrations of davanone (34.5% and 32.3%, respectively).

Keywords: *Artemisia abyssinica*, chemical composition, camphor, davanone, Yemen.

1. Introduction

Artemisia abyssinica Sch. Bip. ex A. Rich., known as “boitheran” in Yemen, is an aromatic, grey, silky-hairy plant with pale yellow flower-heads and is well known as a stimulant and an analgesic. It is short lived perennial plant, with sparingly branched stems that are grooved especially above. Leaves are alternate, grey-green, deeply bipinnatisect with linear segments, 4-10 cm long. It is widely spread on the high plateau from 2200 to 3600 m and often abundant on roadsides, alluvial plains and abandoned fields [1]. It is used in Yemen for treating headache and as insect repellent. In Saudi Arabia, the decoction of fresh whole plant is traditionally used to treat diabetes mellitus [2]. The plant has also been used in folk medicine as an anthelmintic, antispasmodic, antirheumatic and antibacterial agent [3]. Antioxidant, antileishmanial and antitrypanosomal activities have also been recorded for *A. abyssinica* essential oil [3]. In this report, we present the essential oil compositions for *A. abyssinica* from three different regions of Yemen, namely Taiz (higher than 1500 m), Sana'a (higher than 3000 m) and Alhodiadah (coastal region).

2. Materials and Methods

2.1 Plant Material

The aerial parts of *A. abyssinica* L. (Asteraceae) were collected in during September-October 2011, from Sana'a, Taiz and Hoediadah province, Yemen. The plant was identified by Hassan M. Ibrahim of the Botany Department, Faculty of Sciences, Sana'a University. Voucher specimens (comp-art-1a-c) have been deposited at the Pharmacognosy Department, Sana'a University, Yemen. Dried aerial parts from plants were hydrodistilled for 3 h in a Clevenger type apparatus according to the European Pharmacopoeia method [4]. The obtained oils were subsequently dried over anhydrous Na₂SO₄ and kept at 4 °C until analysis.

2.2 Gas Chromatographic-Mass Spectral Analysis

The essential oils of *A. abyssinica* were analyzed by GC-MS using an Agilent 6890 GC with Agilent 5973 mass selective detector [MSD, operated in the EI mode (electron energy = 70 eV), scan range = 40-400 amu, and scan rate = 3.99 scans/sec], and an Agilent ChemStation data system. The GC column was an HP-5ms fused silica capillary with a (5% phenyl)-polymethylsiloxane stationary phase, film thickness of 0.25 µm, a length of 30 m, and an internal diameter of 0.25 mm. The carrier gas was helium with a column head pressure of 48.7 kPa and a flow rate of 1.0 mL/min. Inlet temperature was 200 °C and interface temperature was 280 °C. The GC oven temperature program was used as follows: 40 °C initial temperature, hold for 10 min; increased at 3 °C/min to 200 °C; increased 2°/min to 220 °C. A 1% w/v solution of the sample in CH₂Cl₂ was prepared and 1 µL was injected using a split ratio of 1:30.

Identification of the oil components was based on their retention indices determined by reference to a homologous series of *n*-alkanes, and by comparison of their mass spectral fragmentation patterns with those reported in the literature [5] and stored on the MS library [NIST database (G1036A,

revision D.01.00)/ChemStation data system (G1701CA, version C.00.01.080)]. The percentages of each component are reported as raw percentages based on total ion current without standardization. The essential oil compositions of *Artemisia abyssinica* are summarized in Table 1.

Table 1: Chemical compositions of *Artemisia abyssinica* essential oils collected from three locations in Yemen.

RI ^a	Compound	Percent Composition ^b		
		Taiz	Sana'a	Alhodiadah
851	Ethyl 2-methylbutanoate	0.3±0.1	0.1±0.1	0.2±0.0
941	α -Pinene	1.1±0.4	0.5±0.3	1.1±0.2
952	Isobutyl butanoate	0.4±0.1	0.3±0.1	0.3±0.1
954	Camphene	0.8±0.3	0.5±0.2	0.9±0.2
976	Sabinene	---	---	tr ^c
993	Myrcene	0.1±0.1	0.7±0.3	0.1±0.0
1017	α -Terpinene	0.1±0.1	0.1±0.1	0.1±0.0
1025	<i>p</i> -Cymene	0.2±0.1	0.1±0.0	0.2±0.1
1029	Limonene	0.1±0.1	---	0.1±0.0
1031	1,8-Cineole	---	---	0.1±0.0
1059	γ -Terpinene	0.3±0.1	0.3±0.2	0.3±0.1
1067	<i>cis</i> -Sabinene hydrate	2.8±0.7	3.6±0.7	5.8±0.2
1087	Terpinolene	tr	---	0.1±0.0
1098	<i>trans</i> -Sabinene hydrate	0.3±0.1	0.4±0.2	0.5±0.4
1101	Linalool	2.1±0.6	2.7±0.5	1.6±0.7
1124	<i>cis-p</i> -Menth-2-en-1-ol	---	---	0.1±0.0
1146	Camphor	29.6±0.8	42.1±3.3	42.5±2.3
1165	Borneol	0.2±0.1	1.0±0.4	0.6±0.1
1177	Terpinen-4-ol	2.0±0.5	3.8±0.8	3.9±0.3
1190	α -Terpineol	0.2±0.2	0.1±0.1	0.4±0.1
1285	Bornyl acetate	1.3±0.4	2.3±0.5	2.3±0.3
1379	Ethyl (<i>Z</i>)-cinnamate	0.5±0.2	0.2±0.1	0.2±0.1
1467	Ethyl (<i>E</i>)-cinnamate	1.9±0.6	0.5±0.2	0.5±0.1
1567	(<i>E</i>)-Nerolidol	5.1±0.9	4.0±0.6	4.5±0.7
1595	Davanone	49.4±5.8	34.5±3.5	32.3±2.0
1733	Chamazulene	0.7±0.4	1.2±0.5	0.3±0.1
	Total Identified	99.5	99.3	98.8

^a Retention Indices on HP-5ms fused silica capillary column.

^b The compositions are based on averages (\pm standard deviations) for three separate injections for each sample of *Artemisia abyssinica* essential oil.

^c tr = "trace" (< 0.05%).

3. Results and Discussion

A total of 26 compounds were identified in the essential oils of *A. abyssinica* from Yemen, accounting for about 99% of the compositions (Table 1). *A. abyssinica* essential oils were rich in camphor and davanone with lesser amounts of (*E*)-nerolidol, *cis*-sabinene hydrate, terpinen-4-ol, linalool, and bornyl acetate. The *A. abyssinica* oils from Yemen are remarkably different in composition from those reported from different samples from Ethiopia: which were rich in 4-hydroxycyclohexanemethanol (21.3%) and α -terpinolene (9.2%) [6]; yomogi alcohol (38.5%), artemisyl acetate (24.9%), and artemisia alcohol (6.7%) [7]; and 4,5-dihydroxyocta-3,5-diene-2,7-dione (55.0%) [8]. Clearly there is wide variation in the volatile components of *A. abyssinica*, which can be attributed to (a) individual genetic variability, (b) variation among different plant parts and developmental stages, or (c) variation due to environmental conditions [9,10].

4. Conclusions

The essential oil compositions for *Artemisia abyssinica* collected from three different habitats in Yemen have been determined by GC-MS. While the compositions of the Yemeni

samples are qualitatively similar, they are remarkably different from *A. abyssinica* samples from Ethiopia. It would be interesting to see analyses of *A. abyssinica* oils from other geographical locations.

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