



Short communication

Chemical Composition of the Essential Oil of *Cuminum cyminum* L. Seeds from Western India

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Article History: Received: 06 December 2013/Accepted in revised form: 26 July 2014

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Abstract

The essential oil from the seeds of *Cuminum cyminum* L. was isolated by hydrodistillation method and the chemical composition was determined by gas chromatography-mass spectrometry (GC/MS). The yield of the oil was found to be 3.0% (on dry weight basis). A total of twenty six components, representing 96.7% of the oil were identified. Cuminaldehyde (49.4%), *p*-cymene (17.4%), β -pinene (6.3%), α -terpinen-7-al (6.8%), γ -terpinene (6.1%), *p*-cymen-7-ol (4.6%) and thymol (2.8%) were the major components in the oil.

Key words: *Cuminum cyminum* L., Apiaceae, Spice, Essential oil, Cuminaldehyde

Introduction

Cuminum cyminum L., (Family: Apiaceae), commonly known as cumin or Jira in India, is an aromatic plant, native to Egypt, the Mediterranean region, Iran and India. It is one of the important commercial spice crops, cultivated throughout India for the purpose of spice, flavour, culinary and is used in pharmaceutical preparations alone or with other known spices and medicinal plants [1]. India is the world's largest producer and consumer of cumin. Turkey, Syria, China, US, Iran, Indonesia, Sudan, Egypt, Morocco, Algeria and Libya are other leading producers of cumin in the world. Cumin is commercially sold in India and abroad as seeds and seed powder. The value added products like essential oil and oleoresin of cumin are also exported and used in India. In India, Rajasthan and Gujarat are the first and second largest cumin seed producer states and contributes 90% of the total production in the country. India exports cumin seeds to Bangladesh, Japan, Malaysia, Nepal, Pakistan, Singapore, South Africa, UAE, UK and the US [2]. As per estimate of Indian Spice Board, cumin shared about 6.0% among the major spices export from India in 2006-07. The flavor of the seed is warm, heavy, spicy and curry like, dominated by the flavor

component cuminaldehyde [2]. The fruits of cumin are reported to possess stomachic, stimulant, carminative, astringent and coolant properties. Its fruits are also found to be useful in dyspepsia, diarrhoea and in veterinary medicine [1,3]. The seeds are used in snake-bite (Chopra *et al.*, 1996). In Iranian folk medicine, the fruits have been used to treat diarrhea, toothache and epilepsy [4]. Essential oil is reported to possess anticonvulsant, antinociceptive, anti-inflammatory, antidiabetic, antimicrobial and antifungal activities [5-11]. It is essential oil is reported to possess antiseptic, analgesic, anti-inflammatory, sedative, stimulants and stomachic properties [12]. Cumin seeds contain variable amounts of essential oil (2.0-4.5%) and cuminaldehyde (20.0-40.0%) has been reported as a main compound [1,13-14].

Earlier reports showed that its essential oil has been widely analyzed by different workers from abroad as compared to Indian cumin. In brief, Baser *et al.*, 1992 [15] reported that essential oil of cumin seed contained cuminaldehyde (19.2-27.0%), *p*-mentha-1,3-dien-7-al (4.3-12.3%), *p*-mentha-1,4-dien-7-al (24.5-44.9%), α -terpinene (7.1-14.1%), *p*-cymene (4.6-12.0%) and β -pinene (3.0-8.9%) while cuminaldehyde (19.9-23.6%), *p*-mentha-1,3-dien-7-al (11.4-17.5%) and *p*-mentha-1,4-dien-7-al (13.9-

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16.9%) were major compounds in cumin from Turkey [9]. Lacobellis *et al.*, 2005 [8] reported that *p*-mentha-1,4-dien-7-al (27.4%), cuminaldehyde (16.1%), γ -terpinene (12.8%), β -pinene (11.4%), *p*-mentha-1,3-dien-7-al (8.7%) and *p*-cymene (5.6%) whereas γ -terpinene (29.1%), *p*-cymene (25.2%), β -pinene (19.9%), cuminaldehyde, (18.7%) and perillaldehyde (2.4%) were main components in cumin seed oil growing in Italy [16]. The analysis of essential oils from Pakistan showed the presence of cuminaldehyde (37.4%), *p*-cymene (16.4%), *p*-menth-1,3-dien-7-al (15.0%), β -pinene (9.8%), γ -terpinene (8.1%) and *p*-menth-1,4-dien-7-al (5.5%) in cumin seeds [17]. However, different composition with cuminyl alcohol (30.0%), cuminaldehyde (25.9%), β -pinene (16.3%), *p*-cymene (15.5%) and α -terpinene (5.6%) in cumin oil were also reported from Pakistan [10]. The volatile oil analysed from China showed that the seeds contain 3.8% oil, which contain cuminal (36.3%), cuminic alcohol (16.9%), γ -terpinene (11.1%), safranal (10.9%), *p*-cymene (9.8%) and β -pinene (7.7%) as the major compounds [18]. Jirovets *et al.*, 2005

[19] reported that the cuminaldehyde (36.0%), β -pinene (19.3%), *p*-cymene (18.4%) and γ -terpinene (15.3%) while cuminal (32.3%) and safranal (24.3%) were main compounds [20]. Similarly, cuminaldehyde (37.2%), *p*-menthadienal (26.2%), γ -terpinene (12.2%), β -pinene (11.5%) and *p*-cymene (8.7%) were the major compounds in cumin oil [21]. Interestingly, Iranian essential oil obtained from the seed, lacked cuminaldehyde while α -pinene (29.2%), limonene (21.7%), 1,8-cineole (18.1%), linalool (10.5%), linalyl acetate (4.8%) and α -terpineol (3.2%) were main components [11]. The essential oil has also been reported to contain different amount of cuminaldehyde in Mediterranean (47.4-51.5%), Mexican (62.7%), Iranian (32.4%), Indian (16.0%) and Pakistani (20.0%) seeds [13].

A report on the analysis of the essential oil from Indian cumin seeds, collected from the different regions showed the presence of *p*-cymene (23.0-39.0%), β -pinene (22-27%), γ -terpinene (11-27.0%), cuminal (8.0-17.0%) and *p*-mentha-1,4-dien-7-ol (1.0-5.5%) as major compounds [22]. Above reports also showed the availability of different chemotypes world widely but Indian cumin essential oil was reported to contain less amount (8.0-20.0%) of cuminaldehyde [13,22]. Literature survey revealed that no analysis of the essential oil from the cumin seeds has been done from western parts of India and

thus details chemical analysis of the oil was carried out by GC/MS to reconfirm the quality and amount of cuminaldehyde together with other constituents, in commercially grown cumin seeds sold in the region.

Material and Methods

Isolation of essential oil

The mature seeds of *Cuminum cyminum* (cumin) were purchased from local market at Anand, Gujarat. The seeds (1.0kg) were powdered and hydrodistilled in Clevenger type apparatus for 4 hrs. The distillate was extracted with diethyl ether, the ethereal layer was dried over anhydrous sodium sulphate and ether distilled off on gently heated water bath. The yields of the oil were found to be 3.0% from on dry weight basis. The essential oils were store at 4-8 °C until further analysis.

Gas chromatography-mass spectrometry

Analysis of the volatile oils of cumin was performed on a GC/MS (Focus-PolariQ) Benchtop Ion Trap Mass spectrometer equipped with a ZB-5 capillary column (30 m x 0.25 mm i.d., film thickness 0.25 μ m) equipped with TriPlus autosampler. Chromatographic conditions were as follows: injector temperature was 220 °C, helium as carrier gas at a flow-rate of 1 ml/min; injection volume was 1.0 μ l (20mg/ml in diethyl ether); respectively. The column temperature was held at 60 °C for 5 min., and programmed at 3°C/min to 220 °C and held for 10 minutes with split mode injection (1:20) the MS transfer line and source temperatures were 240 °C and 200 °C. The GC column was coupled directly to quadrupole ion trap mass spectrometer in EI mode at 70eV with the mass range of 30-450 a.m.u at 1 scan/s. Kovat's retention indices were calculated using standard hydrocarbons (C₈-C₂₀ n-alkanes, Sigma-Aldrich). The individual compounds were identified by mass spectra and their identities were confirmed by comparing their mass spectra with Mass Spectral Library (Ver. 2, 2005) and literature [23].

Results and Discussion

Cumin, one of the important crops, cultivated for commercial purpose in different states of India, is widely used as spice and medicine alone or together with other ingredients. The seeds of the cumin were found to contain 3.0% volatile oil obtained by hydrodistillation method, on dry weight basis. A

total of twenty six compounds, constituting 96.7% of the oil were identified by GC-MS and are shown in table Table 1 and Figure 1. Cuminaldehyde (49.4%), *p*-cymene (17.4%), β -pinene (6.3%), α -terpinen-7-al

Table 1 Composition of the essential oil of *Cuminum cyminum* seeds

Peak No.	Compound	RI	Amount (%)
1	Heptanal	902	t
2	Cumene	930	t
3	α -Thujene	931	0.2
4	α -pinene	939	0.4
5	Sabenene	954	0.1
6	β -pinene	979	6.3
7	Myrcene	990	0.3
8	α -phellandrene	1002	0.1
9	δ -3 carene	1011	t
10	α -terpinene	1017	t
11	<i>p</i> -cymene	1024	17.4
12	Limonene	1029	0.3
13	1,8-cineole	1031	0.1
14	γ -terpinene	1059	6.1
15	<i>m</i> -cymenene	1085	0.2
16	<i>trans</i> -pinocarveol	1141	0.1
17	Terpinen-4-ol	1177	0.3
18	<i>p</i> -cymene-8-ol	1182	0.4
19	α -terpineol	1188	0.2
20	Myrtenol	1195	0.1
21	<i>o</i> -cumenol	1196	0.1
22	Cuminaldehyde	1241	49.4
23	α -terpinen-7-al	1285	6.8
24	<i>p</i> -cymen-7-ol	1290	4.6
25	Thymol	1290	2.8
26	Carvacrol	1299	0.4
Aliphatic hydrocarbons			t
Monoterpene hydrocarbons			31.4
Oxygenated monoterpenes			12.6
Aromatic derivatives			52.7
Total number of compound identified			96.7
RI=Retention index; t= trace amount (lesser than 0.05%)			

(6.8%), γ -terpinene (6.1%), *p*-cymen-7-ol (4.6%) and thymol (2.8%) were identified as main compounds besides fifteen minor (0.4-0.05%) and four compounds in trace (<0.05%) amounts.

The volatile aromatic derivatives constitute the major portion (52.7%) of the oil and main compounds were cuminaldehyde (49.4%) and thymol (2.4%) while *o*-cumenol (0.1%) and carvacrol (0.4%) were in minor amounts. The oil was also found to be rich in monoterpene hydrocarbons (31.4%) and contained *p*-cymene (17.4%), β -pinene (6.3%) and γ -terpinene (6.1%)

were as main components followed by oxygenated monoterpenes (12.6%), which contained α -terpinen-7-al (6.8%) and *p*-cymen-7-ol (4.6%) as major compounds. Aliphatic hydrocarbons were found in trace amount (<0.05%) in the oil.

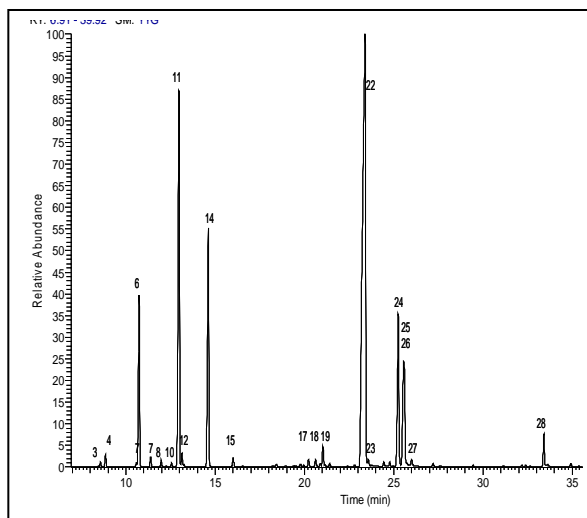


Fig. 1 Total ion chromatogram of the essential oil of *Cuminum cyminum* (cumin) seeds

Comparing the chemical constituents identified in the oil with those reported earlier, results showed considerable quantitative and qualitative variations even among the major compounds identified by the workers from the various countries. Cumin oil in the seeds from western parts of India has been found to contain higher amount of cuminaldehyde than reported from other parts of India, Pakistan, Iran, Turkey, Italy and others but less than Mediterranean and Mexican seeds [1,8-10,13-15,17,19,21,22]. Cuminaldehyde has been found to be a major compound in cumin seed oil except Iranian cumin, which lacked cuminaldehyde [11]. Also comparing the past work on chemical analysis of essential oil, results showed the existence of cuminaldehyde and cuminaldehyde free chemo-types of cumin in nature. This analysis confirmed that the essential oil from cumin seeds of the western parts of India contain higher amount (~49.4%) of cuminaldehyde than reported (~8-20.0%) from other parts of India [22] and thus can be used as rich source of both, essential oil and cuminaldehyde.

Acknowledgment

The author is thankful to the Director, Directorate of Medicinal and Aromatic Plants Research, Anand, Gujarat for providing the facilities.

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