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Chemical composition of essential oil of anise (*Pimpinella anisum*), cumin (*Cuminum cyminum*), fennel (*Foeniculum vulgare*) and parsley(*Petroselinum crispum* Mill.) seeds

Guilles Figueredo[1], Mehmet Musa Özcan[2*], Pierre Chalard[1], Mustafa Mete Özcan[3], Nurhan Uslu[2], Fahad AL Juhaimi[4]

[1]Lexva Analytique 460 rue du Montant 63110 Beaumont FRANCE
[2]Department of Food Engineering, Faculty of Agriculture, University of Selcuk, 42031 Konya, Turkey
[3]Aydoğanlar High Vocational College, Selçuk University, Konya,Turkey
[4]Department of Food Science & Nutrition, College of Food and Agricultural Sciences, King Saud University, Riyadh-Saudi Arabia

Abstract

The essential oils of leave of anise, cumin, fennel and parsley provided from Saudi Arabia were extracted by hydrodistillation, and analysed by GC and GC-MS. The percentage yields of the essential oils from seeds were 0.81%, 1.28%, 0.64 %and 0.52% v/w, respectively. The major constituents varied depending on species. The main components were E-anethole (93.00%), ¥-himachalene (2.85%), methyl chavicol (1.13%) and appiol (0.22%) in anise oil; E-anethole (62.63%), fenchone (13.27%), methyl chavicol (11.19%) and limonene (7.98%) in cumin oil; beta-pinene (36.46%), ¥-terpinene (36.29%), p-cymene (10.43%), terpinene-7-al-¥ (3.48%), sabinene (2.02%) and α-pinene (1.92%) in fennel oil and α-pinene (39.27%), β-pinene (29.61%), limonene (9.73%), myristicin (6.70%), appiol (4.75%), myrtenal (1.82%) and sabinene (1.59%) in parsley oil.

Keywords: anise, cumin, fennel, parsley, seed, essential oil, composition, methyl chavicol (estragol), E-anethole

1. Introduction

Parsley (*Petroselinum crispum* Mill.) is a biennial plant growing to 0.3-0.6 m long. It is frequently used as a garnish or as a flavoring in salads and many cooked dishes and also used for medicinal purposes [1,2]. The dried leaves known as parsley flakes are particularly used in the instant food sector as an ingredient to flavor soups and sausages [3]. Fennel (*Foeniculum vulgare*) is a perennial or annual herbaceous and a typical aromatic plant that grows in several regions all over the world [4,5]. Fennel oil is used in cooking and for correcting less pleasant odours and flavours in oral and medicinal preparations [6,7]. Fennel has been prescribed as a muscle relaxant, a weak diuretic, carminative and a mild stimulant [8].

There are usually considerably variations in the major components of *Foeniculum vulgare* Mill. subsp. *piperitum* (Ucria) Count fruits in north of France were reported to be limonene (52.4 and 56.9 %), piperitenone oxide (21.5 and 14.2%) and γ-terpinene (12.1 and 5.1 %) [9]. In previous investigation on the essential oil of *F. vulgare* subps. *piperitum* fruits, methyl chavicol (47.09 %), limonene (29.07 %), fenchone (13.43 %) and fenchly acetate (exo) (1.95 %) were found to be the major components [10]. Many species of *Pimpinella* L. (Apiaceae) are agronomically important, particularly those with distinctive aromas and flavours. The most widely known and cultivated *Pimpinella* species is *P. anisum* [11,12]. In addition,

Corresponding author: Dr M M Özcan; E-mail: mozcan@selcuk.edu.tr; Tlf:+90.332.2232933; Fax:+90.332.2410108

essential oils of some *Pimpinella* species have been used to treat sedative, antidepressant, carminative, antiseptic, diuretic, mutagenic, pectoral, tonic and stimulant properties [13-15]. Different species of *Pimpinella* can be annuals, biennials and perennials and are generally characterised by the presence of fibrous collars at the top of the root stock [16]. The aim of this study is to determine essential oil compositions of *P.anisum, P.crispum, F.vulgare and C.cyminum* growing wild in Saudi Arabia.

2. Materials and Methods

2.1. Material

Plant fruits (anise, cumin, fennel (sweet) and parsley) were provided from Saudi. The plant was identified by Dr Dural and a voucher specimen (SA1, SA2, SA3 and SA4) was deposited at the herbarium of Selçuk University, Faculty of Agriculture, Department of Food Engineering, in Konya, in Turkey.

2.2. Methods

*Extraction of the essential oil***:**The aerial parts of anise, cumin, fennel (sweet) and parsley plant seeds were extracted by using a Clevenger type apparatus for 4 h. The obtained essential oils (0.81%, 1.28%, 0.64 %and 0.52%, respectively; v/w) were dried over anhydrous sodium sulfate, and stored at -18 ºC until GC/MS analysis.

2.3. Idendification of components

*Analytical GC:*The essential oil were analysed on a Agilent gas chromatograph Model 6890, equipped whith a DB5 MS column (30m X 0,25mm, 0,25µm), programming from 50°C (5 min) to 300°C at 5°C/mn, 5 min hold. Hydrogen as carrier gas (1,0 ml/min); injection in split mode (1 : 60) ; injector and detector temperature, 280 and 300°C respectively. The essential oil is diluted in hexane : 1/30.

*GC-MS Analysis:*The essential oil were analysed on a Agilent gas chromatograph Model 7890, coupled to a Agilent MS model 5975, equipped whith a DB5 MS column (30m X 0.25mm, 0.25µm), programming from 50°C (5 min) to 300°C at 5°C/mn, 5 min hold. Helium as carrier gas (1,0 ml/min) ; injection in split mode (1 : 100); injector and detector temperature, 250 and 280°C respectively. The MS working in electron impact mode at 70 eV ; electron multiplier, 1200 V ; ion source temperature, 230°C ; mass spectra data were acquired in the scan mode in *m/z* range 33-450. The essential oil is diluted in hexane : 1/30. The components were identified by comparing linear Kovats indices, their retention times and mass spectra with those obtained from the authentic samples and/or the MS library. The library search was carried out using a Wiley GC/MS Library of Essential Oil Constituents. The percentage composition of the essential oil was computed from GC peak areas without correction factors. Qualitative analysis was based on a comparison of retention times and mass spectra with corresponding data in the literature [17]. Results of the research were analysed for statistical significance by analysis of variance [18].

3.Results and discussion

The oil yields of the aerial parts of anise, cumin, fennel (sweet) and parsley were 0.81%, 1.28%, 0.64 % and 0.52%, v/w, respectively. A total of 18, 19, 22 and 24 compounds which account for about 99.70%, 99.95%, 99.26 % and 99.48 % of the essential oils of anise, cumin, fennel and parsley, respectively. The oil was colourless to pale-yellow in colour. The essential oils analysed by GC/MS for determination of their components and results are given in Table 1 as a relative peak area of each constituent. More than 90% of the studied essential oils constituents were identified. It seems that there were partly similarities among chemical compositions of the four essential oils. In some of essential oils, the main constituents accounted for more than 60% of total oil, e.g., anise and fennel (E-anethole 93.00% and 62.63%, respectively). The main components were E-anethole (93.00%), gamma-himachalene (2.85%), methyl chavicol (1.13%) and appiol (0.22%) in anise oil; E-anethole (62.63%), fenchone (13.27%), methyl chavicol (11.19%) and limonene (7.98%) in cumin oil; beta-pinene (36.46%), gamma-terpinene (36.29%), p-cymene (10.43%), terpinene-7-al-gamma (3.48%), sabinene (2.02%) and alpha-pinene (1.92%) in fennel oil and alpha pinene (39.27%), beta-pinene (29.61%), limonene (9.73%), myristicin (6.70%), appiol (4.75%), myrtenal (1.82%) and sabinene (1.59%) in parsley oil. Romeilah et al. (18) reported that parsley oil contained 18.23% apiol, 16.16% alpha-pinene, 11.16% beta-pinene and 3.23% limonene. Arslan et al. [19] determined that essential oil content of *P.anisum* leave varied from 1.3 to 3.7%.

Table 1. Essential oil composition of some aromatic plant seeds (%)[a]

RT	KI	Components	Anise	Cumin	Fennel	Parsley
5.31	925	α-thujene	-	0.74±0.09[b]	-[c]	0.39±0.03
5.47	931	α-pinene	0.05±0.01*	1.92±0.013	0.56±0.07	39.27±0.69
5.78	947	Camphene	-	-	0.09±0.01	0.29±0.03
6.25	972	Sabinene	-	2.02±0.03	0.16±0.03	1.59±0.09
6.35	976	β-pinene	-	36.46±0.89	0.11±0.01	29.61±0.78
6.58	992	Myrcene	-	2.26±0.21	0.43±0.07	0.73±0.03
6.87	1005	α-phellandrene	-	0.79±0.09	0.07±0.01	-
6.91	1011	δ-3-carene	-	0.10±0.01	-	-
7.07	1018	α-terpinene	-	0.24±0.03	-	-
7.22	1026	p-cymene	-	10.43±0.17	0.15±0.03	1.07±0.09
7.37	1030	eucalyptol	-	0.39±0.03	0.17±0.01	-
7.30	1031	Limonene	-	0.75±0.07	7.98±0.67	9.73±0.56
7.31	1032	β-phellandrene	-	0.58±0.03	0.43±0.09	0.61±0.09
7.42	1040	Z-β-ocimene	-	-	0.47±0.03	-
7.60	1050	E-β-ocimene	-	-	0.03±0.01	-
7.82	1057	γ-terpinene	-	36.29±0.47	0.17±0.03	1.23±0.24
8.28	1088	terpinolene	-	0.08±0.01	-	-
8.36	1087	fenchone	-	-	13.27±0.38	-
8.57	1100	linalool	0.27±0.01	-	-	-
9.30	1144	camphre	-	-	0.21±0.03	-
9.43	1159	pentylbenzene	-	-	-	0.10±0.01
9.45	1160	pentylcyclohexadiene	-	-	-	0.17±0.03
9.83	1174	Terpinen-4-ol	-	0.06±0.01	-	-
10.05	1193	myrtenal	-	-	-	1.82±0.17
10.08	1195	Methyl chavicol	1.13±0.11	-	11.19±0.38	-
10.09	1196	p-menth-3-en-7-al	-	0.34±0.09	-	-
10.26	1198	estragol	-	-	0.10±0.01	-
10.55	1217	Acetate de fenchyl exo	-	-	0.13±0.01	-
10.75	1239	cuminaldehyde	-	2.45±0.13	0.55±0.09	-
10.85	1251	Z-anethole	0.21±0.03	-	0.14±0.01	-
10.90	1253	anisaldehyde	0.19±0.01	-	0.22±0.03	-
11.40	1283	E-anethole	93.00±0.36	-	62.63±0.29	-
	1287	α-terpinene-7-al	-	0.58±0.09	-	-
11.43	1290	Terpinene-7-al-γ	-	3.48±0.17	-	-
12.15	1339	δ-elemene	0.08±0.01	-	-	0.10±0.01
12.58	1380	daucene	-	-	-	0.09±0.01
	1391	β-elemene	0.06±0.01	-	-	-
13.11	1418	β-caryophyllene	-	-	-	0.13±0.01
13.49	1446	Sesquisabinene B	-	-	-	0.16±0.01
13.51	1450	α-himachalene	0.30±0.03	-	-	-
13.86	1479	γ-himachalene	2.85±0.19	-	-	-
13.90	1480	Germacrene-D	0.10±0.01	-	-	-
13.97	1486	β-selinene	-	-	-	0.54±0.03
	1489	zingiberene	0.32±0.03	-	-	-
13.99	1493	Methyl-(E)iso-eugenol	0.04±0.01	-	-	-
14.05	1494	α-selinene	-	-	-	0.09±0.01
14.11	1499	β-himachalene	0.18±0.03	-	-	-
14.18	1508	β-bisabolene	0.21±0.02	-	-	-
14.17	1509	Z-α-bisabolene	-	-	-	0.06±0.01
14.34	1520	myristicin	0.08±0.01	-	-	6.70±0.17
14.61	1554	elemicin	-	-	-	0.19±0.01
15.31	1594	carotol	-	-	-	0.07±0.01
16.08	1681	appiole	0.22±0.03	-	-	4.75±0.13
17.72	1823	Pseudoisoeugeyl 2-methylbutyrate -E	0.43±0.07	-	-	-
		Total	99.70	99.95	99.26	99.48

[a]Compound listed in the order of elution from a HP-5MS column.
[b]Each compound is mean of two values
[c]non-identified
*mean±standard deviation (n:3)

The major compounds of *Pimpinella tirupatiensis* are beta-bisabolene (9.2%), delta-3-carene (8.9%), cis-carveol (6.7%), elemol (5.8%), delta-cadinol (4.4%), methyl-geranate (4.3%) and gamma-nonalactone (3.4%) [20]. The major component of the essential oil of *P.anisum* was trans-anethole (78.63-95.21%) [19]. Başer et al. [21] reported that cumin seed oil contained 19.25-27.02% cuminaldehyde, 7.06-14.10% alpha-terpinene, 4.61-12.01% p-cymene and 2.98-8.90% beta-pinene. Arslan et al. [22] reported the percentage of anethole to be 86 to 88% in sweet fennel oil and 74% in bitter fennel oil while limonene was only 4 and 2% respectively in sweet and bitter fennel oil. These results are in agreement with many authors like the following; the E-anethole was found as the main component in anise and fennel oils [23]; the main compound of parsley seeds was α-pinene in cumin oil was determined as a dominant compound [21,24,25]. It was reported that the chemical composition of oils are very variable according to harvest years. The environmental conditions and nutritional status of the plant caused to this fact.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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