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Chemical composition of essential oil of the species *Oenanthe fistulosa* L. growing in Algeria

Nabila SOUILAH[a,b], Hamdi BENDIF[c,d*1], Mohammed HARIR[e], Abderrahim BENSLAMA[f], Abdenassar HARRAR[f], Lakhdar DJARRI[a], Salah AKKAL[a] and Kamel MEDJROUBI[a]

[a] *Unit of Valorization of Natural Resources, Bioactives Molecules and Physicochemical and Biological Analyzes, Department of Chemistry, Faculty of Exact Sciences, University of Constantine, Costantine, Algeria.*

[b] *University of 20 Aout 1955 of Skikda, B.P.26 Route El-Hadaiek Skikda 21 000 ,Algeria*

[c] *Department of Sciences Nature and Life, Faculty of Sciences, University of Mohamed Boudiaf-Msila, Algeria*

[d] *Laboratory of Ethnobotany and Natural Substance, Department of Natural Sciences Normal School Superior of Kouba, Algeria*

[e] *Department of Biotechnology, Faculty of Natural and Life Sciences, University of Science and Technology - Mohamed Boudiaf, Oran, Algeria*.

[f] *Department of Biochemistry and Microbiology, Faculty of Sciences, University of Mohamed Boudiaf-Msila, Algeria*.

ABSTRACT

Background: *Oenanthe fistulosa* is an Algerian medicinal plant used in traditional medicine to treat different diseases.

Objective: This present research aimed to carry out the chemical composition of essential oils from the aerial parts of *Oenanthe fistulosa*.

Methods: Oils were extracted by hydro-distillation using Clevenger apparatus, and analyzed by Gas Chromatography Mass Spectrometry (GC-MS).

Results: Eighteen components have been identified, and have been classified into six groups: oxygenated sesquiterpenes (7 components), hydrocarbon sesquiterpenes (4 components), oxygenated diterpene (1 component), alkanes (3 components), aldehydes (2 components) and ketone isoprenoid (1 component). The major groups were alkanes and the oxygenated sesquiterpenes (42.61 and 27.23%, respectively). In the alkanes groups we find three major components, such as: heptacosane (3.79%), 1-Eicosane (4.39%) and heneicosane (34.43%). In the sesquiterpene oxygenated we find two major components, which are: bylongipinocarveol (3.81%) andcaryophyllene oxide (14.30%). In the aldehydes group, the major components is octadecanal with a rate of 6.68%, where the diterpeneoxygenated group was represented by phytol component (5.05%).

Conclusion: This study is the first investigation to the chemical composition of essential oil of the species *O. fistulosa* L. growing in Algeria. The GC-MS analysis of the essential oils reveals the presence of 23 components, in which 18 products were identified. Where the caryophyllene oxide as main copound, which is effective in preserving food, drugs and cosmetics.

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[1] **Contact**: Dr. Hamdi BENDIF, Faculty of Sciences, University of Mohamed Boudiaf-Msila, Algeria, Phone: +213662397062
hamdi.bendif@univ-msila.dz

Introduction

The genus *Oenanthe* belongs to the family *Apiaceae*. It includes 40 species, distributed in the temperate northern hemisphere (in Europe, western Asia, India and northern Africa) [1]. It is also used in traditional medicine as a feature of lockjaw (trismus), as the spasm of the muscles of chewing [2]. Most of the *Oenanthe* species are highly toxic in all its parts, causing respiratory, digestive, nervous and circulatory disorders, often followed by rapid death [1]. The *Oenanthe* species are characterized by a series of polyacetylenic alcohols illustrated by œanthotoxin as toxic components [3]. Large amounts of diacetylene epoxydiol-2 comefrom *Oenanthe fistulosa* L. seeds, while, the roots are rich in acetylene, found in falcarindiol, oenanthotoxin anddihydroantenoxin. The oenanthotoxin has shown activity against gamma-aminobutyric acid (GABA) receptors [3]. Oenanthotoxin and dihydro-oenanthotoxin strongly block GABA ergic responses, providing a molecular justification for the symptoms of poisoning from the decoction of the *O. crocata* species and related species. These observations are relevant to a series of historical and ethno-pharmacological observations on the identification of sardonic grass and the molecular details of facial muscle contraction caused by its ingestion (*Risussardonicus*) [4]. The chemical composition of the essential oil of *O. crocata* showed the presence of some terpenes, 1,8-cineole, camphor, 1-octyn3-ol-3-methyl, 8,10-heptadecadiene-4,6-diyne-1,12-diol have been isolated [5]. The aim of this work is to study of the chemical composition of the essential oil obtained from the aerial part of *O. fistulosa* grown in Alegria.

Materials and methods

Plant material

The aerial part of *O. fistulosa* was collected in full bloom from El Kala, province of El Taref (Northeastern from Algeria) in May 2015 (**Fig. 1**). The botanical determination was performed by Mr. Abdeslam Gurira (forest engineer in El Kala National Park), using available literature, and a voucher specimen was deposited in the herbarium of chemistry department laboratory under the reference ChifaDZUMCAPBC000040. After collection, plant material was dried at room temperature in darkness for one week and cut into small pieces.

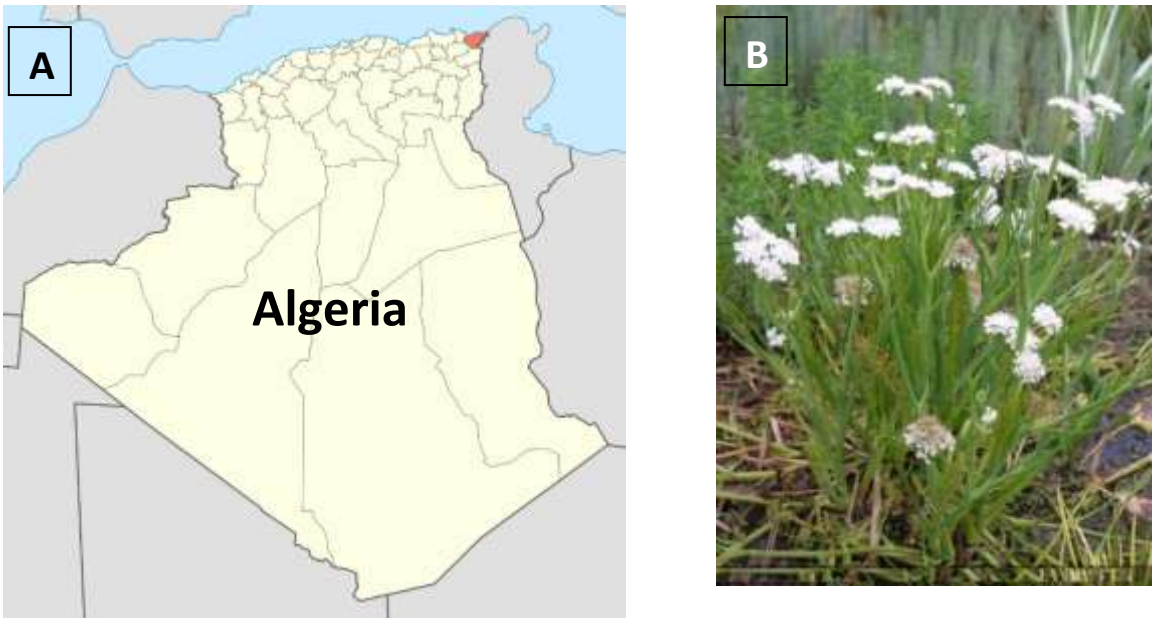

Fig. 1: A: El Kala, Geographic position of T El Taref (El Kala) in Algeria; B: *Oenanthe fistulosa* L.

Essential oils extraction

The essential oils of the aerial parts of plant were extracted by hydrodistillation according to [6]. The dried sample (50 g) is subjected to hydro-distillation in a Clevenger apparatus using a round bottom flask with 1 L of distilled water for 3 h. The mixture is brought to a boil with a flask heater. The essential oils obtained are stored in safest flasks in the dark and at a temperature of -20 °C. The essential oil yielded was calculated on a dry weight basis (w/w).

Gas Chromatography Mass Spectrometer (GC-MS) analysis method

The essential oil of *O. fistulosa* was analyzed by GC-MS. GC analyzes were performed using a 50: 1 Perkin-Elmer Clarus 500 Series GC system, equipped with a flame ionization detector (FID) and a BPX-5 apolar capillary

column equipped with mass spectrometer (30m x 0.25mm x 0.25m id).Helium (1.0 mL/min) was used as the carrier gas. The temperature of the injector and the FID operated were set at 250 ° C. A column of 50 °C initial temperature was raised to 220 °C with a rate of 8 °C/ minute and was held for 5 minutes. Mass spectrometer (MS) conditions were as follows: temperature of the transfer line at 250 °C, ion source at 250 °C and ionization energy at 70 eV. Standard components were available for the majority of essential oil constituents, and Kovat´s retention indices (IR) were determined for all components in the sample using the Van den Dool and Kratz equation [7] according to the retention time series of the n-alkane homologs. The relative peak area percentages of the compounds were calculated based on the FID data. The essential oil components were identified by comparing the mass spectra (MS) with respect to those reported in online libraries and with RIs reported in the literature with the BPX-5 column [8-9] and Adams [10].

Results and Discussion

Hydro-distillation of *O. fistulosa* gave an essential oil of yellow color, with a very strong and persistent odor, and with a quantity of 1 ml which corresponds to a yield of 0.2% (v/m). The results obtained by [11] showing a yield of 0.3% (v/m) in another species of the same genus *O. crocata* were inconsistent with our results (0.2%) [11]. The low value of the extraction yield of aerial parts can be attributed to the nature of habitat and to the geographical position of the plant. The crude composition of the essential oil is summarized in **Table 1** and **Fig.2.**

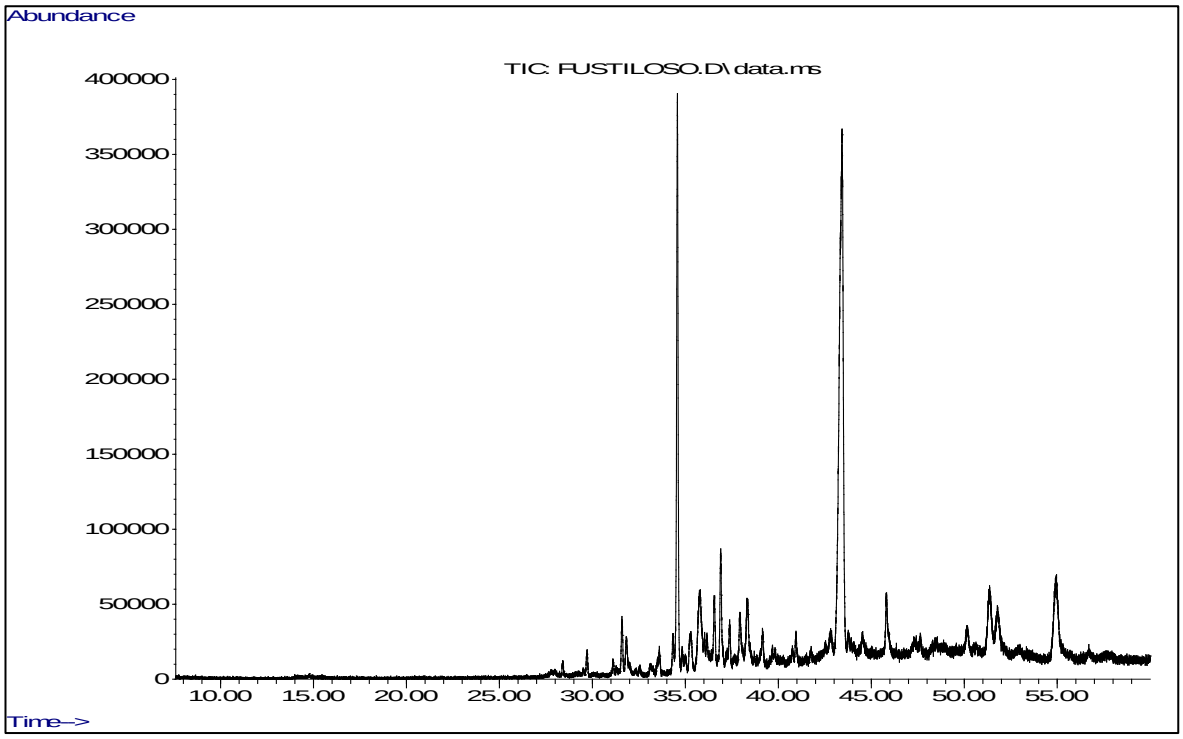

Fig.2: Gas chromatogram of *O. fistulosa* essential oil

The compounds are ranked in order of their retention time calculated on an apolar stationary phase. The gas chromatography of the essential oil reveals the presence of 23 components, where the 18 identified components represent 88.01% of essential total oil, with the presence of 7 oxygenated sesquiterpenes, 4 hydrocarbon sesquiterpenes, 3 alkanes, 2 diterpens oxygenated and 2 aldehydes. Our obtained results do not comply with the results of [11] on the essential oil of the species *O. crocata*. These researchers recorded the identification of 31 components, where 85.8% are hydrocarbon monoterpenes, 3.8% oxygenated monterpenes, 6.9% hydrocarbon sesquiterpenes and 0.3% oxygenated sesquiterpenes, with the total absence of alkanes, aldehydes and diterpens. While the common components between the two species are spathulenol with 0.3% and 0.98% in *O. crocata* and the *O. fistulosa* respectively, and caryophyllene oxide with traces in *O. crocata* and 14.30% in *O. fistulosa*. This difference can be explained by physiological variability and genetic factors [12]. The raw composition of the essential oil is dominated by a large amount of sesquiterpenes (11 components), which represents the rate of 31.63% from the total of 88.01% of the identified compounds. Among thesesesquiterpenes, we note that the oxygenated sesquiterpenes represent 27.2% and the hydrocarbon sesquiterpenes represent 4.4%. The main compounds of oxygenated sesquiterpenes are: caryophyllene oxide

(14.30%), longipinocarveol (3.81%) and ledene oxide (3.56%). While the main compounds of hydrocarbon sesquiterpenes are: α-Selinene (1.34%) and 2-Isopropenyl-4a, 8-dimethyl-1,2,3,4,4a,5,6,8a-octahydronaphthalene (1.27%). Oxygenated sesquiterpene Caryophyllene oxide has the ability to preserve food, drugs and cosmetics, and has antifungal effect [13]. It is also considered as local anesthetic agent [14], with analgesic and anti-inflammatory effects [15], and as an anti-cancer of the prostate and breasts [16]. According to [17] the oxygenated sesquiterpenelongipinocarveol is an anti-withering, anti-malaria, anti-convulsant and antioxidant product. While, according to [18] ledene oxide is considered as an antifungal. Our results show the total absence of the monoterpenes which constitute the majority of the essential oils of the higher plants. While, the diterpens are represented by phytol (5.05%) and a ketone isoprenoid represented by hexahydrofarnesyl acetone (0.86%). Phytol constitutes about one-third of the chlorophyll mass, and is generally considered as the most abundant acyclic isoprenoid compound in the biosphere [19]. It plays an essential role in the assembly, the structure and in the function of plant photosynthetic reaction centers and cyanobacteria [20]. Phytol is also a constituent and a precursor of both tocopherols [21], which include vitamin E [22] and vitamin K [23] in plants and cyanobacteria. According to research obtained by [24], the phytol has a role as an antibacterial activity, against the bacteria responsible for the major part of nosocomial infections (*Staphylococcus aureus*). We note the presence of 3 alkanes (42.61%) in the essential oil, such as: heneicosane (34.43%), 1-Eicosane (4.39%) and heptacosane (3.79%). We also observethe presence of two aldehydes: Octadecanal (6.68%) and 7-Hexadecenal (1.18%). Heneicosane is a pheromone that acts on the sexual behavior of an insect *Aedesaegypti*, a vector of Dengue disease, which affect about 50 to 100 million person per year in the world [25]. This olfactory substance when treated on water allows the attraction of females towards the nesting sites and consequently, facilitates the fight against this species [26].

Table 1: Composition of the essential oil from aerial part of *O. fistulosa* growing in Algeria.

N°	Compound [a]	RT [b]	%[c]	RI lit[d]	IM [e]	Crud Chemical formula
1	α-Bergamotene	29.707	0.59	1415	MS	$C_{15}H_{24}$
2	2-Isopropenyl-4a,8-dimethyl-1,2,3,4,4a,5,6,8a-octahydronaphthalene	31.593	1.27	n.i.	MS	$C_{15}H_{24}$
3	α-Selinene	31.828	1.34	1493	MS	$C_{15}H_{24}$
4	n.i.	33.603	0.91	n.i.	MS	n.i.
5	Spathulenol	34.337	0.93	1556	MS	$C_{15}H_{24}O$
6	CaryophylleneOxide	34.569	14.30	1562	MS	$C_{15}H_{24}O$
7	n.i.	35.293	1.71	n.i.	MS	n.i.
8	Phytol	35.782	5.05	2098	MS	$C_{20}H_{40}O$
9	Isoaromadendreneepoxide	36.032	0.72	1661	MS	$C_{15}H_{24}O$
10	Diepicedrene-1-oxide	36.158	1.12	1548	MS	$C_{15}H_{24}O$
11	Eudesm-11-en-1α-ol	36.562	2.79	1670	MS	$C_{15}H_{26}O$
12	Longipinocarveol	36.900	3.81	1634	MS	$C_{15}H_{24}O$
13	8-Hydroxy-4-isopropylidene-7-methylbicyclo[5.3.1]undec-1-ene	37.381	1.20	1746	MS	$C_{15}H_{24}$
14	n.i.	37.939	2.47	n.i.	MS	n.i.
15	ledeneOxide	38.332	3.56	1670	MS	$C_{15}H_{24}O$
16	n.i.	39.154	1.67	n.i.	MS	n.i.
17	Hexahydrofarnesylacetone	40.952	0.86	2131	MS	$C_{18}H_{36}O$
18	7-Hexadecenal	42.811	1.18	1448	MS	$C_{16}H_{30}O$
19	Heneicosane	43.424	34.43	2100	MS	$C_{21}H_{44}$
20	n.i.	50.160	1.99	n.i.	MS	n.i.
21	1-Eicosane	51.366	4.39	2015	MS	$C_{20}H_{40}$
22	Heptacosane	51.789	3.79	2698	MS	$C_{27}H_{56}$
23	Octadecanal	54.942	6.68	1819	MS	$C_{18}H_{36}O$

Percentage of different classes of chemical compounds

Classes	**%**	**Number of components**
Alkanes	42.61	3
Oxygenatedsesquiterpenes	27.23	7

Not identified	8.75	5
Aldehydes	7.86	2
Diterpenes	5.05	1
Hydrocarbonsesquiterpenes	4.4	4
Ketoneisoprenoid	0.86	1
Total	96.76	23

[a] Compounds are listed in order of their elution from a BPX-5 column.
[b]Retention time.
[c]Relative percentage values.
[d]Linear retention index taken from [10].
[e]Identification methods: MS, based on comparison with WILEY, ADAMS and NIST 08 MS databases.
n.i.: Not Identified

Conclusion

The essential oil of *O. fistulosa* aerial part was obtained from 50g by hydro-distillation, with a yield of 0.2% (v/m). The GC-MS of the essential oils reveals the presence of 23 components, in which 18 products were identified. The composition of the essential oil is dominated by a large amount of sesquiterpenes such as caryophyllene oxide which is effective in preserving food, drugs and cosmetics. And can also be used as a local anesthetic agent, analgesic, anti-inflammatory and in treatment of the prostate and breast cancer. However, the presence of Heneicosane which is a pheromone that acts on the sexual behavior of an insect *Aedesaegypti*, a vector of Dengue disease.

Conflicts of interest

The authors declare no conflict of interest.

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