Dynamic Headspace GC-MS Analysis of the Essential Oil of Indian *Coriandrum sativum* Fruits

Kamal K. Pande [1], Lata Pande [2], Bharat Pande [3] , Atul Pujari [4], Pankaj Sah [5,6] and Stuti Sah [7]

[1, 4] Department of Biotechnology, MB Post Graduate College, Haldwani, Kumaun University, Nainital, Uttarakhand (India)
[2] Foods and Nutrition Lab, Department of Home Science, Kumaun University, Nainital, Uttarakhand State 263002, (India)
[3] Department of Chemistry, MB Post Graduate College, Haldwani, Kumaun University, Nainital, Uttarakhand State, (India)
[5] Department of Botany, DSB Campus Kumaun University, Nainital, Uttarakhand State 263002, (India)
[6] Department of Applied Sciences, Higher College of Technology, PO Box 74, PC 133, Al-Khuwair, Muscat (Sultanate of Oman)
[7] Department of Microbiology, College of Basic Sciences and Humanities, GB Pant University of Agriculture Science and Technology, Pant Nagar Uttarakhand State (India)
kemscience@gmail.com, pankaj@hct.edu.om, drpankajsah1@gmail.com

Abstract: The fruits of coriander are alterative, antbilious, antispasmodic, aphrodisiac, appetizer, aromatic, carminative, diaphoretic, diuretic, refrigerant, stimulant, stomachic and tonic. It contains an essential oil (up to 1%) constituted mainly linalool (60—70%), other monoterpenoids are (citronellol, geraniol, myrcene, α-and γ -terpinene, limonene, α-phellandrene and β-phellandrene, *p*-cymene, and β-pinene, borneol and camphor) and fatty acids. Present study shows 70.11% β-linalool, 6.63% geraniol acetate of total gc area. This study reports 29 main volatile compounds by dynamic headspace gc-ms analysis and most abundant being limonene oxide (38.67%). [Kamal K Pande, Lata Pande, Bharat Pande, Atul Pujari, Pankaj Sah and Stuti Sah. Dynamic Headspace GC-MS Analysis of the Essential Oil of Indian *Coriandrum sativum* Fruits.
[Kamal K. Pande, Lata Pande, Bharat Pande, Atul Pujari, Pankaj Sah and Stuti Sah. **Dynamic Headspace GC-MS Analysis of the Essential Oil of Indian *Coriandrum sativum* Fruits.** *Rep Opinion* 2016;8(8):19-22]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). http://www.sciencepub.net/report. 4. doi:10.7537/marsroj080816.04.

Keywords: Coriandrum sativum; Essential oil; Dynamic head space GC-MS analysis

1. Introduction:

The plant of *Coriandrum sativum* grows to a height of 2 feet with a spread of 9 inches. The bright, green leaves are fan shaped and become more feathery towards the top of the plant. The flowers, which bloom from mid- to late summer, are small and white, formed in umbel-like clusters. The flowers are hermaphrodite (have both male and female organs) and are pollinated by Insects. The plant is self-fertile. It is noted for attracting wildlife. The plant prefers light (sandy) and medium (loamy) soils and requires well-drained soil. The plant prefers acid, neutral and basic (alkaline) soils and can grow in very alkaline soil.

The fruit has been used as a drug for indigestion, against worms, and as a component of embrocations for rheumatism and pains in the joints. The fruits of coriander are: alterative, antibilious, antispasmodic, aphrodisiac, appetizer, aromatic, carminative, diaphoretic, diuretic, refrigerant, stimulant, stomachic, tonic [1].

Fresh leaves are pungent and aromatic. The essential oil of coriander stimulates the secretion of gastric juices and is a carminative and spasmolytic; in vitro it has antibacterial and antifungal effects [2], [3]. It contains an essential oil (up to 1%) constituted of (3*S*)-linalool (main, 60—70%), other monoterpenoids (citronellol, geraniol, myrcene, α-and gamma -terpinene, limonene, α-phellandrene and β-phellandrene, *p*-cymene, and β-pinene, borneol, and camphor), and fatty acids (oleic, linolenic, and palmitic acids *etc.*) [4].

Ishikawa *et al* investigated water-soluble constituents of spices, and showed the relationship between the essential oil and the water-soluble constituent [25]. Toru *et. al.* separate two monoterpenoid triols, seven monoterpenoid glycosides, three norcarotenoid glucosides, an aromatic compound, seven aromatic compound glycosides, two alkyl glucosides, eight glucides, uracil, and two nucleosides [5],[6].

Linalool (59.6-71.6%) has been reported as the main constituent of the essential oil of coriander fruits [7], [8].

Fifteen main volatile compounds in *Coriandrum sativum* L. were separated and identified by headspace SPME-GC-MS analysis The main compounds in headspace of *Coriandrum sativum* L. identified by mass spectrometry included decanal, 2-

decenal, 1-decanol,*trans*-2-decen-1-ol,*trans*-2-decen-1-al,*trans*-2-tridecenal etc [9].

The essential oils composition of coriander (*Coriandrum sativum* L.) fruits obtained by hydrodistillation was studied at three stages of maturity by GC–FID and GC–MS. Essential oil yields showed marked increase during maturation process and forty one compounds were identified. Geranyl acetate (46.27%), linalool (10.96%), nerol (1.53%) and neral (1.42%) were the main compounds at the first stage of maturity (immature fruits). At the middle stage, linalool (76.33%), *cis*-dihydrocarvone (3.21%) and geranyl acetate (2.85%) were reported as the main constituents. Essential oils at the final stage of maturity (mature fruits) consist mainly on linalool (87.54%) and *cis*-dihydrocarvone (2.36%). Additionally, accumulation of monoterpene alcohols and ketones was observed during maturation process of coriander fruit [10].

Biological Activity:

Coriander *Coriandrum sativum* L. (Umbelliferae) were found to possess bactericidal activity against *Salmonella choleraesuis* ssp. *choleraesuis* ATCC 35640. (2*E*)-Dodecenal (C_{12}) was the most effective against this food-borne bacterium with the minimum bactericidal concentration (MBC) of 6.25 µg/mL (34 µM), followed by (2*E*)-undecenal (C_{11}) with an MBC of 12.5 µg/mL (74 µM). The time−kill curve study showed that these α,β-unsaturated aldehydes are bactericidal against *S. choleraesuis* at any growth stage and that their bactericidal action comes in part from the ability to act as nonionic surfactants [11] .

Essential oils were extracted from the fruits of *Coriandrum sativum L.* assayed in vitro for antibacterial activity to *Escherichia coli* and *Bacillus megaterium*, bacteria routinely used for comparison in the antimicrobial assays, and 27 phytopathogenic bacterial species and two mycopathogenic ones responsible for cultivated mushroom diseases. A significant antibacterial activity, as determined with the agar diffusion method, was shown by *C. sativum* essential oil [12].

Table 1: Chemical composition (%) of Coriandrum satvium (seed) by dynamic hs/gc-ms

Pk	RT	Area %	Common Name	Method of Identification
1.	3.696	0.50	dehydroquinate	a,b
2.	4.663	0.36	n-hexanal	a,b
3.	8.603	17.10	(r)-α-pinene	a,b
4.	9.105	0.58	camphene	a,b
5.	10.060	3.59	α-tricyclene	a,b
6.	10.655	0.30	β-pinene	a,b
7.	11.145	0.12	n-caprylaldehyde	a,b
8.	11.488	0.18	terpinolene	a,b
9.	11.961	38.67	limonene oxide	a,b
10.	12.887	0.25	γ-terpinen	a,b
11.	13.342	0.65	trans-sabinenhydrate	a,b
12.	13.441	0.75	3-norcarene	a,b
13.	13.843	0.21	2-carene	a,b
14.	14.001	0.22	cis-linalool oxide	a,b
15.	14.467	27.18	cyclofenchene	a,b
16.	15.096	0.21	(+)-3-carene	a,b
17.	15.673	3.45	camphor	a,b
18.	16.507	0.51	borneol	a,b
19.	16.763	0.46	γ-terpinen	a,b
20.	17.136	0.65	α-terpineol	a,b
21.	17.218	2.05	α-terpineol	a,b
22.	17.527	0.40	α- terpinolen	a,b
23.	21.327	0.12	limonene oxide	a,b
24.	22.405	0.97	3-careen	a,b
25.	22.697	0.05	n-tetradecane	a,b
26.	23.332	0.07	β-cis-caryophyllene	a,b
27.	24.888	0.09	d-germacrene	a,b
28.	25.023	0.09	β-selinene	a,b
29.	26.870	0.18	α-farnesene	a,b

a = Retention Index; b = MS (GC-MS) Library

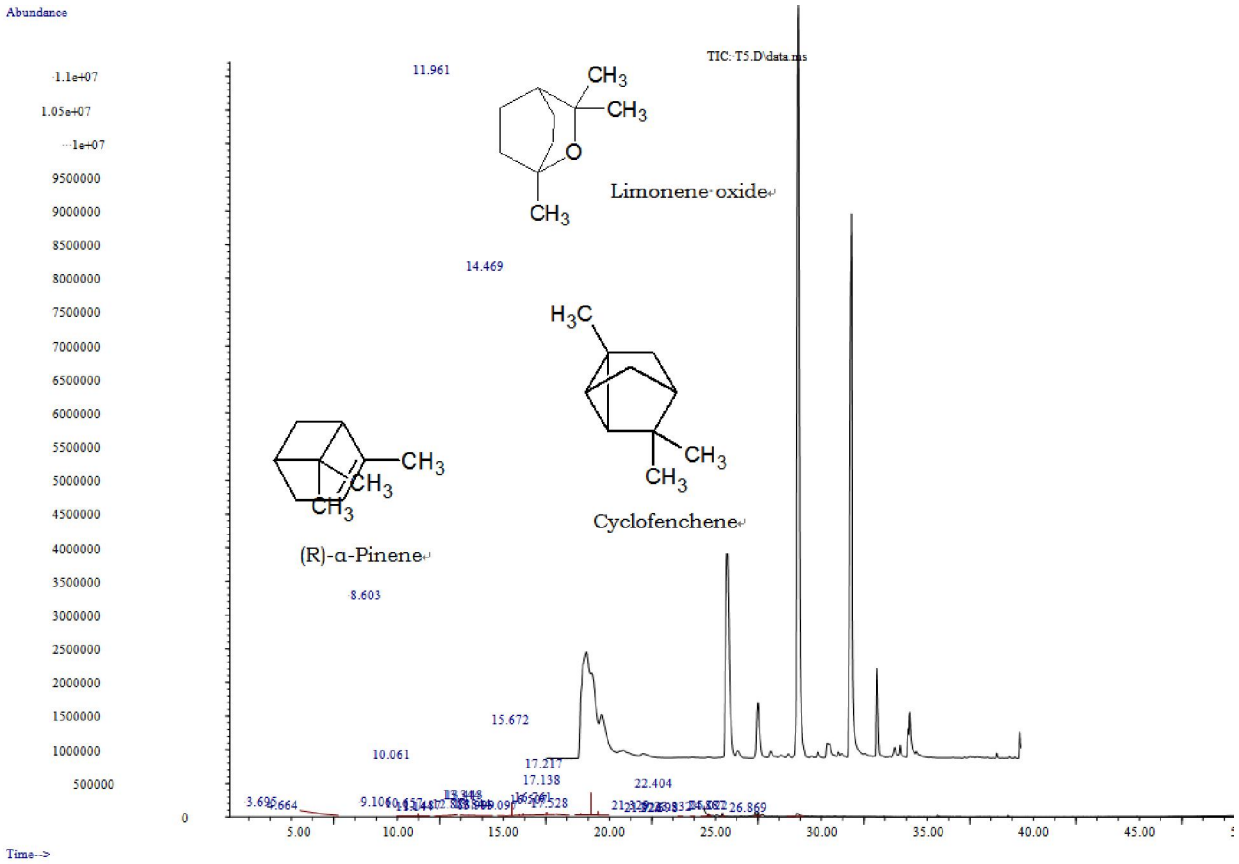

Figure 1: Dynamic headspace gc of essential oil of *Coriandrum satvium* (seed).

The effect of coriander seeds (*Coriandrum sativum*) on carbohydrate metabolism was studied in rats fed a high fat cholesterol diet. The spice showed significant hypoglycemic action. There was an increase in the concentration of hepatic glycogen as was evident from the increased activity of glycogen synthase. Activity of glycogen phosphorylase, and gluconeogenic enzymes, revealed decreased rates of glycogenolysis and gluconeogenesis. The increased activities of glucose-6-phosphate dehydrogenase and glycolytic enzymes suggest the utilization of glucose by the pentose phosphate pathway and glycolysis [13].

2. Material and Methods

Dynamic Headspace GC-MS Analysis

The whole aerial parts of fresh coriandrum satvium were shade dried and crushed to powder. One gram of powdered material was taken for dynamic headspace gc-ms analysis. Head space (hs) gc-ms of coriandrum satvium revealed the presence of twenty nine volatile organic components and all of them were identified by comparing their mass spectra with ms library except one. The dominant component of the oil is a monoterpene hydrocarbon. The monoterpene hydrocarbons, oxygenated monoterpenes, aldehydes, sesquiterpenes and unidentified compounds amounted to 52.88%, 45.72%, 0.48, 0.43%, and 0.50% respectively. The major constituents are 38.67% limonene oxide, 27.18% cyclofenchene, 17.1% (r)-α-pinene, 3.59% α-tricyclene, 3.45% camphor, 2.05% α-terpineol, 0.97% careen, 1.4% γ-terpinen, 0.65% α-terpineol, 0.58% camphene, 0.57% borneol. (Table 1, Figure1).

Discussion

Hussain *et al.* and J. A. Pino *et al.* have reported linalool (59.6-71.6%) as the main constituent of the essential oil of coriander fruits [4], [5]. Present study also shows 70.11% β-linalool, 6.63% geraniol acetate of total gc area. Chunhui Deng *et al.* Separated and identified fifteen main volatile compounds in coriandrum sativum by headspace gc-ms analysis [6]. This study reports 25 main volatile compounds by dynamic head space gc-ms analysis and most abundant being limonene oxide (38.67%).

Acknowledgements:

The authors are grateful to the Principal, Government Post Graduate College Haldwani,

Nainital (India) for providing necessary research facilities.

Correspondence to:
Dr. Kamal Kishore Pande
Coordinator Biotechnology Department
Govt. MB Post Graduate College, Haldwani
Uttarakhand State (India)
Email: kemscience@gmail.com

References:

1. Norman, J. "The Complete Book of Spices," Dorling Kindersley, p. 32 (1990).
2. British Pharmacopoeia 1, The Stationery Office, pp. 466—467 (1999).
3. European Pharmacopoeia, 3rd edition, Council of Europe Publishing, p. 672 (1997).
4. Herbal Drugs and Phytopharmaceuticals," ed. by Wichtl, M. CRC, Press, Stuttgart, pp. 159—160 (1994).
5. Ishikawa T., Kudo M., Kitajima J., *Chem. Pharm. Bull.*, 50, 501—507
6. Toru Ishikawa, Kyoko Kondo, and Junichi Kitajima; Water-Soluble Constituents of Coriander; *Chem. Pharm. Bull.* 51(1) 32—39(2003) Vol. 51, No. 1 (2002).
7. Hussain, A., Virmani, O.P., Sharma, A., Kumar, A. and Misra, L.N. *Major Essential Oil-Bearing Plants of India*, Central Institute of Medicinal and Aromatic Plants, Lucknow, India (1988).
8. Pino, J. A., Rosado, A., Fuentes, V., *J. Essent. Oil Res.* 8, 97-98 (1996).
9. Deng, C., Song, G., Hu, Y. and Zhang, X. Determination of the volatile constituents of Chinese *Coriandrum sativum* L. by Gas Chromatography-Mass spectrometry; Chromatographia, Volume57, Numbers 5-6 (2003).
10. Msaada, K., Hosni,K. et al Changes on essentialoil composition of coriander (*Coriandrumsativum* L.) fruits during three stages ofmaturity ; Changes on essential oil compositionof coriander (*Coriandrum sativum* L.) fruitsduring three stages of maturity;Food Chem, Volume 102, Issue 4, Pages 1131-1134 (2007).
11. Hussain, A. Virmani, O.P., Sharma, A., Kumar, A. and Misra, L.N. Major Essential Oil-Bearing Plants of India, Central Institute of Medicinal and Aromatic Plants, Lucknow, India (1988).
12. Pino, J. A., Rosado, A., Fuentes, V., J. Essent. Oil Res. 8, 97-98 (1996).
13. Chunhui Deng, Guoxin Song, Yaoming Hu and Xiangmin Zhang. Determination of the volatileconstituents of Chinese Coriandrum sativum L. by gas chromatography-Mass spectrometry; Chromatographia, Volume 57, Numbers 5-6(2003).

8/24/2016