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# American Journal of Essential Oils and Natural Products

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American  
Journal of  
Essential  
Oils and  
Natural  
Products

ISSN: 2321 9114  
AJEONP 2015; 2 (3): 28-30  
© 2015 AkiNik Publications  
Received: 27-02-2015  
Accepted: 14-04-2015

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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 Na<sub>2</sub>SO<sub>4</sub> 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 CH<sub>2</sub>Cl<sub>2</sub> 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 <sup>a</sup>	Compound	Percent Composition <sup>b</sup>		
		Taiz	Sana'a	Alhodiadah
851	Ethyl 2-methylbutanoate	0.3±0.1	0.1±0.1	0.2±0.0
941	$\alpha$ -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 <sup>c</sup>
993	Myrcene	0.1±0.1	0.7±0.3	0.1±0.0
1017	$\alpha$ -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	$\gamma$ -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	$\alpha$ -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

<sup>a</sup> Retention Indices on HP-5ms fused silica capillary column.

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

<sup>c</sup> 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  $\alpha$ -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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