Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(1): 113-116
Received: 19-11-2016
Accepted: 20-12-2016

Omnia Mahmoud Hassan
Sudan Academy of Science, Khartoum, Sudan

Itmad Awad Elhassan
Industrial Research and Consultancy Centre, Khartoum, Sudan

Correspondence
Omnia Mahmoud Hassan
Sudan Academy of Science, Khartoum, Sudan

Characterization of essential oils from fruits of umbelliferous crop cultivated in Sudan II. *Coriandrum sativum* L. (Coriander) and *Foeniculum vulgare* Mill (Fennel)

Omnia Mahmoud Hassan and Itmad Awad Elhassan

Abstract
Some of the plant families known as excellent sources of essential oils; Umbelliferae (Apiaceae) is one of them. The objective of this study is to give an overview about content and constituents of oils from two umbelliferous crops, *Coriandrum sativum* L. and *Foeniculum vulgare* Mill, cultivated in Sudan. The essential oils from the samples were obtained by hydro-distillation and analyzed by GC-MS for identification of their chemical composition. The essential oil content of *C. sativum* fruits was 0.8% (v/w). About 97% of the present investigated coriander oil was monoterpenes, 87% of which were oxygenated. No sesquiterpenes were detected in the oil. The major constituents identified were linalool (64.61%) α-pinene (5.94%), (+)-2-bornanone (4.73%), α-terpinolene (6.79%), α-pinene (5.94%), and geranyl acetate (2.46%). Composition of the essential oil from coriander cultivated in Sudan resembled the composition of previously investigated essential oils from coriander world-wise in term of linalool domination. The essential oil content of *F. vulgate* fruits was 0.8% (v/w). Nineteen compounds were detected in the oil. Monoterpenes comprises the main constituents (98.06%), among which (80.67%) were oxygenated, whereas sesquiterpenes represent only about (0.66%) of the oil. Estragole (68.96%), D-limonene (15.41%) and anethole (8.51%) were the main identified constituents. According to the present research findings, *F. vulgare* cultivated in Sudan could be classified as estragole chemotype.

Keywords: *C. sativum*, *F. vulgate*, anethole, estragole

1. Introduction
Some of the plant families known as excellent sources of essential oils; Umbelliferae (Apiaceae) is one of them. The family is rich in secondary metabolites and embodies numerous genera of high economic and medicinal value. Numerous compounds, belonging to different chemical classes, have been isolated from essential oils of umbelliferous crops [1-4]. Many umbelliferous crop have medicinal uses for gastrointestinal complaints, cardiovascular ailments, and as stimulants [5].

Coriandrum sativum L. (Coriander) is an annual herb native to the temperate regions of Europe and Asia. The composition of the essential oil of coriander fruits in some of the world has been studied and found differ from each other. Linalool was reported as major constituent. The essential oils from fruits of *C. sativum* L. from Bangladesh contained linalool (37.7%), geranyl acetate (17.6%) and γ-terpinene (14.4%) as the major compounds [6].

The yield and composition of hydrodistilled essential oils from seventeen samples of coriander seeds from different European countries (France, Estonia, Hungary, Holland, Russia, Greece, Moldavia, Armenia, Germany, Czech, Austria, Turkey and Britain) were investigated. The yields of essential oil was variable (1 - 52 ml/kg), but the major constituent in the oils was linalool (58.0-80.3%) [7]. All parts of *C. sativum* herb are in use as flavoring agent and/or as traditional remedies for the treatment of different disorders in the folk medicine systems of different civilizations. *C. sativum* seed extract is used as a traditional medicine for diabetic patients [8]. Stimulation of insulin secretion from colon B- cell line was observed [9]. Also the crude aqueous and hydro-alcoholic extracts of the *C. sativum* seeds showed anthelmintic activities [10].

C. sativum fruit essential oil has been reported to inhibit a broad spectrum of micro-organisms [11-14].

Foeniculum vulgare (Fennel) is mainly cultivated in Europe as an annual vegetable for its edible bulbous leaf base. A perennial form of fennel is also grown as a herb (for its leaves and seeds). Both are slightly sensitive to frost and best adapted to a Mediterranean climate [15].

F. vulgare essential oil composition varies according to origin. The main compounds detected in *F. vulgare* oil from Portugal were fenchone (16.9–34.7%), estragole (2.5–66.0%) and trans-anethole (7.9–77.7%) [16]. Essential oils of the fruits of two cultivars of Egyptian fennel (*F. vulgare* var. *azoricum*, and *F. vulgare* var. *dulce*) were dominated by *trans-Anethole* (46.26-61.11%) followed by Limonene (12.53-27.78%) [17]. The main constituents of the fennel oil from Iran were *trans*-anethole (49.64%), Fenchyl acetate (14.21%), estragole (8.67%), fenchone (6.37%) and limonene (4.23%) [18]. Fennel essential oil from Indonesia contained anethole (52.38%), estragole (21.37%), and α-fenchone (15.74%) as main constituents [19]. In essential oil of *F. vulgare* from Serbia, *trans*-anethole was dominant (83.43%) followed limonene (9.34%) [20].

F. vulgare fruits and essential oil have antispasmodic, diuretic, anti-inflammatory, analgesic, hepatoprotective and antioxidant effects [21-24]. *F. vulgare* essential oil exhibited antibacterial and antifungal activity against food spoilage bacteria and fungi [16, 25]. The objective of this was characterization of essential oils from fruits of *Coriandrum sativum* L. and *Foeniculum vulgare* Mill. Cultivated in Northern Sudan

2. Materials and Methods

2.1 Materials

Coriandrum sativum L. and *Foeniculum vulgare* Mill fruits were brought from Nile Province (Northern Sudan) schemes in Feb.-March/2016.

2.2 Essential oil isolation

One hundred grams of each provided herbal sample were subjected to hydrodistillation for 4 h using Clevenger's apparatus. The distilled essential oil was dried over anhydrous sodium sulphate, filtered and stored in a sealed vial at 4 °C. The yield of the oil (v/w %) was calculated based on the plant dry matter.

2.3 GC-MS analysis of the oils

The essential oils were analyzed by gas chromatography coupled with mass spectrometry (GC-MS-QP-2010 Plus-SHIMADZU). The sample was dissolved in dichloromethane (1%) and injected at 250 °C (injector temperature) into a capillary column type HP-1(30 m X 0.25 mm i.d, 0.25 µm film thickness, stationary phase (95% diethyl-5% diphenylsiloxane), using helium as a carrier gas at a flow rate of 1.2 ml/min. The injected volume was 1 µl and the injection mode used was split (split ratio 300), the injection temperature was 250 °C. The oven temperature was raised from 35 °C (hold for 3 min) to 240 °C at the rate of 5 °C/min, then at the rate of 3 °C/min, raised to 280 °C, hold for 3 min. Interface temperature was 250 °C; the ion source temperature was 200 °C. The start time was 4 min and the end time was 61.33 min. The mass and scan range was set at *m/z* 35-800.

2.4 Identification of components

The essential oils constituents were identified by their retention time and computer matching of their mass spectra with those found in NIST and Wiley libraries database.

3. Results and Discussion

The essential oil content, prepared by hydrodistillation from *C. sativum* fruits, was found to be 0.8% (v/w). The obtained oil was pale yellow liquid, bearing the characteristic aromatic odor of coriander. The refractive index and specific gravity of the prepared coriander oil were 1.46268 and 0.876 respectively, at 27 °C. Investigation of the chemical constituents of the coriander oil by GC-MS revealed detection of twenty six compounds, their percentage are illustrated in Table (1).

Table 1: Essential oil composition of *C. sativum* essential oil

Peak	Retention Time	Compound	Area%
1	10.819	***α***-pinene	5.94
2	11.312	Camphene	0.77
3	12.182	***β***-Phellandrene	0.31
4	12.269	***β***-Pinene	0.52
5	12.791	***β***-Myrcene	0.80
6	13.910	Cymene	1.07
7	14.031	D-Limonene	1.75
8	15.039	***α***-Terpinene	6.79
9	15.573	1-octanoL	0.38
10	15.968	***α***-Terpinolene	0.43
11	16.571	Linalool	64.61
12	17.806	(+)-2-bornanone	4.73
13	17.989	Citronellal	0.91
14	18.516	BorneolL	0.26
15	18.815	4-Terpineol	0.40
16	19.246	***α*** - Terpineol	0.42
17	19.536	n-decanal	0.38
18	20.261	***β***-citronellol	0.60
19	21.019	Geraniol	1.72
20	21.169	2-Decenal	0.17
21	21.958	Anethole	1.33
22	24.442	Geranyl acetate	2.46
23	26.611	2-Dodecenal	0.18
24	33.561	Tetradecanoic acid	2.04
25	35.193	1-E-propenyl-4-methoxypheny 2-methylbutanoate	0.28
26	37.561	Hexadecanoicacid	0.74

About 97% of the present investigated coriander oil was monoterpenes, 87% of which were oxygenated. No sesquiterpenes were detected in the oil (Fig.1).

The dominant oxygenated monoterpene was linalool (64.61%). The other major constituents were α-pinene (5.94%), (+)-2-bornanone (4.73%), α-terpinolene (6.79%), α-pinene (5.94%), and geranyl acetate (2.46%). Composition of the essential oil from coriander cultivated in Sudan resemble the composition of previously investigated essential oils from coriander world-wise in term of linalool domination and presence of α-pinene, terpinene and geranyl acetate in appreciable quantities.

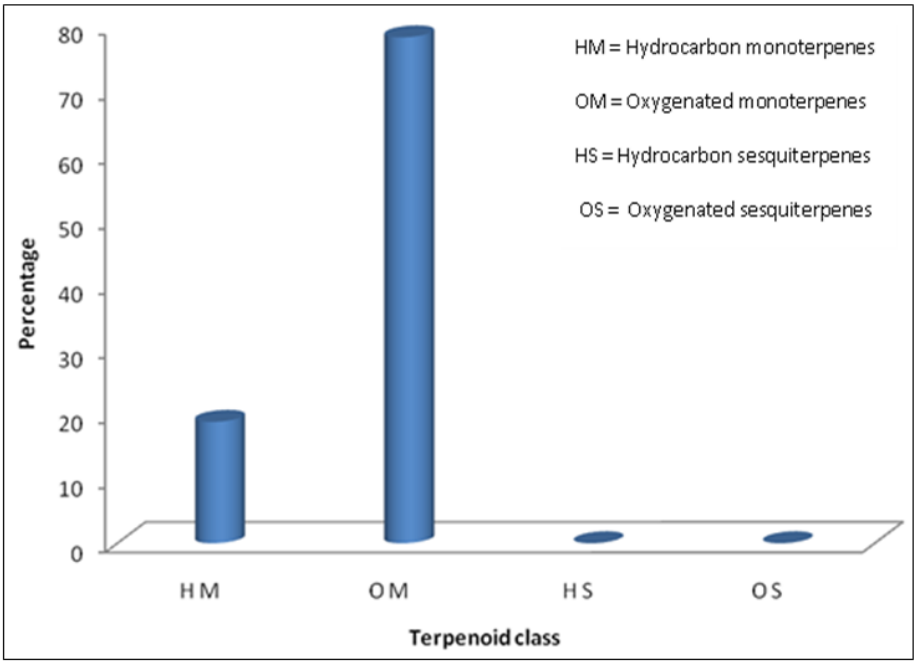

Fig 1: Terpenoidal composition of *C. sativum* essential oil

The hydrodistilled *F. vulgate* (fennel) fruits essential oil content was found to be 0.8% (v/w). The oil obtained was pale yellow liquid, bearing the characteristic aromatic odor of fennel. The refractive index and specific gravity of prepared fennel oil were1.51989 and 0.965, respectively, at 27 ºC.

The gas chromatogram showed detection of nineteen compounds in the oil, their abundance are shown in Table (2). Monoterpenes comprises the main constituents (98.06%), among which (80.67%) were oxygenated, whereas sesquiterpenes represent only about (0.66%) of the oil (Fig.2).

Table 2: Essential oil composition of *F. vulgare* essential oil

Peak	Retention time	Compound	Area, %
1	10.766	-pinene***α***	0.62
2	12.135	***β***-phellandrene	0.19
3	12.742	***β***-myrcene	0.10
4	13.858	o-cymene	0.74
5	13.998	D-limonene	15.41
6	14.070	Eucalyptol	0.20
7	14.294	Trans-β-ocimene	0.12
8	14.971	***α***-Terpinene	0.21
9	15.926	D-Fenchone	1.50
10	17.484	Limonene oxide	0.58
11	19.464	Estragole	68.96
12	19.651	Unidentified	0.27
13	20.701	Carvone	0.65
14	21.907	Anethole	8.51
15	30.474	Dill-apiole	0.25
16	31.546	***β***-elemol	0.25
17	36.531	Unidentified	0.16
18	37.498	Hexadecanoic acid	0.41
19	40.797	9-hexadecenal	0.86

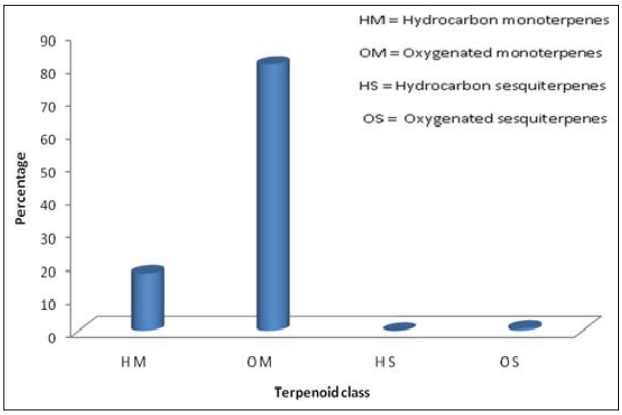

Fig 2: Terpenoidal composition of *F. vulgare* essential oil

The major constituent identified in fennel oil in the present study was estragole (68.96%), followed by D-limonene (15.41%) and anethole (8.51%), in contrast to previously investigated fennel oil, world-wise, in which the major detected compound was anethole. Four chemotypes were described for *F. vulgare* essential oil, namely anethole; estragole; anethole/estragole and anethole/fenchone [16]. Chemical polymorphism is characteristic of this species and several factors such as climatic and environmental conditions, harvesting season and the stage of seed ripening can influence the content of essential oil and its composition in fennel [26, 27]. According to the present research findings, *F. vulgare* cultivated in Sudan could be classified as estragole chemotype.

4. Conclusion

The dominant constituent in essential oil of *C. sativum* (coriander) cultivated in Northern Sudan was linalool (64.61%), whereas *F. vulgare* essential oil contained estragole as the main constituent (68.96) and thus could be classified as estragole-chemotype.

5. References

1. Rechinger KH. Family Umbelliferae. In Flora Iranica Akademische Drucku. Verlagsanstalt, Graz, Austria. 1972, 162.
2. Margaris N, Koedam A, Vokou D. (eds.). Aromatic Plants: Basic and Applied Aspects. Martinus Nijoff Publishers, the Haghue/Boston/London. 1982, 165-173.
3. Heywood VH. The biology and chemistry of the Apiaceae. The Linnean Society of London, London. 1999.
4. Ebadollahi A. Plants Essential Oils from Apiaceae Family as Alternatives to Conventional Insecticides. Ecologia Balkanica. 2013; 5(1):149-172.
5. Heywood VH, Brummitt RK, Culham A, Seberg O. Apiaceae. In: Flowering Plant Families of the World. New York. 2007, 35-38.
6. Bhuiyan NI, Begum J, Sultana M. Chemical composition of leaf and seed essential oil of *Coriandrum sativum* L. from Bangladesh. Bangladesh J Pharmacol. 2009; 4:150-153.
7. Raal A, Orav A, Arak E. Essential Oil Composition of *Coriandrum sativum* L. Fruits from Different Countries. Journal of Essential Oil Bearing Plants. 2011; 14(1):118-123.
8. Deepa B, Anuradha CV. Antioxidant potential of *coriander sativum L* seed extract. Journal of Experimental Biology. 2011; 49:30-38.
9. Gray AM, Flatt PR. Insulin-releasing and insulin-like activity of the traditional anti-diabetic plant *Coriandrum sativum* (coriander). Journal of Nutrition. 1999; 81(3):203-209.
10. Debella A, Feleke A, Makonnen E, Tilahun G, Eguale T. *In vitro* and in vivo anthelmintic activity of crude extracts of *Coriandrum sativum* against Haemonchus contortus. Journal of Ethnopharmacology. 2007; 110:428-433.
11. Delaquis PJ, Stanich K, Girard B, Mazza G. Antimicrobial activity of individual and mixed fractions of dill, cilantro, coriander and eucalyptus essential oils. International Journal of Food Microbiology. 2002; 74:101-109.
12. Duman AD, Telci I, Dayisoylu KS, Digrak M, Demirtas I, Alma MH. Evaluation of bioactivity of linalool-rich essential oils from Ocimum basilucum and Coriandrum sativum varieties. Natural Product Communications. 2010; 5:969-974.
13. Lo Cantore P, Iacobellis NS, De Marco A, Capasso F, Senatore F. Antibacterial activity of *Coriandrum sativum* L. and *Foeniculum vulgare* Miller Var. vulgare (Miller) essential oils. Journal of Agricultural and Food Chemistry. 2004; 52:7862-7866.
14. Silva F, Ferreira S, Queiroz JA, Domingues FC. Coriander (*Coriandrum sativum* L.) essential oil: its antibacterial activity and mode of action evaluated by flow cytometry. Journal of Medical Microbiology. 2011; 60:1479-1486.
15. EPPO (European and Mediterranean Plant Protection Organization) Standards. Guidelines on good plant protection practice- Umbelliferous crops, EPPO Paris, France. 2000.
16. Silva LA, Mota AS, Martins MR, Arantes S, Lopes VR, Bettencourt E. *et al.* Antimicrobial Activity and Chemical Composition of the Essential Oils of Portuguese *Foeniculum vulgare* Fruits, Natural Product Communications. 2015; 10(4):673-676.
17. Saleh MA, Shahat AA, Ibrahim AY, Hendawy SF, Omer EA, Hammouda FM. *et al.* Chemical Composition, Antimicrobial and Antioxidant Activities of Essential Oils from Organically Cultivated Fennel Cultivars. Molecules. 2011; 16:1366-1377.
18. Moghtader M. Comparative survey on the essential oil composition from the seeds and flowers of *Foeniculum vulgare* Mill. From Kerman province. Journal of Horticulture and Forestry. 2013; 5(3):37-40.
19. Setyawan E, Damayanti A. Essential Oil Extraction of Fennel Seed (*Foeniculum vulgare*) Using Steam Distillation. International Journal of Science and Engineering. 2012; 3(2):12-14.
20. Acimovic M, Tesevic V, Todosijevic M, Djisalov J, Oljaca S. Compositional characteristics of the essential oil of *Pimpinella anisum* and *Foeniculum vulgare* grown in Serbia. Botanica Serbica. 2015; 39(1):09-14.
21. Choi EM, Hwang JK. Antiinflammatory, analgesic and antioxidant activities of the fruit of *Foeniculum vulgare.* Fitoterapia. 2004; 75(6):557-565.
22. Misharina TA, Polshkov AN. Antioxidant properties of essential oils: autoxidation of essential oils grom laurel and fennel and effects of mixing with essential oil from coriander. Prikladnaia Biokhimiia Mikrobiologiia. 2005; 41(6):693-702.
23. Parejo I, Viladomat F, Bastida J, Rosas-Romero A, Flerlage N, Burillo J. *et al.* Comparison between the radical scavenging activity and antioxidant activity of six distilled and nondistilled mediterranean herbs and aromatic plants, Journal of Agricultural and Food Chemistry. 2002; 50(23):6882-680.
24. Ozbek H, Ugras S, Dulger H, Bavram I, Tuncer I, Ozturk G. *et al.* Hepatoprotective effect of *Foeniculum vulgare* essential oil. Fitoterapia. 2003; 74(3):317-319.
25. Gulfraz M, Mehmood S, Minhas N, Jabeen N, Kausar R, Jabeen K. *et al.* Composition and antimicrobial properties of essential oil of *Foeniculum vulgare*. African Journal of Biotechnology. 2008; 7(24):4364-4368.
26. Bernath J, Nemeth E, Petheo F, Mihalik E, Kalman K, Franke R. Regularities of the essential oil accumulation in developing fruits of fennel (*Foeniculum vulgare* Mill.) and its histological background, Journal of Essential Oil Research. 1999; 11:431-438.
27. Piccaglia R, Marotti M. Characterization of some Italian types of wild fennel (*Foeniculum vulgare* Mill.). Journal of Agricultural and Food Chemistry. 2001; 49(1):239-244.