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**Chemical composition of leaf and seed essential oil of *Coriandrum sativum* L. from Bangladesh**

## Chemical composition of leaf and seed essential oil of *Coriandrum sativum* L. from Bangladesh

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### Abstract

The essential oils from leaves and fruits of *Coriandrum sativum* L. were analyzed by gas chromatography mass spectroscopy (GC-MS). The leaf oil contained 44 compounds mostly of aromatic acids containing 2-decenoic acid (30.8%), E-11-tetradecenoic acid (13.4%), capric acid (12.7%), undecyl alcohol (6.4%), tridecanoic acid (5.5%) and undecanoic acid (7.1%) as major constituents. The seed oil contains 53 compounds where the major compounds are linalool (37.7%), geranyl acetate (17.6%) and  $\gamma$ -terpinene (14.4%). The compositions of both oils varied qualitatively and quantitatively.

### Introduction

Coriander (*Coriandrum sativum* L.), an annual herb of the parsley family (Apiaceae), is native to the Mediterranean region and is extensively grown in Bangladesh, India, Russia, central Europe and Morocco and has been cultivated since human antiquity (Small, 1997). The plant is grown widely all over the world for seed, as a spice, or for essential oil production. At one time, coriander was among the worlds leading essential oil plants (Lawrence, 1993). The green leaves of coriander are known as "asotu" in the Eastern Anatolian region or "cilantro" in the United States, and are consumed as fresh herb. The odor and flavor of mature seed and fresh herbage are completely different.

While aliphatic aldehydes (mainly C<sub>10</sub>-C<sub>16</sub> aldehydes) with fetid-like aroma are predominant in the fresh herb oil (Potter, 1996), major components in the oil isolated from coriander fruit include linalool and some other oxygenated monoterpenes and monoterpene hydrocarbons (Bandoni et al., 1998; Anitescu et al., 1997). The entire plant when young is used in preparing chutneys, sauces, in flavoring curries and soups. Coriander fruits are extensively used as condiments, in the preparation

of curry powder, pickling spices, sausages and seasonings. They are used for flavoring pastry, cookies, buns and cakes. It is widely used as folk medicine as carminative, spasmolytic, digestive and galactagogue; seed extract antimicrobial; used in lotions and shampoos; with castor oil useful in rheumatism (Anonymous, 1950; Asolkar et al., 1992; Chopra et al., 1956; Ghani, 2003; Yusuf et al., 1994). The composition of the essential oil of coriander fruits in some of the world has been studied and found differ from each other. They reported linalool as major constituents (Coleman and Lawrence, 1992; Leung and Foster, 1996; Tashinen and Nykanen, 1975; Pino et al., 1996). It is reported that coriander seed oil contains linalool (60-70%) and 20% hydrocarbons and the composition of the herb oil completely differs from the seed oil (Guenther, 1950). Rastogi and Mehrotra reported (1993) detection of  $\alpha$ -pinene, limonene,  $\beta$ -phellandrene, eucalyptol, linalool, borneol,  $\beta$ -caryophyllene, citronellol, geraniol, thymol, linalyl acetate, geranyl acetate, caryophyllene oxide, elemol and methyl heptenol in seed oil by TLC.

Telci et al. reported (2006) that in the ripe fruits, the content of essential oil is comparably low (typically, less than 1%); the oil consists mainly of linalool (50 to 60%)



and about 20% terpenes (pinenes,  $\gamma$ -terpinene, myrcene, camphene, phellandrenes,  $\alpha$ -terpinene, limonene, cymene). Asolkar et al. (1992) reported a type from Mysore contained high geranyl acetate. Oil of coriander is a valuable ingredient in perfumes. Its soft, pleasant, slightly spicy note blends into scents of oriental character. Ghani reported (2003), the presence of linalool, pinene, cymene, phellandrene, geraniol and borneol.

There are no previous references in literature about these Bangladeshi oils. In this work we have determined the chemical composition of leaf and seed oils of *C. sativum*. These features allow it to be identified for medicinal use and classified among the other oils available in the international market.

## Materials and Methods

### Plant materials

The plant materials of *C. sativum* were collected from the plants grown in the campus of BCSIR Laboratory, Chittagong during October, 2008. The specimen was identified by Dr. Mohammad Yusuf, Ex-Director-in-charge, BCSIR Labs. Chittagong. One-voucher specimen (Y-635) was deposited in the herbarium of BCSIR Laboratory, Chittagong.

### Extraction of essential oil

Samples of leaf was harvested from healthy, well-grown, two-year-old plants. Freshly harvested leaves (400 g) and seeds (300 g) were grounded in a blender separately. The grounded leaves and seeds were subjected to hydrodistillation using a modified Clevenger-type glass apparatus for 4 hours for isolation of oils separately. The oil samples were stored at 0°C in air-tight containers after drying them over anhydrous sodium sulfate and filtered before going to GC-MS analyses.

### GC-MS analysis

The essential oils from leaves and fruits of *C. sativum* were analyzed by GC-MS electron impact ionization method on GC-17A gas chromatograph (shimadzu) coupled to a GC-MS QP 5050A mass spectrometer (shimadzu); fused silica capillary column (30 m x 0.25 mm; 0.25 mm film thickness), coated with DB-5 (J & W); column temperature 100°C (2 min) to 250°C at the rate of 3°C/min; carrier gas, helium at constant pressure of 90 Kpa. Acquisition parameters full scan; scan range 40-350 amu.

### Identification of the compounds

Compound identification was done by comparing the NIST library data of the peaks with those reported in literature, mass spectra of the peaks with literature data. Percentage composition was computed from GC-

MS peak areas on DB-5 column without applying correction factors.

## Results and Discussions

The essential oils from leaves and seeds of *C. sativum* were studied for physicochemical properties and component studies analyzed by GC-MS (Table I). The leaf oil contains 44 compounds mostly of aromatic acids of which the major are 2-decenoic acid (30.8%), E-11-tetradecenoic acid (13.4%), capric acid (12.7%), undecyl alcohol (6.4%) and tridecanoic acid (5.5%; Table II). Other major constituents in the leaf oil are undecanoic acid (2.1%), 2-dodecanal (1.3%), 2-undecenal (3.9%), cyclododecane (2.5%), decamethylene glycol (1.2%), decanal (1.4%) and dodecanoic acid (2.6%). The seed oil contains 53 compounds (Table III) of which the major compounds are linalool (37.7%), geranyl acetate (17.6%) and  $\gamma$ -terpinene (14.4%). Other major compounds in the fruit oil are  $\beta$ -pinene (1.8%), m-cymene (1.3%), citronellal (2.0%), citronellol (1.3%), citral (1.4%), geraniol (1.9%), citronellyl acetate (1.4%),  $\alpha$ -cedrene (3.9%), and  $\alpha$ -farnesene (1.2%) and  $\beta$ -sesquiphellandrene (1.6%). The present study revealed that the oil isolated from Bangladeshi seeds are similar to the others in respect of the presence of linalool and geranyl acetate (Coleman and Lawrence, 1992; Leung and Foster, 1996; Tashinen and Nykanen, 1975; Pino et al., 1996; Rastogi and Mehrotra, 1993; Telci et al., 2006). In addition it contains  $\gamma$ -terpinene as one of the major compounds. This confirms that the variations in the cultivar reported is not due to geographic divergence and ecological conditions but that is due to different chemotype than ours. On the basis of above fact it may be concluded that *C. sativum*, growing widely in Bangladesh, may be utilized as a source for the isolation of natural linalool and 2-decenoic acid respectively. As a result of this study, the essential oil of *C. sativum* has been extracted and its components identified. The high concentration of linalool and 2-decenoic acid in leaf and seed oil make it respectively potentially useful in the medicines and perfumery purposes. In addition to its use as a scent in domestic products such as soap, detergent, shampoo, and lotion, linalool is also used as a chemical intermediate. One common downstream product of linalool is vitamin E. Linalool is also used by pest professionals as a flea, and cockroach insecticide (Lewinshon et al., 2001).

Table I

### Physicochemical properties of leaf and seed essential oil of *C. sativum*

Parameters	Leaf oil	Seeds oil
Essential oil % (FWB)	0.1	0.4
Specific gravity	0.8	0.9
Optical rotation at 32°C	-5°	+9°
Refractive index at 32°C	1.4	1.5

Table II		
Chemical composition of leaf essential oil of <i>C. sativum</i>		
SN.	Name of chemical compounds	Percentage
1	g-Thionodecalactone	0.2
2	1,2-Decanediol	0.5
3	<i>n</i> -Cetyl alcohol	0.4
4	2,4-Dimethylheptane	0.2
5	2-Decenoic acid	30.8
6	2-Dodecanal	1.3
7	2-Tridecanal, (E)	1.0
8	2-Undecenal	3.9
9	4-Allylphenyl acetate	0.2
10	5-Nonanol ,5-methyl	0.3
11	Anisole, P-allyl.	0.3
12	Benzene	0.1
13	$\beta$ -Cinene	0.1
14	Z-Nonene	0.1
15	Cyclododecane	2.5
16	Cyclooctanol	0.6
17	Decahydroazulene	0.4
18	Decamethylene glycol	1.2
19	Decanal	1.4
20	d-Limonene	0.2
21	Dodecanal	1.3
22	Dodecanoic acid	2.6
23	E-11-tetradecenoic acid	13.4
24	Ethylidenecyclooctane	0.3
25	Eucalyptol	0.3
26	1-Pentadecene	0.1
27	$\alpha$ -Caryophyllene	0.3
28	$\alpha$ -Pinene	0.5
29	m-Mminoaniline	0.3
30	Capric acid	12.7
31	Nonanoic acid.	1.2
32	Nonanol	0.4
33	Octanoic acid	0.6
34	o-Cymene	0.1
35	Oleic acid	0.6
36	Oxirane tetradecyl	0.1
37	Oxirane, octyl	0.3
38	E-2-Ethyl-3-methyl thiophane	0.2
39	E-Undecanoic acid	5.0
40	Tridecanoic acid	5.5
41	Undecanal	0.3
42	Undecanoic acid	2.1
43	Undecyl alcohol	6.4
44	Undecylenic acid	0.3

Table III		
Composition of seed essential oil of <i>C. sativum</i>		
SN.	Name of chemical compounds	Percentage
1	$\gamma$ -Terpinene	14.4
2	Camphene	0.1
3	E-Verbenol	0.3
4	Sabinene	0.2
5	$\beta$ -Pinene	1.8
6	2-Oxabicyclo[2.2.2]octan-6-ol,1,2,3-trimethyl	0.0
7	$\beta$ -Myrcene	0.6
8	Cyclooctanol	0.0
9	$\alpha$ -Thujene	0.0
10	m-Cymene	1.3
11	Limonene	0.4
12	E-Ocimene	0.1
13	Z-Ocimene	0.0
14	Lilac alcohol	0.1
15	$\alpha$ -Terpinene	0.0
16	Z-Verbenol	0.1
17	Linalool	37.7
18	Isothujol	0.0
19	$\alpha$ -Campholenal	0.2
20	Citronellal	2.0
21	Umbellulone	0.1
22	Borneol	0.3
23	4-Terpineol	0.1
24	Terpinyl acetate	0.3
25	Decanal	0.1
26	Z-verbenone	0.1
27	Citronellol	1.3
28	Citral	1.4
29	Geraniol	1.9
30	Eugenol	0.9
31	Carveol	0.2
32	Undecanal	0.6
33	Methyl geranate	0.2
34	Myrtenyl acetate	0.4
35	Citronellyl acetate	1.4
36	Geranyl acetate	17.6
37	Z-myrtenyl acetate	0.1
38	$\beta$ -Elemene	0.1
39	Dodecanal	0.2
40	Caryophyllene	0.3
41	$\beta$ -Farnesene	0.1
42	2-Dodecanal	0.2
43	Curcumene	1.0

Table III

Composition of seed essential oil of <i>C. sativum</i> (Continued)		
SN.	Name of chemical compounds	Percentage
44	$\alpha$ -Cubebene	0.1
45	$\alpha$ -Cedrene	3.9
46	$\alpha$ -Farnesene	1.2
47	$\beta$ -Bisabolene	0.8
48	$\beta$ -Sesquiphellandrene	1.6
49	E-Nerolidol	0.1
50	Artumerone	0.0
51	8-Hexadecenal, 14-methyl-, (Z)	0.2
52	$\alpha$ -Bisabolol	0.2
53	<i>n</i> -Hexadecanoic acid	0.1

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## Conflict of Interest

Authors declare no conflict of interest.

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