Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2018, 10(7): 30-34

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Chemical Composition and Antioxidant Activity of the Essential Oil of Wild Carrot *Daucus carota* L. from Morocco

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ABSTRACT

The focus of this study was to determine the chemical composition of Moroccan carrot seeds essential oil using a GC-MS method and its antioxidant activity in methanolic solutions by assessing the 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity. The results of this work showed that the essential oil of Moroccan Daucus carota L. seeds is mainly constituted of the sesquiterpenes carotol and daucol (48.43 % and 18.60% respectively). The radical scavenging activity assay gave a concentration of essential oil required to inhibit 50% of the DPPH free radical of IC50=30,5 mg/ml demonstrating that this essential oil may be considered as an interesting source of natural antioxidants.

Keywords: *Daucus carota*; Essential oil; Antioxidant activity

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INTRODUCTION

Plants are still considered to be a valuable source of natural bioactive compounds that can be used to provide a soft medication, without side effects, against human diseases. Among these biomolecules, the presence of some important compounds like polyphenols, flavonoids or sesquiterpenes is often related to a marked antioxidant activity of the plant. These natural antioxidants have been shown to effectively reduce the oxidative stress and prevent or delay the damages caused by many conditions like inflammatory and rheumatic diseases, asthma or cancer [1-4]. *Daucus carota* L. (Apiaceae) is an aromatic plant used in traditional medicine for its therapeutic properties like antibacterial and antifungal activity of its essential oils (carrot oil). *Daucus carota* L. essential oil, extracted from the plant seeds, has also been shown to be antioxidative but its chemical composition is variable according to the area of harvest, and the stage of development [5]. The aim of this work is to determine the chemical composition of Moroccan *Daucus carota* L. essential oil and to evaluate the in vitro antioxidant activity using the DPPH (2,2-diphenyl-1-picrylhydrazil) free radical scavenging assay.

EXPERIMENTAL SECTION

Plant Material

The seeds of *Daucus carota* L. collected from different locations in Morocco and bought from herbalists were dried and ground to a fine powder before essential oil extraction.

Essential Oil Extraction

Essential oil was isolated by water distillation from the seeds powder, using a Clevenger-type apparatus, according to the procedure described in the European Pharmacopoeia.

Gas chromatography - Mass Spectrometry

Essential oil profile was characterized by gas chromatography (GC) (Agilent 7890A Series GC) coupled to mass spectrometry (MS) equipped with the multimode injector and 123-BD11 column with a dimension of 15 m × 320

μm × 0.1 μm and electron impact ionization. 40 μL of essential oil was solubilized in 1 mL chloroform and injected into the column by split mode 1/20 using helium as carrier gas at 4 mL/min. The ion source and quadruple temperatures were 230°C and 150°C respectively. The oven temperature program was started at 50°C and maintained 1 min, then increased at 20°C/min until 320°C before to be increased until 360°C by 3°C/min and finally kept constant for 10 min. Detection was done using full scan mode between 30 to 1000 m/z and the identification was performed using NIST 2014 MS Library.

Antioxidant Activity Assessment by DPPH Free Radical Scavenging Assay

The free radical scavenging capacity of the essential oil was determined using DPPH (2,2-diphenyl-1-picrylhydrazil) assay according to the method described by Koleva et al. [6].

1ml of methanolic solutions of the essential oil at different concentrations (0-400 mg/ml) are mixed (in test tubes) with 2 mL of a 0.004% methanolic solution of DPPH.

The mixtures were shaken vigorously and incubated for 30 min, in the dark, at room temperature.

Absorbance of the resulting solutions was measured at 517 nm using a VWR UV-1600 PC double-beam UV/Visible spectrophotometer against methanol.

As positive reference, methanolic solutions of ascorbic acid at different concentrations were used.

Percentage of DPPH scavenging activity was determined as follows:

DPPH Radical Scavenging Activity (%)=[(A0−A1)/A0], where A0 is the absorbance of control and A1 is the absorbance of sample.

The IC50 value, which is the concentration of essential oil required to inhibit 50% of the DPPH free radical, was determined.

RESULT AND DISCUSSION

Chemical composition of essential oil

D carota L. seeds essential oil yields only 0.6% of essential oil. The essential oil was analyzed by GC-MS as described above. The chromatogram obtained from this analysis is shown in Figure 1. The qualitative and quantitative composition are presented in Table 1, where compounds are listed in order of their retention times (RT).

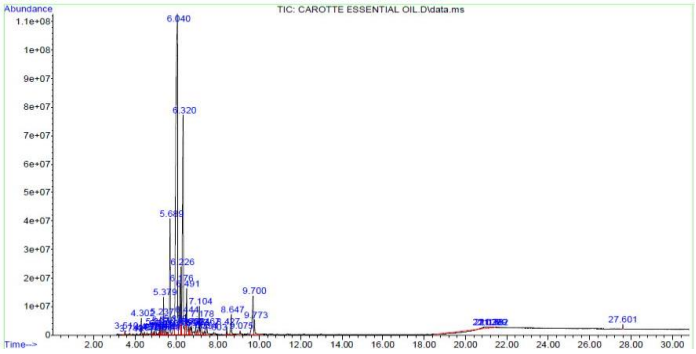

Figure 1: Chromatogram of the GC-MS analysis of wild carrot seeds essential oil

Table 1: Chemical composition of *Daucus carota* L. seeds essential oil by GC-MS

RT (min)	Area %	Compounds
3.506	0.12	Anethole
3.742	0.08	Ethanone, 1-(2-hydroxy-5-methylphenyl)
4.3	0.71	3-Isopropyl-6,8a-dimethyl-1,2,4,5,8,8a-hexahydroazulene
4.461	0.09	Bicyclo[3.3.0]octane, 3,7-bis(ethylidene)
4.579	0.08	Caryophyllene

4.794	0.24	Santalol E-cis,epi-beta-Bicycloheptane
4.912	0.13	Beta-copaene
5.009	0.6	Beta-Famesene
5.159	0.1	Benzene, 1-(1,5-dimethyl-4-hexenyl)
5.202	0.23	Isocaryophillene
5.234	0.66	Cyclopentanecarboxylic acid, 4-methoxyphenyl ester
5.309	0.51	Isonicotinic acid, dodecyl ester
5.374	1.29	Beta.-Bisabolene
5.449	0.27	Aromandendrene
5.481	0.17	Cis-Calamenene
5.545	0.18	5alpha-Hydroxy-4alpha,8,10,11-tetramethyltricycloundecene
5.685	6.04	Ylangenol
5.878	1.23	Caryophyllene oxide
6.039	48.43	Carotol
6.179	3.74	1,8-Naphthyridin-2-amine,7-methyl
6.222	2.35	5-Amino-3-phenylpyrazole
6.318	18.6	Daucol
6.447	0.95	Aciphyllene
6.49	2.32	1(2H)-Naphthalenone
6.597	0.42	Naphthalene, 1,6-dimethyl-4-(1-methylethyl)
6.662	0.53	Asarone
6.726	0.61	Ylangenol
6.93	0.43	3,7,11-Trimethyl-dodeca-2,4,6,10-tetraenal
7.005	0.29	Isoaromadendrene epoxide
7.102	1.29	Isopropylphosphonic acid, dimethylester
7.177	1.11	Butylphosphonic acid, isobutyl propyl ester
7.349	0.26	4-Isopropylcyclohexanone
7.467	0.59	Alloaromadendrene oxide
7.8	0.08	Isolongifolol
8.422	0.27	Pirimiphos methyl
8.648	1.44	n-Hexadecanoic acid
9.077	0.13	Muurola-4,10(14)-dien-1.beta-ol trans-Calamenene
9.7	3.86	Oleic Acid
9.775	0.88	Muurola-4,10(14)-dien-1.beta-ol

The main components were carotol (48,43 %) and daucol (18,60 %).
The other important components were: ylangenol, oleic acid, caryophyllene, isocaryophillene and isonicotinic acid in different amounts.
The chemical composition of essential oil extracted from seeds in our study is different from that of wild carrot of Serbia which is characterized by the presence of α-pinene, sabinene, β-myrcene, limonene and germacrene D [7]. Another study on Algerian wild carrot found that the essential oil from seeds is predominantly composed of oxygenated monoterpens (66.08 %) and oxygenated sesquiterpens (16.41%). The main components were geranyl acetate (52.45%), cedrone S and asarone [5].
This variability of composition could be explained by the differences in genetic, geographic and climatic factors.

Free radical scavenging activity on DPPH of *Dauccus carota* essential oil

Antioxidant compounds donate electrons to DPPH thus causing its reduction, and in reduced from its color changes from deep violet to yellow. The DPPH assay has been extensively used for screening antioxidants such as polyphenols [8].
In our study, the DPPH free radical scavenging method was used to determine the concentrations of methanolic solution of the essential oil at which it scavenges 50% of the DPPH solution termed as IC50 values. Ascorbic acid was used as standard for this purpose. The lower the IC50 value of an antioxidant the higher would be its free radical scavenging power. The scavenging abilities of different methanolic solutions (different concentrations) of *Daucus carota* L. essential oil were concentration-dependent as presented in Figure 2.

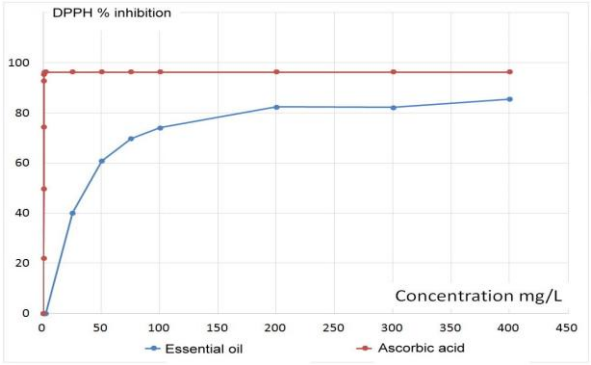

Figure 2: DPPH scavenging activity of the wild carrot seeds essential oil

The radical-scavenging activity expressed by the IC50 value was 30.5 mg/mL. This value is better than the results obtained in another similar study that found an IC50 value of 76.33 mg/mL for the Algerian variety [5]. This variability is mainly related to the differences in the molecular composition of the two essential oils. Meanwhile, the results we obtained confirm that *Daucus carota* L. seeds essential is of great interest regarding its free radical scavenging potential.

CONCLUSION

The radical-scavenging activity expressed by the IC50 value was 30.5 mg/mL. This value is better than the results obtained in an other similar study that found an IC50 value of 76.33 mg/mL for the Algerian variety [5]. This variability is mainly related to the differences in the molecular composition of the two essential oils. Meanwhile, the results we obtained confirm that *Daucus carota* L. seeds essential is of great interest regarding its free radical scavenging potential.

ACKNOWLEDGEMENT

The authors wish to thank all the individuals and institutions who made this work possible.

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