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Composition and antifungal activity of the essential oil of the root of *Ferula hermonis*

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Introduction

The dried root of *Ferula hermonis Boiss*. (Umbelliferae) (**Figure 1**), a plant growing in the mountains between Lebanon and Syria, locally known as Zallouh root, is used in folk medicine to treat erectile dysfunction [1].

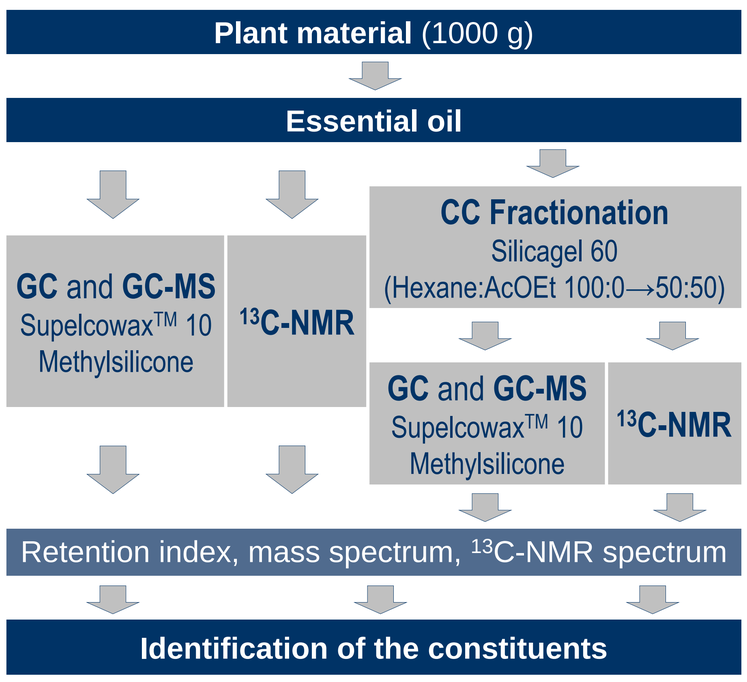
In the present work, the composition and the antifungal activity of its essential oil are described.

Material and methods

Plant material

Air-dried roots of *Ferula hermonis* were provided by The Jordanian Pharmaceutical Manufacturing Co. (Naor, Jordan).

Essential oil analysis.



Isolation and structure determination of 3,5-nonadiyne

Successive fractionation of the essential oil through silicagel 60 (0.035-0.070 mm) eluting with different gradient systems of hexane:AcOEt and final purification through Sephadex® LH-20 eluted with MeOH afforded the unknown compound **1** which represented 4.4% of the essential oil.

Structure elucidation of **1** was done using standard spectroscopic techniques, such as ^{1}H-RMN, ^{13}C-RMN, DEPT, H,H-COSY, HSQC, HMBC, EI-MS and CI-MS. It was identified as 3,5-nonadiyne.

Compound 1: 3,5-Nonadiyne

Antifungal activity

MIC and MFC values of the essential oil and its major constituent α-pinene were determined by an agar dilution assay following the method described in [2]. Fungi were provided by Colección Española de Cultivos Tipo (CECT, Valencia, Spain). Nystatin and amphotericin B were used as positive controls.

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Results

The composition of the essential oil is shown in **Table 1** and its antifungal activity in **Table 2**.

Table 1. Essential oil of *Ferula hermonis* root.

Components	%	Components	%
α-Pinene*	43.4	γ-Cadinene*	1.7
Camphene	0.2	δ-Cadinene*	1.5
Hexanal	0.1	ar-Curcumene*	0.6
β-Pinene*	1.4	*trans*-α-Bisabolene*	0.5
Verbenene*	0.4	α-Cadinene*	t
3-Carene*	0.4	Myrtenol*	0.3
β-Myrcene	0.2	*cis*-Calamenene	t
Limonene*	0.2	*trans*-Carveol*	0.2
p-Cymene	0.2	*trans*-Calamenene*	t
3,5-Nonadiyne*	4.4	Thymyl acetate	t
α-Cubebene*	0.2	α-Calacorene*	0.3
α-Copaene*	0.3	α-Copaene-11-ol	0.4
Daucene*	0.4	Selina-3,7(11)-diene*	t
α-Gurjunene	t	*cis*,*trans*-Farnesol	0.4
γ-Gurjunene	0.3	Eudesmol	0.2
Aristolene*	0.2	Viridiflorol*	0.1
Pinocarvone*	0.2	Epicubenol*	t
cis-α-Bergamotene	t	*trans*-Daucen-8-en-4-β-ol*	t
trans-α-Bergamotene*	0.4	Germacradien-11-ol*	t
β-Elemene	0.3	α-Bisabolol oxide B*	1.0
β-Gurjunene*	0.1	Spathulenol*	1.1
Terpinen-4-ol*	t	β-Bisabolol*	t
Aromadendrene*	1.2	α-Bisabolol oxide A	0.9
Myrtenal*	0.3	T-Cadinol*	0.4
trans-Pinocarveol*	0.5	T-Muurolol*	0.1
cis-Verbenol*	0.6	α-Bisabolol*	11.1
trans-β-Farnesene*	3.2	α-Cadinol*	0.1
trans-Verbenol*	1.9	β-Eudesmol	t
β-Cubebene	t	Myristicin	0.3
γ-Muurolene*	t	Selin-11-en-4-α-ol*	t
Ledene*	0.2	Cadinadien-8-ol*	t
α-Terpineol*	t	10-Hydroxy-α-humulene*	1.3
Selina-4,11-diene*	1.0	Jaeschkenadiol angelate*	0.1
β-Selinene*	0.5	Jaeschkenadiol*	1.9
α-Selinene*	0.4	Jaeschkenadiol benzoate*	1.2
α-Muurolene*	0.3	p-Cymene-8-ol	0.4
β-Bisabolene*	1.1	γ-Selinene	0.1
Bicyclogermacrene*	1.0	**Total identified**	**92.2**

Compounds are listed by elution order in the polar column except the last two, which were only detected in the methylsilicone column.
* Identified by ^{13}C-NMR analysis of the total oil and/or after fractionation.
t: traces (≤ 0.05%).

Table 2. MIC and MFC (μg/ml) of the essential oil of *Ferula hermonis* root and α-pinene.

Fungi	Essential oil *F. hermonis*		α-Pinene		Amphotericin B		Nystatin	
	MIC	MFC	MIC	MFC	MIC	MFC	MIC	MFC
An	na	na	na	na	4	0	2	0
Af	na	na	na	na	2	2	4	4
Pp	na	na	na	na	2	2	4	4
Tm	157	157	142	142	0.5	0.5	2	2
Ca	na	na	na	na	1	>16	2	>16
Cl	na	na	na	na	0.25	0.5	1	2
Sc	na	na	na	na	0.5	1	2	4

An: *Aspergillus niger*, ***Af***: *A. fumigatus*, ***Pp***: *Penicillium purpurogenum*, **Tm**: *Trichophyton mentagrophytes*, ***Ca***: *Candida albicans*, ***Cl***: *C. lactis-condensi*, ***Sc***: *Saccharomyces cerevisiae*, **na**: not active.

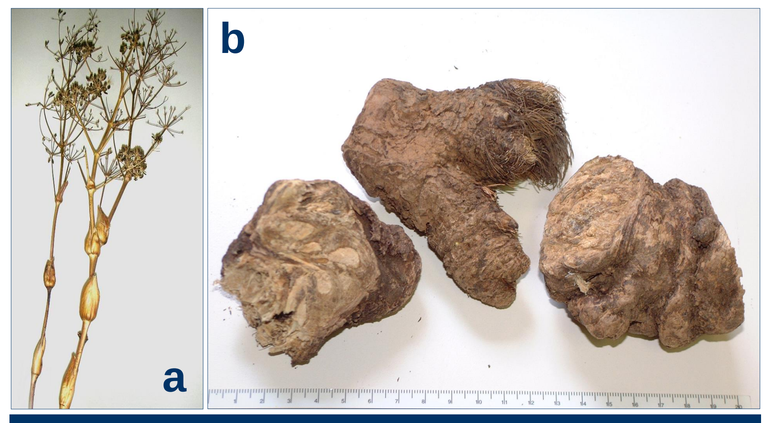

Figure 1. *Ferula hermonis* Boiss.: plant (**a**) and root (**b**).

Discussion

The roots of *Ferula hermonis* gave an essential oil yield of 1.5% (v/w).

GC, GC-MS and ^{13}C-NMR analysis of the total oil and the fractions obtained by CC allowed the identification of seventy five constituents, meaning more than 90% of the total sample (**Table 1**). From them, 54 compounds were identified as sesquiterpenes, whereas only 19 were monoterpenes.

The major constituent was α-pinene (43.3%), followed by α-bisabolol (11.1%), 3,5-nonadiyne (4.4%), β-farnesene (3.2%) and δ-cadinene (2%).

The unusual constituent 3,5-nonadiyne has only been reported twice before, in the essential oils from the roots of *Selinum tenuifolium* [3] and *Cachrys ferulacea* [4] (Apiaceace) where it reached percentages higher than 80%.

The essential oils from aerial parts of several *Ferula* sp. have been the object of previous works; however, only few reports on the composition of the volatile oil from the roots are available in the literature. In some of them, the main constituents were monoterpene hydrocarbons such as α- and β-pinene or 3-carene [5-7].

Results on the antifungal activity (**Table 2**) showed comparable values for the MIC and MFC of the essential oil (both, 157 μg/ml) and α-pinene (142 μg/ml) against *T. mentagrophytes.* No activity against the other strains was detected up to 2.5 mg/ml and 2.3 mg/ml. Research of other active constituents of the essential oil is being performed currently.

References

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