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Physicochemical Profile of Essential Oil of *Daucus carota*

N. Behidj-Benyounes, K. Benyounes, T. Dahmene, N. Chebouti, S. Gana

***Abstract*—**Essential oils have a significant antimicrobial activity. These oils can successfully replace the antibiotics. So, the microorganisms show their inefficiencies resistant for the antibiotics. For this reason, we study the physicochemical analysis and antimicrobial activity of the essential oil of *Daucus carota*. The extraction is done by steam distillation of water which brought us a very significant return of 4.65%. The analysis of the essential oil is performed by GC / MS and has allowed us to identify 32 compounds in the oil of *D. carota* flowering tops of Bouira. Three of which are in the majority are the α-Pinene (22.3%), the carotol (21.7%) and the limonene (15.8%).

***Keywords*—**α-Pinene, carotol, *Daucus carota*, limonene.

I. Introduction

It is now proven that about 20% of plant species growing in the world have therapeutic or cosmetic virtues, because they contain molecules or active ingredients with various biological properties [1]. Among these molecules or these chemical components essential oils.

With the appearance of side effects of synthetic drugs and the increasing resistance of pathogenic microorganisms in relation to conventional antibiotics, many scientific searches are currently moved towards the way of the use of active biological extracts of aromatic and medicinal plants, particularly towards essential oils [2], [3] note that the use of these natural substances is a very promising and very effective in fighting against pathogens. Hess [4] reported that aromatherapy is the methods which take advantages of the activity of essential oils by prescribing the use for therapeutic purposes of their volatile compounds to treat, mitigate, or prevent diseases. Reference [4] confirms that at present, the pharmaceutical and cosmetic industries get their raw materials from natural resources such as essential oils.

According to [5], the essential oils are part of the composition of perfumes and cosmetics. In the global context of competition to produce drugs based on aromatic plants, this study is conducted in order to extracted essential oils for the valorisation of aromatic plants.

N. Behidj-Benyounes is with the Laboratory of soft technologies, valorisation, physico-chemistry of biological material and biodiversity, Department of biology, Faculty of sciences, University of Boumerdes, 35000 Algeria (phone: 00213772595094; fax: 0021324816643; e-mail: behidj_nassima@ yahoo.fr).

T. Dahmene and N. Chebouti are with the Laboratory of soft technologies, valorisation, physico-chemistry of biological material and biodiversity, Department of biology, Faculty of sciences, University of Boumerdes, 35000 Algeria (phone: 00213772595094; fax: 0021324816643).

K. Benyounes is with the department of Mining and Petroleum engineering, Faculty of Hydrocarbons and Chemistry, University of Boumerdes, 35000 Algeria (phone: 00213772595094; fax: 0021324816643; e-mail: khaled_benyounes@ yahoo.fr).

S. Gana is with the Department of biology, Faculty of sciences, University of Boumerdes, 35000 Algeria (phone: 00213772595094; fax: 0021324816643).

II. Material and Methods

A. Material

We have used the flowering tops of the wild carrot. It is a wild carrot of Northern Algeria (Bouira). It is a biennial plant of the family *Apiaceae* (formerly *Umbelliferae*). Harvesting is done at the time of flowering during May 2014.

B. Methods

We have proceeded with the extraction, physicochemical characterization of essential oil of *Daucus carota*.

C. Phytochemical Study

The kinetic study of essential oil yield of *Daucus carota* has been carried out by ahydrodistillation in order to calculate the yield of essential oil. It was determined the humidity rate and the yield. To get a good essential oil in quantitative and qualitative terms, it is necessary to use a pilot extractor. The extraction method used is the method of extraction by steam distillation of water. It is based on the fact that most of the volatile compounds contained in the plants can be driven by steam, because of their relatively low boiling point and their hydrophobicity. Under the action of the water steam formed or introduced into the extractor, gas is released from the plant tissue. At this time, it will be driven by the steam. The steam mixture is condensed on a cold surface and the essential oil is removed by decantation [6]. The main variants of the extraction by steam distillation of the water are hydrodistillation, saturated steam distillation and hydro diffusion [7]. The physicochemical properties of essential oil of wild carrot as density, refractive index, optical rotation, the acidity index (AI), the ester index (EI), the saponification index (SI), the gas chromatography (GC) and the coupling chromatography - mass spectrometry (GC / MS) are treated. The amount of water found in vegetable oil is 7.4 ml. The mass of fresh plant material (Mfpm) used is 10 g. The humidity rate (HR) obtained is 74%.

III. Results and discussion

The results obtained show that the enclosed humidity rate in the flower of the wild carrot is equal to 74%. According to [8], plants in fresh state are rich in water which represents half or more of the plant. However, high humidity rate is not always sought; in fact, several studies have showed that the yield of essential oil is inversely proportional to the humidity rate the fact that the essential oil yield is based upon the drying duration of the plant material.

A. Kinetics of Oil Yield

The mass of the essential oil is the difference between the weight of the filled tubes and empty tubes. This allowed us to calculate the yield (Y %) of the studied plant species.

1. Determination of the Yield

The result of the essential oil yield according to the extraction time of the species is 4.65%.

The results of the variation of essential oil yield depending on time are shown in Fig. 1. The general shape of the yield curve depending on time of distillation is growing. It tends towards a level at the end of 120 minutes.

It is found that from time 0 min to 15 min the yield passes from 0% to 4.65%. So the increase of the yield is quick. This evolution continues until 12 minutes where the yield reaches 4.65%. But beyond this period, it tends to stabilize until it reaches a level.

The quick increase of the yield can be explained by the drive of essential oils at the periphery of the plant. This facilitates their extraction by the first steams. The slow evolution of the yield corresponds to the depletion of the rest of the essential oils contained in endogenous deposits. This technique optimizes the extraction duration in order to avoid wasting time energy.

Due to the lack of work done on the kinetics of the essential oil yield of the wild carrot, the results obtained in this study are compared to those given for other species in the family *Apiaceae*. The yield obtained during this study was greater than the one obtained by [9] which is of the order of 2.28% for *Foeniculum vulgare* and to the one obtained by [10] is 1.21% to *Pituranthos scoparius*, and 1, 1% *P. chloranthus* and 1.08% and *P. reboudii*. It is also superior to the yield of *Daucus crinitus* reported by [11]. This yield is of 0.3%). We also note that the yield obtained for this work is more interesting than the one of *Smyrnium olusatrum*, with a yield of 1.2% [12].

These differences are due to several factors, namely the geographical origin, including climatic environmental factors (temperature and humidity), the plant species itself, the plant organ, the stage and the harvest time, conservation of plant material and the extraction method.

The essential oil content also depends on the time of harvesting. The flowering tops and leaves should be harvested before flowering, because according to [18], after flowering, 70% of essential oils evaporate into the air. However, the whole plant is generally harvested during flowering.

B. Chemical and Organoleptic Charactrisation

The results of the organoleptic characteristics of the essential oil of wild carrot are shown in Table I.

Formerly, the organoleptic characterization was the only indication for assessing the value of an essential oil (appearance, color, smell, taste). As this property provides only relative information on these species, it seems necessary to appeal to other characterization techniques.

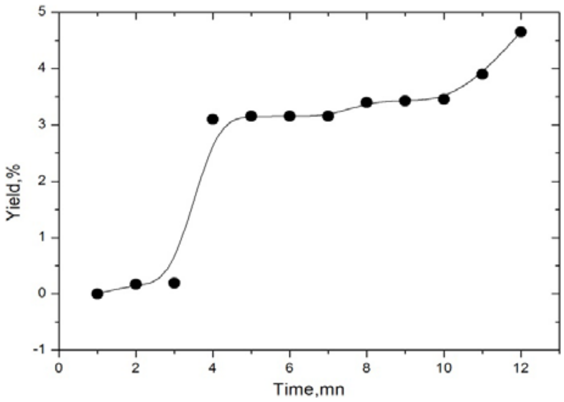

Fig. 1 Variation of essential oil yield of wild carrot over time

These standards are determined by several known global organizations such as [20].

The chemicals characteristics of this oil are explained in Table II.

The results on the organoleptic properties of the essential oil of wild carrot are consistent with those obtained by the AFNOR standards[6].

TABLE I
ORGANOLEPTIC CHARACTERISTICS OF THE ESSENTIAL OIL OF WILD CARROT

Properties	Essential oil of wild carrot	AFNOR (2000)
Appearance	Clear liquid	Clear liquid
Color	Yellow gold	Dark yellow
Odor	Spicy, pleasant, characteristic	Characteristic, sweet

TABLE II
CHEMICAL CHARACTERISTICS OF THE ESSENTIAL OIL OF WILD CARROT

Properties	Essential oil of wild carrot
Relative density at 20°C	0.926
Refractive index at 20°C	1.429
Rotatory power	+0.24°
Acide index	10
Ester index	35
Saponification index	1.4707

While those of physicochemical properties, they are similar to those of [19]. This author, who worked on the same species harvested in Algiers, noted that the refractive index is slightly different from that of Algiers. He mentioned that the density is slightly higher. Thus, the essential oil of Bouira has low optical rotation.

B. Analysis of Chemical Composition of the Essential Oil by Chromatography

The gas chromatography coupling to a mass spectrum allowed us to identify the constituents of essential oils directly, to separate and also to isolate each of the mixture to obtain important data about the structure of unknown organic compounds of *Daucus carota* oil (Fig. 2).

The results of identification of the components of this extract, its retention indices on apolar columns and its relative content column are given in Table III.

We were able to identify 32 compounds which represent

92.3% of the total composition of our essential oil.

TABLE III
COMPOUNDS OF THE ESSENTIAL OIL OF WILD CARROT

Compounds	*Molar mass*	Essential oil	
		IR	*%*
α-thujene	136	929	0.1
α-Pinene	136	939	22.3
Sabinene	136	972	0.6
β-Pinene	136	979	5.5
Myrcene	136	990	8.8
α-terpinene	136	1016	0.2
p-cymene	134	1019	0.4
Limonene	136	1031	15.8
Linalool	154	1097	0.4
Sabina ketone	138	-	-
P-Mentha-1,5-dien-8-ol	152	-	-
Terpinene-4-ol	154	1164	0.2
α-terpineol	154	1179	0.2
2-Decanone	156	1192	0.2
Geraniol	154	1251	0.3
Bornylacetate	196	1284	0.4
α-terpinylacetate	196	1354	0.2
Daucen	204	1379	1.6
α-humulen	204	1451	0.9
E-β-Farnesene	204	1454	0.5
Germacrene D	204	1473	0.5
Bicyclogermacrene	204	1498	0.6
β-bisabolene	204	1500	2.0
E-α-bisabolene	204	1514	1.4
α-Calacorene	204	1537	0.2
Germacrene B	204	1555	0.6
Isoelemicine	208	1559	0.4
Carotol	222	1592	21.7
Dauc-8-en-4b-ol	222	1598	1.0
Daucol	238	1639	0.6
Seline-11-en-4-α-ol	222	1647	0.7
Asaron	208	1671	3.1
Eudesm-6-en-4α-ol	222	1689	0.9
Olefinic monoterpenes			53.7
Oxygenesmonoterpenes			1.3
Olefinicsesquiterpenes			8.3
Oxygenessesquiterpenes			24.9
Other			4.1
Total			92.3

Olefinic monoterpenes are predominated in our gas with more than 53.7 % followed by olefinicsesquiterpenes that are presented with 24.9%.

Fig. 3 shows the relative contents of a few major components.

The results of this study are quite different from those obtained by [19]. It results from this figure an atypical composition for the oil of Bouira. It is characterized by the α-Pinene (22.3%), the carotol (21.7%) and the limonene (15.8%). While for the oil of Algiers is made by the α-Pinene (22.3%) followed by limonene with (15.8%) are the major products. But there is at least Myrcene proportions (1.6% - 8.8%) and asarone (3.1 to 6.7%). These results are very closer to those obtained by [19]. [19] noted that limonene as major compounds and Myrcene and Asarone as minor compounds. In Portugal, according to [20] essential oils of the leaves of the wild carrot have acetate, geranyl the α-Pinene and as main components.

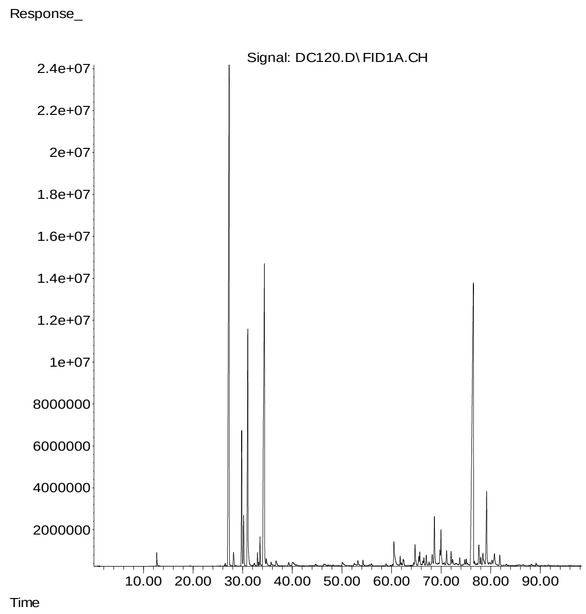

Fig. 2 Chromatogram of essential oil of *D. carota* (Bouira) obtained by steam distillation

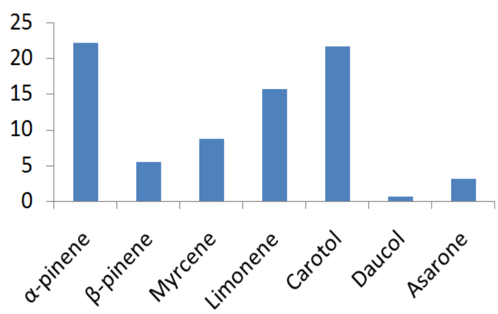

Fig. 3 Main constituents of the essential oil of *D. Carota*

Through this study, a high variability of the components of essential oils of wild carrot can be seen according to the origin of the samples. These differences can be attributed mainly to soil and climatic factors. Indeed, [21] noted that the variations found in the chemical composition of essential oils from qualitative and quantitative point of view, can meet any or the combination of the following factors such as heritage genetics, the age and the environment of the plant

IV. CONCLUSION

The result of the essential oil yield is 4.65%. We were able to identify 32 compounds which represent 92.3% of the total composition of our essential oil.

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