

Effects of Climatic Factors on the Quantity of Essential Oil and Dry Matter Yield of Coriander (*Coriandrum sativum* L.)

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Abstract

Coriander (*Coriandrum sativum* L.), is an annual and Mediterranean region species whose oil is widely used in the food, health, cosmetics, soft drinks and chocolate industries in all around of the world. Considering the importance and use of coriander oil, this study was conducted in a completely randomized design to make quantitative comparisons of coriander essential oil and dry matter yield in different climates of Iran. The cultivation of coriander seeds was carried out in pots with four replications in the cities of Maku, Khoy and Urmia with an altitude of 1182 m, 1148 m and 1332 m, respectively. The extraction of volatile oil was performed by water distillation method using Clevenger apparatus. Results of statistical analysis indicated that environmental factors significantly affected the oil content and the dry matter yield of coriander. The maximum oil content was obtained from the fruits, collected from Maku and Khoy. The minimum oil content was obtained from Urmia. With decreasing altitude and precipitation in the cities of Maku and Khoy, the oil content and dry matter yield increased. Our results clearly showed that the essential oil content of coriander fruits, collected from Makou and Khoy, was identical because of the almost identical climate and environmental conditions of these two cities. It can be concluded that among the climate parameters, altitude and precipitation have the most impact on the essential oil content and dry matter yield of coriander. Low altitudes could increase the essential oil content of coriander.

Keywords: Altitude, Coriander, Dry Matter, Essential Oil, Precipitation

1. Introduction

Coriander (*Coriandrum sativum* L.) is an annual species originated from the Eastern Mediterranean region². Coriander is cultivated in many parts of Iran. Fruits and vegetative organs of coriander contain essential oils of which maximum value is found in fruits^{2,3}.

Coriander oil is obtained from the full fruits by steam distillation⁴. This oil is widely used in the food, health, cosmetics, soft drinks and chocolate industries¹.

Nowadays, the active ingredients of coriander are used in the pharmaceutical industry for the treatment of abdominal pain and bloating and as a food digestive⁵. In traditional medicine, it has been used to relieve digestive disorders as carminative, appetizer, stomach tonic, anti-diarrheal and also as a mouth freshener and oral wound healing^{6,7}.

Environmental and genetic parameters can affect plants Performance^{8,9,18}. Salinity changed essential oil composition of coriander leaves grown in hydroponic

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culture¹⁰. Water stress causes a reduction in grain yield, dry weight, root weight and oil content of coriander¹¹. The effect of animal manure on essential oil of coriander was investigated in the previous studies¹². According to the obtained results, increasing in animal manure up to 20 tons per hectare significantly increased in the essential oil of coriander fruits. The production of secondary metabolites in plants depends on different factors such as temperature, light, plant genotype, altitude, slope, and hormones¹³⁻¹⁵.

Currently, West Azerbaijan province of IRAN is faced with the problem of reducing the water level of the Urmia Lake. Researchers believe that one way to save the lake is reducing water consumption by agriculture farmers, also the little research has been done on how climate effects on the yield of coriander while it is an important medicinal plant with abundant medicinal properties. Therefore, this research was aimed to evaluate the impact of climate on the oil content of coriander seeds.

2. Materials and Methods

2.1 Cultivation Method

The cultivation of coriander seeds was carried out in pots with four replications in the cities of Maku, Khoy and Urmia with elevation 1182, 1148 and 1332, respectively, during 2010-2011. Climatic characteristics of the cities are shown in Table 1. For this experiment, pots (dimensions: 30×30×50 cm) containing 3400 g of soil were used. The Soil used in this experiment was identical. 20 seeds were sowed in each pot. The pots were irrigated with a certain volume of water until emergence and then were placed in the open environment until harvesting the fruits.

2.2 Essential Oil Extraction

In this experiment, the coriander fruits were dried and powdered. Then, a 5-g sample of fruit powder was weighed and poured into an essential oil extraction balloon and distilled water was added to it until the desired volume was reached. The extraction of volatile oil was performed by water distillation method using Clevenger apparatus^{15,16}.

2.3 Statistical Analysis

Data analysis was evaluated at the 5 % level of significance using SPSS version 15 software and Duncan's Multiple Range Test was used for mean comparisons at a significance level of 0.05.

3. Results and Discussion

Results of statistical analysis indicate that environmental factors significantly effect on the oil content and the dry matter yield of coriander. As observed in Table 2, the maximum and minimum oil content were obtained from the fruits collected from Maku and Khoy, and Urmia, respectively.

According to the conducted meteorological studies, Urmia's rainfall is less than Maku and Khoy (Figure 1). In addition, the altitude of these two regions is lower as compared to that of Urmia.

Therefore, with decreasing of altitude and precipitation in the cities of Maku and Khoy, the oil content and dry matter yield increased and our results appear similar to the findings of¹⁷ who studied the effect of water stress on coriander yield.

As seen in Table 1, there is no significant difference in average temperature of the above-mentioned regions

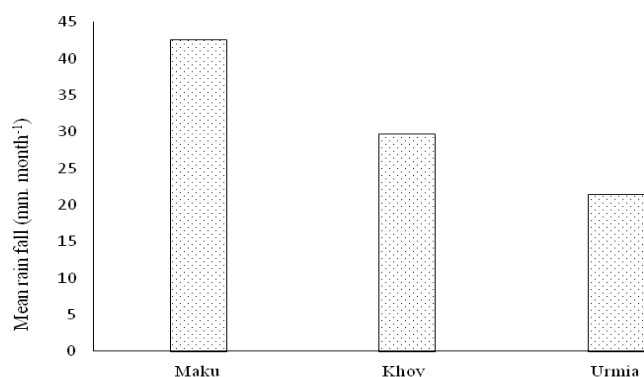
Table 1. Average temperature, monthly rainfall and sunshine hours in Maku, Khoy and Urmia during 2010-2011

Month	Average temperature (° C)			Monthly rainfall (mm)			Sunshine Hours (H)		
City	Maku	Khoy	Urmia	Maku	Khoy	Urmia	Maku	Khoy	Urmia
March	6.2	9	7.06	48.6	62.6	37.3	105.3	160.2	168
April	12.9	15.5	14.6	90.8	53.1	18.3	218.3	250.8	246.8
May	21.7	22.4	20.5	36.5	21.9	43.4	273.4	290.5	328.3
June	21.4	23.7	22.6	60.6	24.2	27.3	280.7	300	336.9
July	23.8	25.8	24.0	8.90	8.7	2.2	306.5	327.1	349.1
Aug	21.7	23.3	21.3	10	8.2	0.1	312.3	334.3	342.2
Mean	17.95	19.95	18.35	42.57	29.78	21.43	1496.5	1662.9	1771.3

Table 2. The amount of oil extracted from coriander fruits in Maku, Khoy and Urmia

City	Essential oil (cc)	Essential oil (%)	Essential oil (gr)	Dry mater yield (g. plant-1)
Maku	0.54 A	0.65 A	0.64 A	4.82 A
Khoy	0.52 A	0.63 A	0.63 A	4.77 A
Urmia	0.30 B	0.51 B	0.51 B	3.64 B

Data followed by a different letter were significantly different ($P \leq 0.05$) according to the Duncan Multiple Range Test. There were no significant differences between both years.

**Figure 1.** Main rain fall in Maku, Khoy and Urmia cities during 2010-2011.

and the differences in essential oil content could not be resulted from temperature.

Our results clearly showed that the essential oil content of coriander fruits collected from Makou and Khoy was identical because of the almost identical climate and environmental conditions of these two cities.

Therefore, according to Table 2, it was found that the quantity of oil of coriander obtained from Maku and Khoy cities was approximately equal and less oil was obtained from the coriander cultivated in Urmia. In this regard, precipitation played on the greatest role.

Meteorological studies showed that Urmia is located on the side of Urmia Lake having moist air and there light intensity is low, But Maku and Khoy have dry air and there light intensity is high. Hence, the dry air, high light intensity and high rainfall in investigated area increased in the rate of the essential oils and dry matter in coriander. In this context, our results is fitted to the results of⁴, but they did the experiment at high altitude and the due of the physiological problems in those areas plants will not be able to grow enough.

4. Conclusion

It is known that the quantity and quality of active ingredients is influenced by genetic and environmental factors and there is a direct relation between production of plant metabolites and climate factors. Thus, it can be concluded that Maku and Khoy cities having almost identical climate have more favorable conditions for the cultivation and production of coriander as compared to Urmia. Hence, the farmers traditionally use drug and aromatic plants without any knowledge about the quality and quantity of them. It is therefore, recommended that the management of ecological parameters while farming could have an important role on the quantity and quality of medicinal plants.

5. References

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