Diurnal Changes in Essential Oil Content of Coriander (Coriandrum sativum L.) Aerial Parts from Iran

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Abstract: Iranian Coriander (Coriandrum sativum L.) is one of the most commonly collected from cultivated Coriander species in Iran. In this study, the diurnal variability of the essential oil content in Coriandrum sativum L. grown in the ecological conditions of Shiraz was studied during 2008. The seed of coriander were sown in April 2008 by hand in rows of 55 cm apart and spaced 35 cm distances between every plant in the row at the experimental farm of Shiraz University in a complete plot design with 3 replications. Shoots in green fruit stage of life cycle of this species including green fruit and leaves were collected 4 times a day (at 6, 12, 18 and 24 o'clock). The content of the essential oil were obtained in the aerial parts samples by using an all glass Cleverger-type apparatus, for 3 h. The results of this experiment indicated that essential oil content changed according to the hour of day and night. Essential oils in 12 h was more than other hours so that yields of essential oil (w t%) at different times were in the order of 6 (0.432%), 12 (0.436%), 18 (0.404%) and 24 (0.319%) treatments. The significant differences were obtained between these hours in 1% level. According to these results, we conclude that for obtaining of more yields of essential oil and other volatile compounds, harvesting of matter plants must be accomplished at special hour in one day.

Key words: Essential oil, Coriandrum sativum L., diurnal variation, Iranian coriander

INTRODUCTION

Coriander (Coriandrum sativum L.) is a culinary and medicinal plant from the Umbelliferae family. This plant is of economic importance since it has been used as flavoring agent in food products, perfumes and cosmetics. As a medicinal plant, C. sativum L. has been credited with a long list of medicinal uses. Powdered seeds or dry extract, tea, tincture, decoction or infusion have been recommended for dyspeptic complaints, loss of appetite, convulsion, insomnia and anxiety (Einaamghoreishi et al., 2005). Moreover, the essential oils and various extracts from coriander have been shown to possess antibacterial (Burt, 2004; Cantore et al., 2004; Kubo et al., 2004), antioxidant (Wangersteen et al., 2004), antidiabetic (Gallagher et al., 2003), anticancerous and antimutagenic (Chithra and Leelamma, 2000) activities such as geranyl acetate, linalool, dihydrocarvone, anethole, camphor, α-pinene, phellandrene, linalyl acetate, limonene, para-cymene, Decanal the main components, content of the essential oils are considered as a quality criterion (Grosso et al., 2008; Zheljazkov et al., 2008) that is shown in Fig. 1.

Numerous studies have been conducted on this species (Zheljazkov et al., 2008; Anitescu et al., 1997), particularly on their volatile compounds (Bandoni et al., 1998; Carruba and la Tore, 2002; Eyres et al., 2005; Grosso et al., 2008; Msauda et al., 2007).

Although synthesis of volatile compound in medicinal plants control by genetic processes, but those productions obviously influenced by environmental factors so that environmental factors cause changes in growth of medicinal plant, quantity and quality of them volatile compound (Alkaloids, Glycosides, Steroids, essential oils, Flavonoids, Phenols, Terpenoids, Tannins, Azotoxides, Carbohydrates, Keton, Saponin, Biter matters, Mucilage, Salsecic acid, etc). The environmental factors as light (quality, intensity and duration), temperature, irrigation, elevation, soil and nutrition elements alone or in combination with to have main

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influence on secondary metabolite situation of plants. The temperature in day duration usually is variable from morning to night. The temperature has more effect on essential oil in medicinal plants. My previous research demonstrated that essential oil content of Eucalypt, Rosemary, White Cedar and Lawson Cypress were varying during time of day (Ramezani, 2007; Ramezani et al., 2009).

There are no data concerning the diurnal variation of composition and yield of the essential oil in this species especially growing in Iran during specific hours of the day and night. Thus, this study reports for the first time diurnal variation of the essential oil content isolated from the aerial parts of Iranian Coriander (C. sativum L.) cultured at Shiraz, Iran.

**MATERIALS AND METHODS**

**Site information:** The experiment was carried out in 2008 at the Experimental Farm of Agricultural Faculty, Shiraz University in Shiraz, located in the Badghas, Fars province, Iran (Table 1).

The soil of experimental plots was a clay silt loam with pH of 7.6. The daily climatic data during this study were obtained from the agro-meteorological station of irrigation department located in a state farm about 1 km far from the experimental site. The mean values for maximum and minimum temperature (°C) for the months of April, May, June and July 2008 were 24.61 and 4.72, 29.68 and 8.7, 35.11 and 12, 35.65 and 15.2, respectively. The average relative humidity and total rainfall of the months of April, May, June and July 2008 were 39.93% and 3.5 mm; 19.2% and 0 mm; 28.76% and 0 mm and 29.74% and 0 mm, respectively.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Results</th>
</tr>
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<tbody>
<tr>
<td>Latitude</td>
<td>29°36'N</td>
</tr>
<tr>
<td>Altitude</td>
<td>52°32'E</td>
</tr>
<tr>
<td>Sea level</td>
<td>1810 m</td>
</tr>
<tr>
<td>Min. Temp* In recent 10 year period</td>
<td>-9°C</td>
</tr>
<tr>
<td>Max. Temp. In recent 10 year period</td>
<td>38°C</td>
</tr>
<tr>
<td>Rain fall in recent 10 year period</td>
<td>400 mm</td>
</tr>
<tr>
<td>Climate class</td>
<td>Semi-arid moderate</td>
</tr>
</tbody>
</table>

*Temp. = Temperature

**Plant material:** Seeds of the Iranian natural population of coriander were provided by the horticultural department of Shiraz University and then were sown in April 2008 by hand in rows of 55 cm apart and spaced 35 cm distances between every plant in the row. Farrow Irrigation was applied 2 times a week during the early stage of growth increasing to up to three times a week during the stages prior to harvest so that was not any water stress. Fertilizer was not applied before sowing and during growth of plant up to harvest so that coriander plants were grown as organic culture.

Coriander shoots were collected from cultivated plants at different time of day during July 2008. According to my previous research on the coriander, we collected aerial parts at green fruits (immature) stage.

The aerial parts were harvested on numerous representative plants and the material was taken immediately to the laboratory to be shade-dried at room temperature (25°C), with ventilation. Under this condition in experiment, 3-5 days typically was required to complete the drying process.

**Isolation of the essential oil:** One hundred grams of dried aerial parts (stems, leaves flower and fruits), wooden parts
were separated and hydro-distilled for 3 h, using an all
glass Clevenger-type apparatus 2. The oil volume was
measured directly in the extraction burette. Yield
percentage was measured as volume (mL) of essential oil
per 100 g of plant dry matter. The distilled essential oils
were dried over anhydrous sodium sulphate, filtered,
weighed and stored in sealed vials at 4°C.

Statistical analysis: The experiments were arranged as a
Completely Randomized Design (CRD) with three
replications of each treatment. The significance of
differences (p<0.01) between treatments was determined
by tukey multiple range tests. All the statistical analysis
was performed using SPSS/PC software version 13.

RESULTS AND DISCUSSION

Differences in the yield of the essential oils under
the influence of the harvest time have been reported
for several plants (Ramezani, 2007; Ramezani et al.,
2009; Lopes et al., 1997; Duschatzky et al., 1999;
Moudachirou et al., 1999; Schwob et al., 2004;
Msaada et al., 2007; Argyropoulou et al., 2007;
Hussain et al., 2008; Angelopoulou et al., 2002;
Marcum and Hanson, 2006; Ebrahimi et al., 2008;
Chericoni et al., 2004; Callan et al., 2007). Also our results
indicated that various hours of diurnal have much influence
on amount of coriander essential oils.

In this study, the essential oil content of coriander
varied from 3.1-4.36 mL kg⁻¹ dry matter according to the
time of day (Table 2). The maximum content of coriander
essential oils from aerial parts was obtained in 12 h
treatment (4.36 mL kg⁻¹ dry matter) so that was significant
difference at 1% level in comparing with 6, 18 and 24 h
treatments (4.32, 4 and 3.1 mL kg⁻¹ dry matter,
respectively). Also, there was significant difference
observed between 6, 18 and 24 h treatment so that base
on these results, optimum time for harvesting of Coriander
aerial parts is 12 h (Fig. 2).

Means followed by the same letter within each column
are not significantly different, as indicated by Tukey test at p<0.01.

We previous research demonstrated that essential oil
content of Eucalypt, Rosemary, white cedar and Lawson
Cypress were varying during hour of day so that maximum
amount of essential oil of these species obtained at 12, 18
and 7, respectively (Ramezani, 2007; Ramezani et al.,
2009).

The harvest hour of these species is very important
for all kinds of usage. It is known that genetic constitution
and environmental conditions influence the yield and
composition of volatile oil produced by medicinal plants.
(Ramezani et al., 2009; Omidbaigi, 2007).

<table>
<thead>
<tr>
<th>Harvest (h)</th>
<th>Essential oil content (mL/100 g dry matter)</th>
</tr>
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<tbody>
<tr>
<td>6</td>
<td>0.432b</td>
</tr>
<tr>
<td>12</td>
<td>0.458a</td>
</tr>
<tr>
<td>18</td>
<td>0.404c</td>
</tr>
<tr>
<td>24</td>
<td>0.319d</td>
</tr>
<tr>
<td>Average</td>
<td>0.397</td>
</tr>
</tbody>
</table>

Fig. 2: Different harvest time effect on essential oil
content of coriander in southwest of Iran in 2008
year. Means followed by the different letter are
significantly difference, as indicated by Tukey
multiple range test (p = 0.01)

Volatile compounds in various plant species are
different that this is resulted in variation yield of essential
oils to environmental factors such as temperature and
light, so that synthesis of these compound in various
hours of diurnal will be vary (Ramezani et al., 2009).

CONCLUSION

As a conclusion of the present study, it could be
stated that harvest at 12 of coriander may result in higher
values of essential oil content.

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