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Comparative study on the effect of different methods of drying on *Mentha piperita* essence

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Abstract

Drying is one of the oldest maintenance crops methods after harvesting. *Mentha piperita* being from Piperita family is used as medicinal herb. In the present research to investigate drying methods effect on its essence percentage, with a randomized block design with eight treatments, have done tow tests by natural way, in shade and sun and 6 experiments using microwave and oven, with 3 repetition. Four powers in 100, 300, 600 and 900 watt have been considered for microwave. Also, effect of oven temperatures in 50 and 70°C on essence composition content has been investigated. The samples have been harvested from the farm located in Niala of Galugah in 2013. In all experiments, the final weight of samples was %10 base on wet weight. The experimental results show that for number of essence extracts, there were no any significant differences between methods and shade- drying was the best method for higher essence extraction.

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Introduction

In the past three decades, tremendous growth in the trade of medicinal plants and their products around the world has occurred. The rapid increase in exports of medicinal plants in the last decade is a clear proof of the global interest in these products and treatments with natural ingredients. Using medical plants with the purpose of treatment has been contemporary with human life history so that throughout the history mankind has had no way except using plants. Essences are combinations of different substances with medical compounds differing from each other and have very effective fragrances (Omidbeigi, 2006). *Mentha piperita* is a scent herb of the Lamiaceae family. The leaves are strongly scented due to the presence of essential oils. Also, elliptic, cross, sharp, jagged, and slightly covered with fluff, and it grows to a height of 4-7 cm and 2-3 cm in width. The main use of peppermint is its essence. *Mentha piperita* is widely used for its medicinal properties such as antispasmodic, anti-sickness, anti-helminthic, carminative, stomachic and others (Lorenzi and Matos, 2002; OmidBeigy, 2005). Its oily essence includes menthols (30-40% or more), menthons (15-25%), methyl acetate (to 10%), and Menthoforan (less than 15%) (Safaei Khorram *et al*, 2008). Because of this and other reasons, peppermint essential oil ranks high in terms of total sales volume (Moraes, 2000).

The essences produced by the species of plants and stored in various organs, are directly related to the biosynthesis, metabolism and biological activity of the plant that are subject to climatic conditions and plant environment. Various factors such as time of harvest, method of collection, drying, packaging and storage affect on quality and quantity of vegetable essences (Stahl, 2002). Because of increasing development of synthetic drugs, use of medicinal plants is somewhat outdated but since of the bad effects of the chemical and its incompatibility with human nature once again specialists and researcher have considered the medicine practitioners and an active ingredient in these herbs. So, the essence is widely used in chemical industry, health, food and medicine, these plants needed to reproduce, and their survival in the nature is necessary to identify which can be useful in the economy of country (Mulabagal, 2004).

Drying (or dehydration) is the oldest method of storage of agricultural produce after harvest. This process involves the removal of moisture by evaporation to reach a certain threshold, so the product can be stored for a long time and it is caused to stop enzymatic activity of bacteria and yeast. Natural drying and drying with hot air, because of the lower costs of removal, is still the most important method used in the production of dry plant material (Soysa, 2011). Drying is the most important phases after producing medicinal plant that have an important role on the quantity of their effective materials (Yadegari, 2013). According to Czepak (1998), the higher the dry matter yield of plants the higher their essential oil yield.

Buschbeck *et al* (1967) studied on dried sweet basil, marjoram, parsley, tarragon, thyme, Mentha Piperita, and dill. According to research results, they found that drying the herb tarragon at 35 °C has no effect on the quantity and quality of essence and also if two plants thyme and mentha piperita are used freshly, the result will be a higher percentage of essence. It is also issued about dill which stated that the best way of use of Karun in the best shape of female plant, harvesting it before seed formation stage and changing color to brown.

Venskutonis *et al* (1997) recommended using macro wave especially for drying herbal medicinal including essence that due to presence of essential oil in their leaf being sensible to high temperature. Also, they expressed that high drying velocity and low inlet energy prevented essence reduction.

In a research, Drouzas *et al* (1999) found that microwave drying method or a combination of microwave and hot air decrease time of drying of plant material without decreasing of its quality.

Azizi *et al* (2010) in order to investigate the effect of different drying methods on the drying time, speed of

weight loss, amount of essence and percentage of Chamazulene flowers (Matricaria recutita L.) compared six different microwave power of 100, 180, 300, 450, 600 and 900-watts, three oven temperatures of 50, 60 and 70 °C, and the normal way (shade and sun). The results showed that the highest percentage of essence obtained in an oven at 50 and 60 degrees in the shade drying methods and highest percentage of Chamazulene was in the normal way and the microwave and the lowest percentage was obtained by drying in an oven.

Many other researchers such as (Sefidkon, *et al.*, 2006; Omidbaigi *et al.*, 2004; Scavroni *et al.*, 2005; Hossain *et al.*, 2010 ; Benbelaid *et al.*, 2013) have established different investigation in drying methods of medicinal plants and producing essence.

The purpose of this study is to investigate the composition of *Mentha Piperita* essence constituents and effect of different drying methods on the essence content and composition of essence of it.

Materials and methods

To perform this research, it was used two years old plant of Mentha Piperita in the farm located in Niala of Galugah in 2013 (Figure 1). Experiments with a randomized block design with eight treatments by shade, sun, oven (50°C and 70°C) and microwave (100 W, 300 W, 600 W and 900 W) established with three replications in university of agricultural sciences located in Sari. (Table 1).

Characteristics of chromatography and Mass Spectrometry devices

the model 7890 Agilent of gas chromatography equipped with a DB5 column with a length of 30 m, an internal diameter of 0.25 mm and a thickness of 0.25 mm by scheduling an initial column temperature of 60°C per minute, and a final temperature of 240°C for 5 min with the increasing temperature of 3°C per minute was used. Also, to determine the composition of essence the injection chamber temperature and chamber detector temperature set at 230°C and 250°C respectively.

For identifying essence composition GC/MS was used with C5937 Agilent and an ionization voltage of 70 V, the same GC column and heat and helium gas as carrier gas. Injection chamber temperature was adjusted 10°C higher than the final temperature of the columns. Essence injection was performed with split at volume of 0.2 microliter.

In drying with sun and shade method, samples were dried for 15 days in 25°C in room and for 8 hours a day for six consecutive days, respectively. The drying time of samples (3) and (2) is considered 24 hours. In tests of microwaves, each 30 grams of *Mentha Piperita* plant was dried and evaluated for 20 minutes, with 5 minutes period. In each of experiments, obtaining essence was done with the water distillation by kelavenger in three replications and essence components were identified and quantified by Gas Chromatography (GC) and gas chromatograph connected to a mass spectrometer GC, (GC / MS) in Agricultural Research Center of Science and Biotech of Mazandaran University.

Fig. 1. .Map of Iran, showing location of Mazandaran province and Sari city.

Due to obtain essence 25 gr of dried plants from each treatment were mixed with 300 ml of water and 3 hours essence extraction process was carried out. Obtained essence was dehydrated by Sodium sulfate and it was placed it in a vial in order to prevent evaporation and doors were covered with Teflon sheet. Then, the product was stored at 4°C to identify compounds and inject into the GC / MS and GC (Figure 2).

Result and discussion

Based on the analysis of variance (Anova) results, using of different drying treatments on all the ingredients except the oil CSH, NIM, NMA and MA have a significant effect on the level of 1%. The probability for attribute MA was observed at significant level of 5%. Also, the results of the Anova table show that the use of different methods of drying had no significant effect on the remaining three attribute (Table 2, 3, 4, 5).

The results of average comparison have shown terpinene-ϒ treatment (6) with 1.13% and treatment (2) with 0.58% were maximum and minimum of this attribute, respectively. Treatments (1) and (8) with 6.6% and 5.47% displayed the maximum and minimum value of 1-8- Cin. Treatment (1) with 1.42% and treatment (2) with 1.04%, had the maximum and minimum value of Limonene, respectively. Also, 1.07% for pinene-β was obtained by treatment (8). Moreover, treatment (2), with maximum amount, does not differ significantly with treatment (1). Maximum value of attribute pinene-α was for treatment (1) with 1.21% and minimum was for treatment (3) with 0.87%. Based on the analysis of the data, attribute CSH was not affected by drying methods. However, the average comparison showed that the treatment of (7) with 0.65% had the maximum value of this substance. Treatments (1) with 0.25% and (2) and (3) with 0.11% displayed maximum and minimum value of Tpin, respectively.

Table 1. Treatments .

Treatment	Shade	Sun	Oven (50°C)	Oven(70°C)
Number of treatment	(1)	(2)	(3)	(4)
Treatment	Microwave (100W)	Microwave (300W)	Microwave (600W)	Microwave (900W)
Number of treatment	(5)	(6)	(7)	(8)

Table 2. Analysis of variance of essence percent in different treatments.

Pinene-β	Limonene	1-8-Cin	Tpin-ϒ	df	S.O.V
0.1	0.0094	0.0069	0.00038	2	Repetition
0.22**	0.049**	0.77**	0.133**	7	Treatment
0.049	0.0057	0.038	0.0044	14	Error
4.91	6.11	3.36	7.74		CV

** and **: significant in level of 5% and 1% , ns: no significant.*

Maximum and minimum value of Linanool was obtained in treatment (1) and treatment (2) with 0.46% and 0.21%, respectively. The effect of (1), (6) and (7) on Neomenthol was the same and maximum and minimum was achieved for treatment (1) and treatment (2) with 9.09% and 7.25%, respectively. Treatment (1) with 35.93% and treatment (2) with 21.33% had maximum and minimum value of Mentone, respectively. Attribute Menthol in treatment (1) with 39.97% was maximum value and in treatment (5) with 34% was minimum. Isomenthol maximum and minimum value, respectively, in treatments (1) was 3.10% were analyzed in a same statistical group with treatment (5) and (6) and belong to treatment (2) with 1.13%. According to the results of the average comparison, maximum value of NIM was in treatment (1) with 0.53% and minimum was obtained in treatment (2) with 0.38%. Based on

the data analysis, attribute NMA and MA have not been affected by methods of drying and the highest value of them were respectively in treatment (7) with 0.61% and treatment (1) with 10.93% and lowest value were in treatment (2) with 0.46% and treatment (7) with 7.77%.

Table 3. Analysis of variance of essence percent in different treatments.

Linanool	Terpinolene	CSH	Pinene-α	df	S.O.V
0/0008	0.00015	0.0031	0.00008	2	Repetition
0.022**	0.0076**	0.006ns	0.036**	7	Treatment
0.0017	0.0008	0.0039	0.0037	14	Error
14.31	17.51	10.69	6.09		CV

Table 4. Analysis of variance of essence percent in different treatments.

Isomenthol	Menthol	Neomenthol	Mentone	df	S.O.V
0.034	2.45	0.062	1.52	2	Repetition
1.51**	12.76**	1.14**	59.87**	7	Treatment
0.033	0.37	0.044	1.21	14	Error
7.82	1.65	2.55	4.14		CV

Table 5. Analysis of variance of essence percent in different treatments.

MA	NMA	NIM	df	S.O.V
0.0003	0.002	4.15	2	Repetition
0.0065*	0.0064ns	3.61ns	7	Treatment
0.002	0.0055	3.53	14	Error
9.96	14.14	19.88		CV

Table 6. Mean comparison of characters.

Number of treatment	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pinene-β	1.72 a	1.8 a	1.25 C	1.55 b	1.12 d	1.32 c	1.56 b	1.07d
Limonene	1.42 a	1.04 e	1.1 De	1.23 acd	1.16 de	1.33 abc	1.34 ab	1.2 ed
1-8-Cin	6.6 a	5.155 d	5.22 D	5.84 c	5.82 c	6.12 bc	6.21 b	5.47d
Tpin-ϒ	1.08 ab	0.58 e	0.65 De	0.72 d	0.73 d	1.139 a	1.01 bc	0.94 c
Linanool	0.46 a	0.21 d	0.22 D	0.27 cd	0.23 d	0.32 bc	0.35b	0.23 d
Terpinolene	0.61 ab	0.53 b	0.54 B	0.61 ab	0.57 ab	0.62 ab	0.65 a	0.52b
CSH	0.25 a	0.11 d	0.11 D	0.14 cd	0.15 cd	0.21 ab	0.15 cd	0.18 bc
Pinene-α	1.21 a	1.0 bc	0.87 D	0.99 bc	0.91 cd	1.03 b	1.08 b	0.90 cd
Isomenthol	3.10 a	1.13 d	2.24 B	2.23 b	3.06 a	2.91 a	1.56 c	2.36 b
Menthol	39.97 a	34.81 d	36.76 C	36.10 c	34.00 d	38.29 b	39.14ab	36.80 c
Neomenthol	9.09 a	7.25 d	7.77 C	8.14 c	8.27 b	8.76 a	8.9 1a	8.04 bc
Mentone	35.93 a	21.33 a	25.16 C	27.47 bc	26.17 dc	23.46 e	29.20 d	24.30de
MA	10.93 a	8.25 a	8.95 A	10.58 a	9.49 a	10.11 a	7.77 a	9.54 a
NMA	0.55 ab	0.46 b	0.49 Ab	0.50 ab	0.52 ab	0.51 ab	0.61 a	0.53 ab
NIM	0.53 a	0.38 c	0.46 Ab	0.42 ab	0.45 bc	0.47 b	0.46 ab	0.41 bc

In each row, means with the similar letters are not significantly different at 5% level of probability.

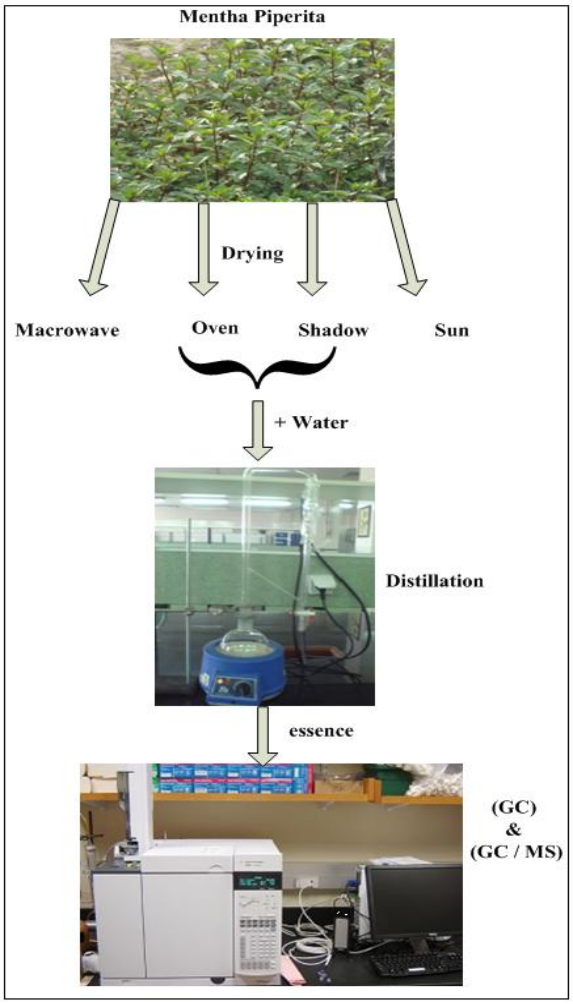

Fig. 2. Process diagram.

Abbreviation

Neoisomenthol	- NIM
Neomenthylacetate	- NMA
1-8-Cineole	-1-8-Cin
Terpinene-ϒ	- Tpin-ϒ
Menthylacetate	- MA
Terpinolene	- Tpin
Cis-sabinene hydrate	- CSh

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