STUDY REGARDING THE QUANTITY OF ESSENTIAL OIL OBTAINED FROM DIFFERENT SPECIES FROM THE LAMIACEAE HERBAL FAMILY

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Abstract: *This paper presents the quantity of oil obtained from different species of plants from the Lamiaceae family.It studies the morphological particularities of the plants, the climate, soil, the optimal time to harvest and which parts of the plant to use for obtaining the essential oils. Also we present the processing of the herb through steam distillation. The studied species are : Salvia officinalis L., Origanum majorana L., Origanum vulgare L., Satureja montana L.,Ocimum basilicum L., Mentha piperita L., Mentha smithiana L., Rosmarinus officinalis L., Melissa officinalis L., Thymus serpyllum L. The sub-mediteranean climate from Timis County enhances the growth of the medical plants from the Lamiaceae family. This family of medical plants has a high global medical interest due to it's active compounds known for their antibacterial action. All of the plants are planted at Young Naturalist Resort from Timisoara.*

Key words*: herb, essential oil, steam distillation, optimal harvest time.*

INTRODUCTION

The plant species from the Lamiaceae family are herbaceos, originary from the mediteranean and subtropical area. They are also known as the mint or deadnettle family. The original family name is Labiateae, so given because the flowers typically have petals fused into an upper lip and a lower lip. Although this is still considered an acceptable alternative name, most botanists now use the name "Lamiaceae" in referring to this family.The leaves emerge oppositely, each pair at right angles to the previous one (called *decussate*) or whorled. The stems are frequently square in cross section, but this is not found in all members of the family, and is sometimes found in other plant families. The flowers are bilaterally symmetrical with 5 united petals, 5 united sepals. They are usually bisexual and verticillastrate (a flower cluster that looks like a whorl of flowers but actually consists of two crowded clusters). (4)

In Romania these plants are grown in the southern, south-west and western area of the country. These areas have a submediteranean climate that enhances the growth of these plants. This family of medical plants are beeing known for the essential oils they contain. The essential oils are beeing used in the pharmaceutycal and cosmetics industry. This paper presents the process and the steps taken to obtain essential oil from 10 different species from the Lamiaceae family.

MATERIAL AND METHODS

The biological material used in this study is represented by *Salvia officinalis L. , Origanum majorana L., Origanum vulgare L., Satureja montana L., Ocimum basilicum L., Mentha piperita L., Mentha smithiana L., Rosmarinus officinalis L., Melissa officinalis L.,*

Thymus serphyllum L. All of these plants were grown at the Young Naturalists Resort from Timisoara.

1.Salvia officinalis L. Perennial undergrowth plant , with dens ramifications. It grows between 30-80 cm in height. It has silver-grey hairs on it's leaves and strain. The leaves are placed opposite to each other.This plant has blue – violet flowers, bilabial with 2 stamens protruding with a connective shaped as a lever and with spiciforme inflorescences. The harvesting period is June-July and the optimum harvesting time is at the start of the first inflorescence. Parts of the plant used for the extraction of the esssential oil : Strain , leaves and flowers all above 10-15 cm from the ground. Dry herb is used for the extraction. The drying efficiency is 3,5:1. (6)

2.Origanum majorana L. Perennial plant , grows between 30-80 cm tall, with aromatic odor, 4 edges strain, with a light green color, woody and branched at the top. The leaves are oppossite sided, with oval shape. The flower is spiciforme. The flower of *Origanum majorana L.* has a clean white colour unlike the flower from *Origanum vulgare L.* which is purple. The havesting period is usually from June to September and the optimal harvesting time is at the beggining of the flowering. For the extraction of the oil aerial parts of the plant are beeing used in dry form. The drying efficiency is 3:1. (17)

3.Origanum vulgare L. Perennial plant, grows between 30-80 cm tall with a strain that has 4 edges , green, sometimes slightly red and covered in hairs, woody and branched at the top.The leaves are oppossite sided with an oval shape. The flowers are purple gathered at the top in spikes. The harvesting period is from June to September and the optimal harvesting time is when the first flowers apear. The plant is used after drying in shade for the extraction of the oil. All the aerial parts of the plant are beeing used for the extraction. The drying efficiency is 3:1. (2,8,9,13).

4.Satureja montana L. Winter savory is a perennial herb in the family Lamiaceae, native to warm temperate regions of southern Europe. It is a semi-evergreen, semi-woody subshrub growing to 41 cm tall. The leaves are opposite, with an oval shape , 1–2 cm long and 5 mm broad. The flowers are 3 to 6 in number and white. The harvesting period can be from July to September but the optimal time to harvest is when the first flowers appear. The herb is processed dry. All the aerial parts are being used. The drying efficiency is 2,5:1. (7,12,18)

5.*Ocimum basilicum L.* It's an anual plant with tropical origins. It strains grow up to 40-60 cm tall , branched. The leaves are oval shaped. The flowers are white, gathered in a spike form. Unlike the other species from the Lamiaceae family, *Ocimum basilicum* is sensitive to cold weather and low teperatures. The harvesting period is June-July but it can also be haversted in september. The optimal harvesting time is when the first flowers apear. All the aerial parts are used for the oil extraction. Ussualy it is used dry for a more optimal exctraction. The drying efficiency is 2:1. (10)

6.Mentha piperita L. Perennial plant, grows up to 100 cm tall. Has highly branched 4 edged strains. The leaves are opposite sided with oval shape. It has a strong distinctive odor. The

flowers have 4 lobs and are gathered in spike form with a light purple color. The harvesting period is June-August. And the optimal time to harvest is when 50 % of the plants have flowers. All the plant above 10 cm from ground is beeing used. It can be used fresh for the extraction of the oil. But if it is used dry the drying efficiency is 5:1.(1,15)

7Mentha smithiana L. Perennial plant, grows to 100 cm tall. Has highly branched 4 edged strains. The leaves are opposite sided with oval shape. It has a strong distinctive odor but weaker than the odor from *Mentha piperita L.*The leaves are porous and with saw shapped edges. The flowers are white and gathered in spike form. The harvesting period is June-August. The optimal time to harvest is when 50 % of the plants have flowers. All the plant above 10 cm from ground is beeing used. It is used dry for the extraction of the oil. The drying efficiency is 2,5:1.(5)

8.Rosmarinus officinalis L. Evergeen perennial shrub with 30-50 cm tall strain but it can grow to 2 meters. The leaves are opposite sided, and flowers are light blue gathered in spike form. It loves the sun and it is sensitive to cold weather. The harvesting period is from April to Octomber depending on the weather conditions. All the aerial plants are beeing used except for the woody parts near the soil. The optimal havesting time is when the flowers start to appear. It is used dry for the extraction of the oil. The drying efficiency is 3:1. (11,16)

9.Melissa officinalis L. Perennial plant that can grow up to 100 cm tall. It has a lignified rhizome, long up to 30 cm. The leaves are porous and have saw edges. It is a subshrub with lemon like odor. The harvesting period is from June to August and the optimal haversting time is when most of the plants have flowers. The flowers have a white color and are organized in a spike form. All the aerial parts of the plant are used for the oil extraction. The plant is used dry. The drying efficiency is 2,5:1 (3)

10.Thymus serpyllum L. It is a low, usually prostrate subshrub growing to 20 cm tall with creeping stems up to 10 cm long. The oval evergreen leaves are 3–8 mm long. The strongly scented flowers are either lilac, pink-purple, magenta, or a rare white, all 4–6 mm long and produced in clusters. The optimal harvesting time is Mai-June when the first flowers appear. All the aerial parts of the plant are being used dried for the oil extraction. The drying efficiency is 3:1. (14)

Satureja montana L., Mentha piperita L., Mentha smithiana L., Rosmarinus officinalis L., Mellisa officinalis L., Thymus serphyllum L. were seeded in 2011 and *Salvia officinalis L., Origanum majorana L., Origanum vulgare L., Ocimum basilicum L* were planted in 2012. *Origanum vulgare L* and *Origanum majorana L.* grew from seeds and the rest of 8 plants were multiplied from seedlings. All the seedlings were watered for 2 weeks in April after they were seeded. Also in July and August 2011-2013 the plantation was consistently watered. In April, May, June and July of 2011 -2013 manual weeding was mandatory. The harvesting of the plants for the oil extraction took place throughout 2013 when each species was at the flowering

time. The aerial parts of the plants were harvested and weighed fresh and dry. The herb was dried in clean shady spaces.

Extraction method description:

The method used for oil extraction was water vapor distillation. Dried herb was distilled using a still. The still's boiling balloon has 10 l capacity. For obtaining the oil, the herb was distilled (strain, leaves and flowers). The vegetal material is placed in the special container above the water boiler balloon. During boil, the water vapors that also contain volatile oil will be pushed through the cooling pipe. The water and oil vapors will condense and will go in the collector container. For each distilling series the container was put above boiling water about 200-300 g of herb. The vegetal material was distilled for about 25 minutes from the moment the first water vapors passed through the dried herb mass.

Separation of oil and water was achieved through deep-freezing. The oil and water containers were introduced in deep-freezer at -18 º C for 24 hours. This way the oil was very easily separated from the water. The oil quantity obtained was measured with a dropper and with a graduate. The essential oil was stored in brown 40 ml bottles.

Thermal regime

The appreciation of climatic conditions was made upon weather readings from The Timisoara Weather Station. The monthly average temperatures recorded in 2011-2013 compared with multiannual average are present in Table 1.

Table 1.

Monthly Average temperatures (ºC) recorded at Timisoara Meteorological Station in 2011-2013 compared to multiannual average

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2011	**-0,7**	**1,1**	**5,8**	**11,2**	**16,3**	**19,4**	**21,1**	**20,4**	**16,5**	**11**	**5,6**	**0,8**
2012	**0,7**	**-5,1**	**7**	**10**	**17,2**	**22,7**	**25**	**23**	**20**	**13**	**8**	**-1**
2013	**1,5**	**4,1**	**5**	**13,2**	**17,4**	**20**	**23,5**	**22,1**	**19,4**	**14,7**	**-**	**-**
Multiannual average	**-1,2**	**0,4**	**6**	**11,3**	**16,5**	**19,6**	**21,6**	**20,8**	**16,9**	**11,3**	**5,7**	**1,4**

Analyzing the data from table 1, we observe that temperatures recorded in harvesting from 2013 have higher than multiannual average values in all months of the year. This together with abundant precipitations in springtime favored plant development.

In April, the monthly average temperature is around 11 °C, in the third decade reaching even 15.9 °C, a very good temperature for plant development.

Regarding average temperatures, the crops have a favorable thermal conditions. If precipitations are lower, the thermic conditions during 2012-2013, especially in vegetative period, it becomes excessive and determines the characteristic of a dry year that affects the growth as well as development of the crops.

Pluviometric regime

The monthly average precipitations recorded in 2011-2013, compared to multiannual average are presented in Table 2.

Table 2.

Monthly average precipitations (mm) recorded at Timisoara Meteorological Station between 2011-2013 compared to multiannual average

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2011	**23,3**	**28**	**31**	**21,9**	**64,5**	**28,7**	**108**	**1,3**	**11,7**	**33,8**	**0,2**	**36,9**
2012	**50,6**	**54,1**	**4,6**	**71,0**	**54,4**	**57,2**	**89,0**	**6,4**	**17,1**	**69,4**	**19,2**	**57**
2013	**52,4**	**38,9**	**98,4**	**33,2**	**97,6**	**47,6**	**22,1**	**45,3**	**40,1**	**38,9**	-	-
Multiannual average	**40,9**	**40,2**	**41,6**	**50**	**66,7**	**81,1**	**59,9**	**52,2**	**46,1**	**54,8**	**48,6**	**47,8**

A general analysis of the precipitations recorded at The Timisoara Weather Station in the research period compared to multiannual average shows us that all 3 years of the experiment cycle, were, in general dry years because of adverse precipitation regime. In the first two months of the year 2012, a growth of monthly average precipitations compared to multiannual average of 9.7mm, respectively 13.9.

The harvesting year, 2013, had a wet spring, especially May. Starting with June 2013, the crop irrigation was necessary until the middle of August, to prevent drying out of the plants.

Soil type and agro-productive features:

Young Naturalists Resort Timisoara, on a surface of 9 ha, there are two types of soil, eutricambosoil and vertosoil.

The experiment perimeter is with brown soil, eutricambosoil, moil moderately gleyed, moderately decarboned on river deposits, moderate clay, with the following morphological characteristics:

Ap = 0-27 cm: medium clay, dark brown, moist, medium polyhedral, moderately developed, moderately porous, lightly battered, friable;

Am = 27-45cm: medium clay, dark brown, moist, small polyhedral, moderately developed, moderately porous, moderately battered, friable;

ABg1 = 45-60 cm: medium clay, dark brown, rare rusty spots, moist, moderately developed, lightly porous, moderately battered, friable;

BVg2 = 60-85 cm: medium clay, dark brown, rusty and dark purple spots (10%), moist, high polyhedral, moderately developed, moderately porous, moderately battered, friable;

BCg2 = 85-100 cm: medium clay, brown-yellow, rusty and dark purple spots (12%), moist, high polyhedral, lightly developed, moderately porous, moderately battered, friable;

CKg3 = 100-149cm: sandy fine clay, yellow with rusty and dark purple spots (20%), moist, very friable, very weak effervescency;

CKg4 = 149-170 cm: sandy moderate clay, yellow-dark purple, wet, very friable, very weak effervescency;

CKgr = 170-200cm: grit sand, dark purple-ashen, very weak effervescency.

Table 3

Main physical features of the soil on which the experiment has taken place

Horizon	Ap	Am	ABg1	BVg2	BCg2	CKg3	CKg4	CKgr
Depth (cm)	0-27	27-45	45-60	60-85	85-100	100-149	149-170	170-200
Grit Sand (2,0-0,2 mm) %	2,6	5,2	2,7	2,8	1,0	1,0	33,6	67,3
Fine Sand (0,2-0,02 mm) %	47,0	44,7	42,1	36,1	47,3	57,9	40,1	22,8
Dust (0,02-0,002 mm) %	24,6	24,2	27,1	30,2	23,7	21,0	13,1	6,0
Clay 2 (under 0,002 mm) %	25,8	25,9	28,1	30,9	28,0	20,1	13,2	3,9
Physical Clay (under 0,01 mm) %	36,5	40,2	45,1	45,4	39,9	34,1	20,4	6,5
Texture	LL	LL	LL	LL	LL	SF	SM	NG
Apparent density (g/cm^3)	1,46	1,51	1,52	1,47	1,48			
Density	2,64	2,66	2,64	2,64	2,66			
Overall porosity (PT %)	44,7	43,3	42,5	44,4	44,4			
Aeration porosity (PA %)	16,9	14,5	12,3	13,4	15,2			
Battering level (GT %)	9,2	12,2	14,4	11,4	10,5			
Hygroscopicity coef. (CH %)	5,34	5,65	6,07	6,60	6,09			
Fading coef. (CO %)	8,0	8,5	9,1	9,9	9,1			
Field capacity (CC %)	19,0	19,0	19,8	21,0	19,7			
Total capacity (CT %)	30,6	28,6	27,9	30,1	29,9			
Water capacity (CU %)	11,0	10,5	10,7	11,1	15,2			
Maximum collapsing capacity (CCD max. %)	11,6	9,6	8,1	9,1	10,2			
Hydraulic conductivity (K mm/hour)	05,0	01,0	01,0	01,0	01,0			
pH (in water)	6,05	6,40	6,60	7,00	7,00	7,55	7,55	7,65
Carbonates ($CaCO_3$ %)						0,42	0,42	0,42
Humus (%)	2,58	2,35	1,96					
Nitrate Index (IN)	2,45	2,26	1,88					
Humus reserves	180,47 t/ha							
P mobile (ppm)	69,14	65,11						
K mobile (ppm)	194,4	182,3						
Exchange basis	22,74	27,54	28,36					
Changeable Hydrogen	3,34	3,47	3,60					
Cationic change capacity	26,08	31,01	31,96					
Saturation grade in bases	87,19	88,81	88,73					

Agrochemical testing results for those surfaces were interpreted accordingly to supplying intervals of the irrigated crops, the fields were cultivated with vegetables.

RESULTS AND DISCUSSIONS

Table 4

Drying efficiency

Nr. Crt.	Species	Harvest date	Weight of fresh herb (g)	Weight of dried herb (g)	Drying efficiency (%)
1	Salvia officinalis L.	02.07.2013	3450	1100	31,88
2	Origanum majorana L.	01.07.2013	1634,2	640	39,16
3	Origanum vulgare L.	24.07.2013	1266	555	43,83
4	Satureja montana L.	02.07.2013	7055	2200	31,18
5	Ocinum basilicum L.	23.08.2013	5460	2140	39,19
6	Mentha piperita L.	24.07.2013	11700	3630	31,02
7	Mentha smithiana L.	24.07.2013	2500	890	35,6
8	Rosmarinus officinalis L.	10.10.2013	8160	3450	42,27
9	Melissa officinalis L.	26.07.2013	11002	5058	45,97
10	Thymus serpyllum L.	01.07.2013	2170	659	30,36

Table 5

Oil quantity obtained

Nr.Crt.	Species	Quantity of essential oil obtained (ml)	Quantity of essential oil obtained from 100 g of herb (ml)
1	Salvia officinalis L.	4,6	0.41
2	Origanum majorana L.	0,9	0,14
3	Origanum vulgare L.	0,75	0,13
4	Satureja montana L.	11	0,5
5	Ocinum basilicum L.	5	0,23
6	Mentha piperita L.	40,5	1,11
7	Mentha smithiana L.	5,5	0,56
8	Rosmarinus officinalis L.	53,5	1,53
9	Melissa officinalis L.	17	0,33
10	Thymus serpyllum L.	4,5	0,68

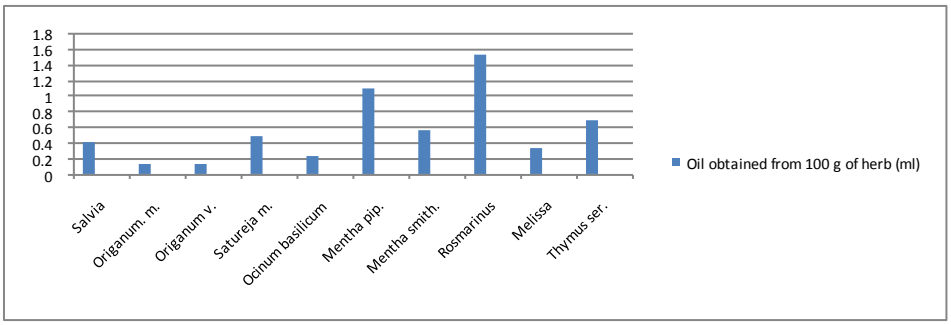

Figure 1: Quantity of oil obtained from 100 g of herb from each species (ml)

The highest quantity of volatile oil was obtained from *Mentha piperita L,* 40.5ml, because this plant has the largest cultivated area from all of the studied plants. From 100 g of dried herb, the most oil was obtained from *Rosmarinus officinalis L.*, with 1.53 ml oil in 100 g of herb, followed by *Mentha piperita L.,* with 1.11 ml obtained from 100g of herb. The herbs with the least essential oil content were *Melissa officinalis L.*, with 0.33 ml of oil in 100 g of herb, *Ocinum basilicum L.* with 0.23 ml of oil obtained from 100g of dried herb, *Origanum majorana L* with 0.13 of oil obtained from 100g of dried herb and *Origanum vulgare L.*, with 0.14 ml of oil obtained from 100g of dried herb. *Melissa officinalis L.* had the best drying efficiency with 45.97%, followed by *Origanum vulgare L.* with 43.83%, *Rosmarinus officinalis L.* with 42.27%, *Ocinum basilicum L.* with 39.19% and *Origanum majorana* with 39.16%. *Thymus serphyllum L.* had a low efficiency with 30.36%, followed by *Mentha piperita L.* with 31.02%, *Satureja Montana L.* with 31.18 and *Salvia officinalis* with 31.88%.

CONCLUSIONS

The year 2013 had a good climate for the development of plants from Lamiaceae family in the western part of Romania. Precipitations were high in spring, in the plants development period and in summertime was hot, sunny but also with precipitations. *Mentha piperita L.*, the plant that accumulated the most oil was harvested after several weeks of sunny weather. High temperatures and light enhaced the growth of essential oil in the plant.

Melissa officinalis L., Origanum vulgare L. and Ocinum basilicum are the plants that accumulate the least essential oil from all the 10 plants studied and *Mentha piperita L.* and *Rosmarinus officinalis L.* are the plants that accumulate the most essential oil. The method of deep-freezing for the separation of oil and water offered certainty that the obtained oil is 100 pure.

The pedoclimatic conditions from the West Plain of Romania are favorable for medicinal plants from the Lamiaceae family. All the species cultivated in 2011-2013 period at Young Naturalists Resort had a good development and bloom according to the known graphs.

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