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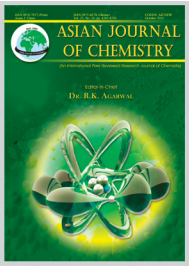

Extraction and Analysis of Essential Oil of Cumin

A. BENREJDAL[1,*], F. DRIDI[1] and M. NABIEV[2]

[1]Faculté des Sciences, Département de Chimie, Université M'Hamed Bouguerra, Boumerdès 35000, Algeria
[2]Laboratoire de Traitement des Eaux Polluées et Extraction des Substances Biologiques Actives, Université M'Hamed Bouguerra, Boumerdès 35000, Algéria

*Corresponding author: Fax: +213 24816762; Tel: +213 24814376; E-mail: a_benrejdal@yahoo.fr

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Among the plants belonging to the Umbelliferae family, we were interested in the cumin (*Cuminum cyminum*) cultivated in Algeria. In this work, we have studied the hydrodistillation process, which showed that in spite of the relatively long duration of the extraction (270 min), we could reach the bearing representing equilibrium. The analysis of essential oil was realized by the method of gas chromatography coupled with the mass spectroscopy (GC/MS). The results allowed to identify the major components which are: the cuminaldehyde and the 1-phenyl-1,2-ethanediol, accompanied with products in small quantity. The results of the physicochemical analyses of essential oil showed that they are in conformity with the A.F.N.O.R norm.

Key Words: *Cyminum*, Hydrodistillation, Cuminaldehyde, Gas chromatography.

INTRODUCTION

Cumin is an essential spice in almost all the culinary preparations such as soups, cakes, breads, cheeses, *etc*. This plant can be originating from Egypt or Syria. Nowadays it is being developed intensively in India, China, Turkey and Iran[1]. Cumin has quite varied medicinal properties, which are stomachic, diuretic, stimulative, astringent and analgesic[2,3].

In this work, we carried out the extraction of the essential oil of cumin by the hydrodistillation[4,5]. The collected extract was analyzed by using the gas chromatography coupled with the mass spectroscopy method[6,7]. The results allowed to know the chemical composition of essential oil, which compared with other works showed a great similarity[8,9].

EXPERIMENTAL

Two hundred grams of dried and pulverized cumin plant seeds, cultivated in the highlands of Algeria was used. The extraction of the essential oil of cumin is achieved by using the hydrodistillation process which lasts 270 min. Knowing that the essential oil is partially water soluble, we use 10 to 20 mL of diethylic ether in order to carry out the separation of the organic phase containing essential oil (the higher part) from the aqueous phase (liquid-liquid extraction type).

The output of the essential oil is defined by the following formula:

$$R(\%) = \frac{m_{HE}}{m_S} \cdot 100 \quad (1)$$

The m_{HE} and m_S represent the mass of essential oil and that of the (dried) vegetable matter, respectively.

Chromatographic analysis: The sample of essential oil was subjected to a chromatographic analysis coupled with the mass spectrometry by using a chromatograph type at GC 17 A Shimadzu and a mass spectrometer type at QP5000 Shimadzu. The operating conditions used for the chromatography were as follows:

A column of the PTE 5 type of 30 meters in length and an internal diameter of 0.25 mm.

The temperature of the injector is 250 ºC.

The temperature of the column: 70 ºC to 220 ºC at a rate of 2 ºC/min.

The carrier gas: Helium having a flow of 0.9 mL /min.

Concerning the mass spectrometry, the detector used is of a Quadripolar electronic impact type.

Organoleptic characters and physicochemical indexes: Essential oils must meet analytical characteristics, which are established by national and international commission experts. To know the quality of the Algerian essential oil of cumin, we carried out organoleptic tests, which are the colour, the aspect and the odor and the search of physicochemical indexes such as: the density, the refractive index, the optical activity, the acid index and the ester index[10].

RESULTS AND DISCUSSION

Influence of the extraction duration on the total output of the essential oil: The evolution of the yield of essential oil

is represented in the Fig. 1. The results represented on this figure show that for a duration of a relatively long extraction (270 min), we could reach the bearing representing equilibrium, a foreseeable result since we are dealing with endogenous deposits easily accessible for the steam.

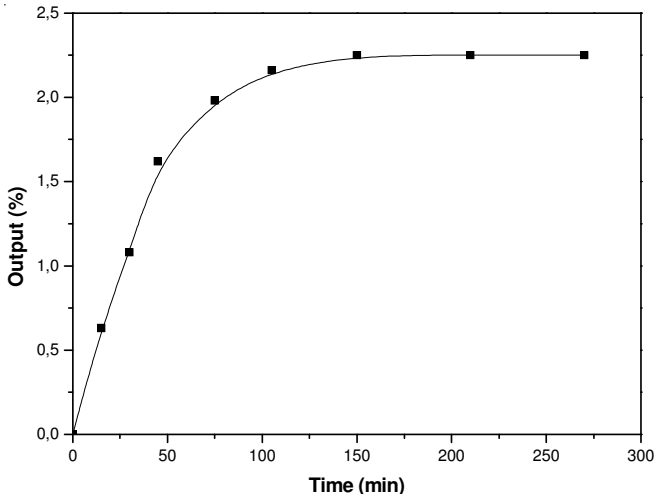

Fig. 1. Evolution of the yield of the cumin essential oil according to time

It is suggested that the main part of the essential oil is extracted at the first 2 h of the processing. In this work, with the use of the gas chromatography coupled with the mass spectroscopy (GC/MS); we were able to identify more than 90 % of the substances which constitute essential oil. In order to confirm this identification we calculated the retention index (IR) of each component according to the Kovats method[6].

The chromatogram of the essential oil is represented in Fig. 2 and its chemical composition is given in Table- 1. Table-1 shows that the Algerian essential oil is mainly composed of cuminaldehyde and the 1-phenyl-1,2-ethanediol, which is in conformity with the literature[8,9,11].

TABLE-1
IDENTIFICATION OF THE COMPONENTS OF THE ESSENTIAL OIL OF CUMIN BY GC/MS ON COLUMN OF THE SAME TYPE AS THE DB5[12-14]

No. peak	IR	Proposed compound
1	960	α-Thujene
2	964	α-Pinene
3	985	Sabinene
4	988	β-Pinene
5	995	Myrcene
6	1018	P-Cymene
7	1021	Limonene
8	1023	1,8-Cineole
9	1045	γ-Terpinene
10	1127	Impurity
11	1138	Impurity
12	1149	Terpin-4-ol
13	1176	(Z) 5-Pentadecen-7-yne
14	1209	2-*Tert*-butyl-4-methylfuran
15	1218	Cuminaldehyde
16	1244	(E) 4-tridecen-6-yne
17	1254	Myrtenal
18	1319	1-Phenyl-1,2-ethanediol
19	1390	4-Methyl-3-hepten-2-one
20	1427	2,5,5-Trimethyl-1,3,6-heptatriene

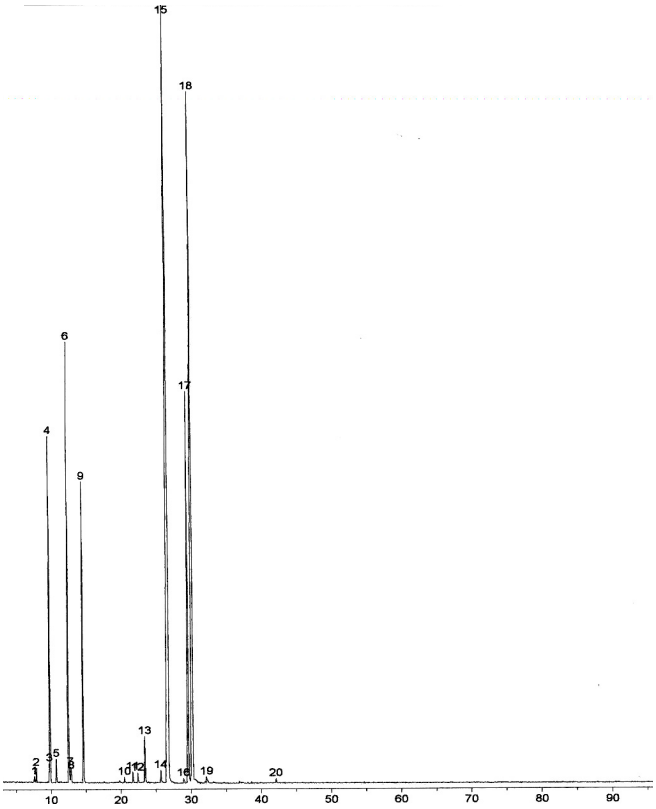

Fig. 2. Essential oil of cumin

Physicochemical characterization of the essential oil: We were able to determine the organoleptic properties of essential oil and compare them with those of A.F.N.O.R norm[15]; the results are represented in the Table-2. In this work, we had to determine the following physical and chemical characteristics: refractive index n_D^t ; density d_{20}^{20} ; acid index (AI) and ester index (EI).

TABLE-2
ORGANOLEPTIC PROPERTIES OF THE ESSENTIAL OIL OF CUMIN

Organoleptic characters	Colour	Aspect	Odour
Essential oil of cumin	Yellow	Liquid	Characteristic odour spiced very strong
A.F.N.O.R norm	Amber yellow to dark yellow	Mobile liquid	Characteristic odour, fatty, aromatic

Table-3 gathers the physicochemical characters of essential oil. According to the results, it is noted that the organoleptic characters and the physicochemical indexes are in conformity with those of A.F.N.O.R norm[15]. On the other hand, we noticed a light increase of the density. This result can be explained by the nature of the cumin fruits cultivated in Algeria and the climatic conditions in which our plant evolved.

TABLE-3
PHYSICAL AND CHEMICAL INDEXES OF ESSENTIAL OIL OF CUMIN

Index	n_D^t	d_{20}^{20}	AI	EI
Essential oil of cumin	1.5014	0.953	5.61	10.09
A.F.N.O.R. norm	1.4900-1.5060	0.905-0.930	/	/

The A.F.N.O.R does not give any indication on the value of the acid index and the ester index, this does not allow to make a comment on the found values.

Conclusion

This study has enabled to fix the extraction duration to 2 h by basing on the total yield of essential oil, so it would not be economically advantageous to prolong the extraction under these conditions beyond 2 h. By using the GC/MS method, we could determine the major components of our essential oil, which are the cuminaldehyde and the 1-phenyl-1,2-ethanediol. These results are in conformity with the allowed standards. The results obtained from the organoleptic properties and from the physical and chemical indexes are in conformity with A.F.N.O.R norm, so we can conclude that our Algerian essential oil is of good quality.

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