BIOCHEMICAL DIVERSITY OF THE *ORIGANUM VULGARE* SSP. *VULGARE* L. AND *ORIGANUM VULGARE* SSP. *HIRTUM* (LINK) IETSWAART GENOTYPES FROM MOLDOVA

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Introduction

Origanum vulgare L. (Oregano) is a herbaceous perennial species from the family of *Lamiaceae* known and used for centuries. Multiple investigations have been carried out in different countries [16, 20, 31, 32, 33] to use and put in value the species. Different biotypes, genotypes, forms, and taxons of Oregano have a strictly local distribution and are distinguished through accentuated morphological and biochemical diversity [11, 19] which is confirmed by the studies on the species, subspecies in the definite areal of prevalence. The relevance of the studies on provenance of Oregano is also determined by the importance of the species as a medicinal, aromatic, culinary, spicy, ornamental, and meliferous plant, supported by the chemical composition – essential oil, flavonoides, vitamins etc. synthesized and accumulated in the aerial part of the plant [34]. Thus, the essential oil [6, 35, 37] and, especially, its major components – carvacrol and thymol, are responsible for the antimicrobial [7, 9, 21], antifungal [8, 24, 40] and antioxidant [7, 22, 25, 27, 37, 41, 42] action, as well as the capacity to inhibit bacterium growth [6, 7, 24, 29, 36, 38]. Oregano essential oil is also successfully employed for its antispastic and antiseptic action [7, 40]. In addition, *O.vulgare* possesses sedative, carminative, emenagogous, diuretically, and other actions. It is also utilized as an aromatizer, preservative in food products [15]. The antimicrobial and antifungal properties of *Origanum vulgare* essential oil are successfully employed for flavouring and preservation, storage of food products [3, 8, 9, 11, 36]. It is known that the decoction of *O.vulgare* possesses antioxidant activity, while its hydroalcoholic extract demonstrates antimicrobial effect [24]. O. vulgare extracts and essential oil are strong candidates to replace synthetic chemicals used by the industry [38]. Six subspecies have been recognized within *O. vulgare* L.: subsp. *vulgare* L., subsp. *glandulosum* (Desfontaines) Ietswaart, subsp. *gracile* (Koch) Ietsw., subsp. *hirtum* (Link) Ietsw. subsp. *virens* (Hoffmanns. & Link) Ietsw, subsp. *viridulum* (Martrin-Donos) Nyman [18].

This work is a continuation of our previous research [13, 14] which includes new genotypes selected for the essential oil content of *Origanum vulgare* L. subsp. *vulgare* and *Origanum vulgare* L. subsp. *hirtum* (Link) Ietswaart. [18].

Materials and methods

The biological material is presented by five genotypes of *O.vulgare* ssp. *vulgare* L. (Ovv) and five genotypes of *O.vulgare* ssp. *hirtum* (Link) Ietswaart (Ovh). The genotypes have been selected from the Aromatic and Medicinal Plant Laboratory collection of the Institute of Genetics, Physiology and Plant Protection. In order to determine the content of essential oil, the samples of fresh herbs, aerial part of the plant, were harvested in the morning hours at the flowering stage. Essential oil was isolated by hydrodistillation for 60 minutes, using the Ginsberg apparatus: 50 g of fresh aerial part per 200 ml of water. The content of the essential oil was recalculated per dry matter. Following distillation, the essential oil was dried over anhydrous sodium sulphate and stored at 4-6 °C. Qualitative and quantitative analyses of the essential oil was conducted using GC coupled with Mass Spectrometry (GC-MS): gas chromatograph -

Agilent Technologies 7890; mass selective detector 5975C Agilent Technologies with a quadruple, capillary column (30m x 0.25mm i.d., film thickness 0.25 μм) at the HP-5ms non-polar stationary phase. The injector and detector temperatures were 250 °C and 280 °C, respectively, using a temperature gradient from T1 = 70° C (2 min), T2 = 200° C (5° C/min) to T3 = 300° C (20° C/min, 5 min). Mobile phase: helium 1ml/min, injected volume of essential oil - 0,03 μl, split rate - 1:100. The identification of the chromatographic peaks was performed with the aid of the software package AMDIS ™, coupled with NIST database. Extraction and total polyphenols determination were carried out by means of procedure according to method described in European Pharmacopoeia with modifications – only total polyphenols were determined, measurements of phenolic compounds not adsorbed by hide powder were not performed. The amount of polyphenols was determined spectrophotometrically, expressed in gallic acid according European Pharmacopeia (5,0:221) with modifications [26].

Results and discussion

The earlier investigations on the assessment of the *Origanum vulgare* L collection have demonstrated the phenotypical diversity corraborated by both the indices of quantitative characters and differences in the content and qualitative and quantitative composition of the essential oil of *O.vulgare* ssp. *vulgare* L. (Ovv) and *O.vulgare* ssp. *hirtum* (Link) Ietswaart (Ovh) [13,14].

The assessment of the promising Ovv and Ovh genotypes in view of the content of the essential oil has confirmed the findings of the precedent years [11,12] that the subspecies *O.vulgare* ssp. *vulgare* is poorer in essential oil than the subspecies *O.vulgare* ssp. hirtum (Table 1) and that this important character varies in the genotypes of the both species considerably. Thus, in the case of the *O.vulgare* ssp. *vulgare* subspecis, the content of essential oil varies from 0,168 % (dry matter) in the Ovv2-38 genotype to 0,360 % (dry matter) in the genotype Ovv7-38. The *O.vulgare* ssp. *hirtum* genotypes are characterized by an elevated content of essential oil, the indices of this character ranging from 2,315% (dry matter) (genotype Ovh7-4) to 4,705% (dry matter), 4,923% (dry matter) in the genotypes Ovh8-40 and Ovh1-78.

A similar difference in the content of essential oil was recorded in Hungary [17] for *O.vulgare* ssp. *hirtum* and in China and Pakistan for Origanum vulgare [15]. Estimation of the essential content in *O. vulgare* (ssp. *vulgare* and ssp. *hirtum*) from the wild flora of Albania also confirms the variability of this character [12]. A very high difference in the content of essential oil (0.1%-1.8%) has been attested in O.vulgare ssp. vulgare in Austria [23]. The variability of this character has also been recorded for the species *O.vulgare* ssp. *glandulosum* (Desf.) Ietswaart (2,5-4,6 %) in Tunisia [27]. It has been also demonstrated that breeding programs have resulted in the development of *O.vulgare* ssp. *hirtum* genotypes characterized by a very high content of essential oil (7-8, 6%) [35].

Table 1. Variability of the essential oil content in the genotypes *Origanum vulgare* ssp. *vulgare* L. and *Origanum vulgare* ssp. *hirtum* (Link) Ietswaart

Origanum vulgare ssp. vulgare		Origanum vulgare ssp. hirtum	
Genotypes	**Essential oil content, % (dry matter)**	**Genotypes**	**Essential oil content, % (dry matter)**
Ovv 2-38	0,168	Ovh 7-40	2,315
Ovv 3-38	0,077	Ovh 8-40	4,705
Ovv 5-38	0,205	Ovh 1-78	4,923
Ovv 6-38	0,239	Ovh 4-78	3,505
Ovv 7-38	0,360	Ovh 6-87	3,540

The *O.vulgare* ssp. *vulgare* stands out for both the content of essential oil and its composition. Qualitative and quantitative analyses performed through GC GC-MS techniques have identified in the essential oil of *O.vulgare* ssp. *vulgare* from 18 components in the genotype Ovv2-38 to 29 components in the genotype Ovv7-38, the identifcation being at a propotion of 92,38%-98,80% (Table 2). Our earlier investigation [13, 14] has revealed forty one components in other genotypes. Some authors have identified forty two components in the *O. vulgare* ssp. *vulgare* population in Lithuania [30] and Germany [2]. In Austria though, a higher number (53) of components has been identified [23].

The concentration of the components identified in the essential oil isolated from the genotypes *O. vulgare* ssp. *vulgare* varies with the genotype. The major component of the essential oil in the genotype of this subspecies is D-germacrene that recorded the values of 26,01%- 33,98% (Table 2). The second major component is β-caryophyllene. This component demonstrated values ranging between 12,16% in the genotype Ovv3-38 and 33,16% in the genotype Ovv6-38. The other component, (+)β-bisabolene is contained at insignificant concentrations in the essential oil isolated from the genotypes Ovv7-38 (6,83%), Ovv5-38 (9,62%), Ovv2-38 (12,65%), and Ovv6-38 (16,04%), while it has not been identified in the essential oil in the genotype Ovv3-38. γ-elemene is present in the essential oil of all the genotypes at a relatively increased concentrations making 3,56%-16,79 %.

The essential oil extracted from all the *O. vulgare* ssp. *vulgare* genotypes assessed contains β-bourbonene, β-caryophyllene, γ-cadinene, γ-muurolene, caryophyllene oxide, β- guaiene, and δ-cadinole, ordinarily, at minor concentrations. The other two components, 1-butanol-3-methyl-acetate and trans-ocimene have been identified in each of the four genotypes at values ranging between 0,83% and 1,88% and 0,57% and 2,81%, respectively. As for the minor components, the presence of thymol (0,32% – 1,45%) has been shown in three genotypes of Ovv5-38, Ovv6-38, Ovv7-38 and that of Carvacrol (0,54% – 3,58%) in the essential oil of the genotypes Ovv3-38, Ovv5-38, Ovv6-38. The earlier assessed genotypes [13, 14] also contained carvacrol and thymol in the essential oil though at more elevated concentrations. Thymol occurs at low concentrations in the oil of our genotypes. A similar value has been attested for this species in Hungary [43]. In total, the presence of thirteen minor components has been demonstrated for the essential oil in each of the three genotypes (Table 2).

Thus, we can conclude that the essential oil major components in the *O. vulgare* ssp. *vulgare* genotypes assessed include Germacrene D (26.01–33.98%); β-caryophyllene (12,16-33,16%); γ-elemene (3,56-16,79%); while β-bisabolene (6,83-16,04) is the major component in four genotyps, their concentrations varying considerably. The chemotypes of *O. vulgare* ssp. *vulgare* are following: 1. germacrene D/ β-caryophyllene/ β-bisabolene; 2. germacrene D/ β-caryophyllene/δ-cadinole/ γ-elemene; 3. germacrene D/ γ-elemene/ β-caryophyllene/ β- bisabolene; 4. β-caryophyllene/ germacrene D/ β-bisabolene; 5. germacrene D/ β-caryophyllene/γ-elemene/β-bisabolene.

These genotypes differ from the earlier assessed ones of *O. vulgare* ssp. *vulgare* [13, 14] in both the number of major compound and their concentrations. For example, germacrene D and β-caryophyllene occur at much more elevated concentrations, while ocimenele (cis- and trans-), on the contrary, at quite low ones. The variability of the number and concentrations of the major components contained in the essential oil of *O. vulgare* ssp. *vulgare* from wild flora in other countries also varies within considerable limits. So, the specimen from wild flora of Lithuania contains in the essential oil the following major components: β-ocimene, germacrene D, β-caryophyllene, and sabinene, each component at different concentrations in the specimen from various localities [30].

The major components of the essential oil isolated from the *O. vulgare* collected in wild flora of Kosovo include sabinene, 1,8-cineole, caryophyllene oxide, β-caryophyllene, p-cymene, α-terpineol, and germacrene D with an accentuated variability in the concentration of each component [28]. It should be mentioned that β-caryophyllene in some of our genotypes occurs at much higher concentrations than those recorded in Kosovo.

Table 2. The qualitative and quantitative composition of *Origanum vulgare* ssp. *vulgare* L. essential oil

Nr. pic	Component	Rt	Area %				
		sample	Ovv2-38	Ovv3-38	Ovv5-38	Ovv6-38	Ovv7-38
1	1-Butanol-3-methyl-acetate	3,55	1,65	-	1,88	0,91	0,83
5	Sabinene	5,42	-	1,59	0,62	-	4,16
6	1-Octen-3-ol	5,45	-	-	-	-	-
7	β-Pinene	5,52	-	-	-	-	-
8	3-Octanone	5,64	-	-	-	-	-
9	β-Mircene	5,74	-	-	-	-	0,33
10	3-Octanol	5,82	-	1,68	-	-	-
11	α-fellandrene	6,10	-	-	-	-	-
12	γ-Terpinene	6,37	-	-	-	-	-
13	p-Cymene	6,56	-	-	1,19	0,11	0,54
14	Limonene	6,67	-	-	-	-	0,48
15	Eucalyptol	6,74	-	-	-	-	-
16	trans-Ocimene	6,82	-	1,76	0,57	0,85	2,81
17	cis-Ocimene	7,08	-	1,15	-	1,72	1,50
18	γ-terpinene	7,38	-	-	2,11	0,29	0,78
19	4-Thujanol	7,60	-	-	-	-	-
20	Linalool	8,38				0,37	1,07
21	Camphor	9,46	-	-	-	-	-
22	Borneol	10,18	-	-	-	-	-
23	4-Terpineol	10,48	-	0,75	-	0,49	2,09
24	α-Terpineol	10,82	-	-	-	-	0,73
25	Timol metil ether	12,22	-	-	-	-	-
26	Linalyl acetate	12,51	0,46	-	-	0,57	0,46
27	Timol	13,45	-	-	1,45	0,69	0,32
28	Carvacrol	13,82	-	2,91	3,58	0,54	-
29	2.5-Diethylphenol	13.99	-	-	-	-	-
30	β-Bourbonene	15,97	0,96	2,28	0,79	0,66	1,15
31	β-Caryophyllene	16,86	31,45	12,16	15,02	33,16	13,21
32	β-Cubebene	17,08	0,73	-	0,75	-	0,33
33	Undecadien-2-one,6,10-dimethyl	17.57	0,51	-	0,59	-	-
34	α-Caryophyllene	17,70	1,59	2,10	1,03	1,48	1,60

35	(+)Aromadendrene	17,88	-	1,31	-	0,36	1,06
36	D-Germacrene	18,38	32,29	26,01	33,98	32,78	31,02
37	Humulene	18.60	0,60	-	-	0,51	0,39
38	γ-Elemene	18,75	3,82	6,75	16,79	3,56	8,32
39	(+)β-Bisabolene	18,98	12,65	-	9,62	16,04	6,83
40	γ-Cadinene	19,36	1,40	3,95	0,94	1,06	2,96
41	γ-Muurolene	20,61	2,27	5,64	0,77	1,23	5,65
42	(-)Spatulenol	20.66	0,97	2,23	2,46	-	-
43	Caryophyllene oxide	20,81	2,18	3,52	1,37	0,58	1,54
44	β-Guaiene	22,10	2,27	5,84	1,10	0,75	3,01
45	δ-Cadinole	22,39	2,41	9,11	1,26	0.86	4,37
46	α-Muurolene	23,23	0,45	1,61	-	-	0,45
47	Sclareol	31,26	-	-	0,73	0,49	0,10
No. identified compounds			18	19	22	24	29
Total, identified compounds %			98,66	92,38	98,60	98,80	98,09

In the essential oil of some provenances of *O. vulgare* ssp. *vulgare* in Turkey, the major components include caryophyllene oxide (34.44%), β-caryophyllene (20.40%), and δ-cadinol (7,02%) [4]. The last component, δ-cadinol, has been also recorded in the genotypes *O. vulgare* ssp. *vulgare* assessed by us, its concentration varying from 0,8% to 9,11% (Table2), and in the oil of the earlier assessed genotypes [13,14]. In the other species, *O. vulgare* L. ssp. *viride* (Boiss), ocimene is the major component (35.1%) with the highest concentration [3]. In our *O.vulgare* ssp. *vulgare* genotypes, ocimenes are minor components and they are not present in the essential oil of all the genotypes assessed.

The qualitative and quantitative analyses of the essential oil separated by hydrodistillation from five *O. vulgare* ssp. *hirtum* genotypes have revealed a different number of components, it varying between 18 in Ovh8-40, 25 in Ovh4-78 and Ovh6-87, representing 99,87 to100% of the total essential oil extracted (Table 3). Other researchers have detected from 19 [21] to 56 [33] and even 81 [39, 40] or 103 [25] components.

The major components of the essential oil in all the *O. vulgare* ssp. *hirtum* genotypes evaluated are carvacrol at a concentration varying between 74.63% and 88.13% depending on the genotype. The second major component is γ-terpinene (3,59-10.69%), followed by p-cymene (2,23-5,06%), the rest of the components being minor at concentrations up to 1% or some of them being at concentrations slightly increased in some genotypes as in the case of β-Caryophyllene (1,49-2,10%) and α-terpinene (1,24-1,45%) (Table 3).

It can be concluded following from the above that carvacrol (74.63-88.13%), γ-terpinene (3,59-10,69%), and p-cymene (2,23-5,06%) are the major components in the essential oil of the genotypes *O. vulgare* ssp. *hirtum* assessed. The *O.vulgare* ssp. *hirtum* genotypes are divided into two chemotypes: 1-Carvacrol/γ-terpinene/p-Cymene and 2- Carvacrol/γ-terpinene/p-Cymene/β-Caryophyllene.

Elevated concentrations of carvacrol (70-93%), that is the major component in the essential oil of *O. vulgare* ssp. *hirtum*, have been found by other authors [25, 31, 35, 43] in both *O. vulgare* ssp. *hirtum* and *O. vulgare* ssp. *scabrum* [1]. In the essential oil of *O.vulgare* ssp. *hirtum* from Sicilia, the major components are thymol (24,0-54,4%), γ-terpinene (9,8-30,5%), p-cimene (5,2%) [40]. Thymol is shown to be one of the major components along with carvacrol in *O.vulgare* ssp. *hirtum* growing wild in Southern Italy [11, 12, 33]. In other biotypes of Italy, the major components are thymol and alfa-terpineol, or linalyl acetate and linalool [11]. Other samples of Albania have the major components thymol, carvacrol, linalool and thymol in Albania [12]. In O. onites essential oil the major components are carvacrol, thymol and linalool [19]. In the essential oil of our genotypes, linalool is a minor component, but linalyl acetate has not been identified.

It has been found that the content and composition of the essential oil are stable in both *O. vulgare* ssp. *vulgare* and *O. vulgare* ssp. *hirtum* during the whole flowering period, which is the time of harvesting [43]. The highest oil content in *O. onites* is at the full flowering stage [19]. According to the findings published by some authors, the content and composition of the essential oil are not dependent on the cultivation conditions of *O. vulgare* (ssp. *hirtum, creticum, samothrake*) [2]. Other researchers claim that the concentration of the major components (sabinene and ocimene) is dependent on the cultivation conditions [9]

Table 3. The essential oil qualitative and quantitative composition of *O. vulgare* ssp. *hirtum* (Link) Ietswaart

Nr. pic	Component	Rt	Area %				
		sample	Ovh 7-40	Ovh 8-40	Ovh 1-78	Ovh 4-78	Ovh 6-87
1	1-Butanol-3-methyl-acetate	3,55	-	-	-	-	-
2	Origanene	4,48	0,45	0,28	0,40	0,90	0,64
3	α-Pinene	4,64	0,19	0,12	0,17	0,41	0,25
4	Camfene	4,95	0,06	-	0,04	0,14	0,07
5	Sabinene	5,42	-	-	-	0,15	-
6	1-Octen-3-ol	5.45	0,42	0,19	0,16	0,11	0,27
7	β-Pinene	5,52	0.06		0,05	0,11	0,07
8	3-Octanone	5,64	-	-	0,05	-	-
9	β-Mircene	5,74	0,78	0,71	0,78	1,35	0,97
10	3-Octanol	5,82	-	-	-	-	-
11	α-fellandrene	6,10	0,10	-	0,10	0,16	0,13
12	α-terpinene	6,37	0,62	0,90	0,59	1,45	1,24
13	p-Cymene	6,56	2,35	2,45	2,23	5,06	3,56
14	Limonene	6,67	0,17	-	0,18	0,29	0,22
15	Eucaliptol	6,74	-	-	-	0,16	-
16	trans-Ocimene	6,82	-	0,16	-	-	0,10
17	cis-Ocimene	7,08	-	-	0,04	0,11	0,07
18	γ-terpinene	7,38	4,10	8,84	3,59	10,69	9,72
19	4-Thujanol	7,60	0,31	0,15	0,49	0,41	0,36
20	Linalool	8,38	0,20	0,62	0,17	0,17	0,24
21	Camphor	9,46	-	-	-	-	-
22	Borneol	10,18	0,24	0,27	0,24	0,42	0,36
23	4-Terpineol	10,48	0,37	0,28	0,33	0,44	0,33
24	α-Terpineol	10,82	0,10	-	0,09	0,15	0,09

25	Timol metil eter	12,22	0,07	-	-	0,10	-
26	Linalyl acetate	12,51	-	-	-	-	-
27	Timol	13,45	0,24	0,17	0,23	0,20	0,23
28	Carvacrol	13,82	87,14	82,63	88,13	74,63	79,54
29	2.5-Diethylphenol	13.99	0,31	-	-	-	-
30	β-Bourbonene	15,97	-	-	-	-	-
31	β-Caryophilene	16,86	0,98	1,49	0,85	2,10	0,76
32	β-Cubebene	17,08	-	-	-	-	-
34	α-Caryophyllene	17,70	0,15	0,23	0,13	0,17	0,11
35	(+)Aromadendrene	17,88	-	-	-	-	-
36	D-Germacrene	18,38	0,24	0,19	-	-	0,13
37	Humulene	18.60	-	-	-	-	-
38	γ-Elemene	18,75	-	-	-	-	-
39	(+) β-Bisabolene	18,98	0,35	0,34	0,45	0,12	0,23
No. identified compounds			24	18	24	25	25
Total identified compounds, %			99,94	100	99,87	100	99,94

Some studies have concluded that the productivity and content of the essential oil in O. vulgare depend on the techniques of planting material production [5].

Antioxidant action of Origanum vulgare species is supported not only by the essential oil, but also by the polyphenols that contains the plant. From this point of view, the genotypes of O.vulgare ssp. vulgare as well as O.vulgare ssp. hirtum were evaluated in the content of polyphenols. The obtained results demonstrate the variability of the content of these compounds in the genotypes of both subspecies. Rich in polyphenols, expressed as gallic acid (GA) (mg/100g) are genotypes belonging O.vulgare subspecies ssp. vulgaris: from 99,25 ± 1,598 to 166,43± 3,594. The genotypes of O.vulgare ssp. hirtum, synthesizes and accumulate polyphenols from 53,51± 0,684 to 85,59±0,719 mg/100g.

The results should be confirmed that between the essential oil and polyphenols content of O.vulgare subsp. vulgare as well as O.vulgare ssp. hirtum there is a negative correlation: A high content of essential oil correlate with the low polyphenols content.

Conclusion

The diversity of Origanum vulgare ssp. vulgare L. and Origanum vulgare L. ssp. hirtum (Link) Ietswaart genotypes has been confirmed through the essential oil content, qualitative and quantitative components.

The content of essential oil varies between 0,077% and 0,360% in the genotypes O.vulgare ssp. vulgare, and between 2,315% and 4,923% in the O.vulgare ssp. hirtum genotypes.

Qualitative and quantitative analyses performed using GC GC-MS techniques have found from 18 to 29 components in the O.vulgare ssp. vulgaris essential oil, depending on the genotype, the identification ratio being 92,38%-98,80%.

The component number varies between 18 and 25 depending on the genotypes of O. vulgare ssp. hirtum, this constituting 99,87%-100 % of the essential oil.

The major components in the essential oil of O. vulgare ssp. vulgare include Germacrene D (33,98–26,01%); β-Caryophyllene (12,16–33,16%); γ-Elemene (3,82 – 16,79%), while β- Bisabolene (6,83-16,04) is the major component in four genotypes.

The O. vulgare ssp. vulgare genotypes are divided into five chemotypes: 1. germacrene D/β-caryophyllene/β-bisabolene; 2.Germacrene D/β-caryophyllene/δ-cadinole/ γ-elemene; 3. germacrene D/ γ-elemene/ β-caryophyllene/ β- bisabolene; 4. β-caryophyllene/ germacrene D/ β- bisabolene; 5. germacrene D/ β-caryophyllene/γ-elemene/β- bisabolene.

The major components in the essential oil of O. vulgare ssp. hirtum are carvacrol (77,61-85,88%), followed by p-cymene (3,64-9,33%) or γ-terpinene (8,22%) and p-cymene (5,30%).

The O.vulgare ssp. hirtum genotypes are divided into two chemotypes: 1-carvacrol/ γ-terpinene/p-cymene and carvacrol/γ-terpinene/p-cymene/ β-caryophyllene.

The variability of the content of polyphenols in the genotypes of both evaluated subspecies has been demonstrated. Rich in polyphenols, expressed as gallic acid are genotypes belonging O.vulgare ssp. vulgaris: from 99,25 ± 1,598 to 166,43±3,594 mg/100g. The genotypes of O.vulgare ssp. hirtum, synthesizes and accumulate polyphenols from 53,51± 0,684 to 85,59±0,719 mg/100g and O.vulgare ssp. hirtum – from 53,51± 0,684 to 85,59 ± 0,719mg/100g.

The results should be confirmed that between the essential oil and polyphenols content in both species is a negative correlation: A high content of essential oil correlate with the low polyphenols content.

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References

1. *Aligiannus N., et. al.* Composition and antimicrobial activity of the essential oils of two *Origanum* species. // J. of Agricultural and Food Chemistry. 2001, 49 (9):4168-4170.
2. *Azizi A., et. al.*Herbage yield, essential oil content and composition of three oregano (Origanum vulgare L.) populations as affected by soil moisture regimes and nitrogen supply. // Industrial Crops and Products. 2009, 29 (2-3):554-561.
3. *Baðcý Y., et. al.* Aroma profile of *O. vulgare* L. subsp. *viride* (Boiss.) Hayek, Satureja hortensis L. and Thymbra sintenisii Bornm. & Aznav. subsp. isaurica P.H. Davis used as condiment and herbal tea in Turkey. //J. of Essential Oil Bearing Plants, Online. 2013, 8 (3):304-311.
4. *Bozari Sedat, et. al.* Chemical content, and toxic effects of essential oil of *O. vulgare* L. ssp vulgare against Zea mays Seedlings. // J. of Essential Oil Bearing Plants. 2014, 17 (1):67-77.
5. *Boyko E., Konik R.* The productivity of *O. vulgare* and *O. tyttanthum,* dependently from the methods of planting material producing. // Modern Phytomorphology. 2012, 2:79-81.
6. *Busatta C., et. al.* Evaluation of *O. vulgare* essential oil as antimicrobial agent in sausage. // Braz. J. Microbiol. 2007, 38 (4):610-616.
7. *Cengiz Sarikurkcua, et. al.*Composition, antioxidant, antimicrobial and enzyme inhibition activities of two *O. vulgare* subspecies (subsp. *vulgare* and subsp. *hirtum*) essential oils. Industrial Crops and Products. Elsevier. 2015, 70:178-184.
8. *Cleff M. B., et. al.* In vitro activity of *O. vulgare* essential oil against *Candida* species. // Braz. J. Microbiol. 2010, 41 (1):116-123.
9. *De Falco E., et. al.* Chemical Composition and Biological Activity of Essential Oils of *O. vulgare* L. subsp. *vulgare* L. under Different Growth Conditions. //Molecules. 2013, 18 (12):14948-14960.
10. *De Martino L., et. al.* Chemical composition and antimicrobial activity of the essential oils from three chemotypes of *O. vulgare* L. ssp. *hirtum* (Link) Ietswaart growing wild in Campania (Southern Italy).// Molecules, 2009, 14 (8):2735-2746.
11. *Elezi F., et. al.* Genetic variation of oregano (*O. vulgare* L.) for etheric oil in Albania. // J. Agricultural Sciences. 2013, 4 (9):449-454.
12. *Gonceariuc, M. et. al.* Genotipuri perspective de *O. vulgare* ssp. *vulgare* L. și *O. vulgare* ssp. *hirtum* (Link) Ietswaart. // Buletinul ASM Ştiinţele vieţii. 2014, 1 (322):41-50.
13. *Gonceariuc, M. et. al.* Essential oil of *O. vulgare* ssp. *vulgare* L. and *O. vulgare* ssp. *hirtum* (Link) Ietswaart from Moldova: Content and Chemical Composition. // International J. of Agriculture Innovations and Research. 2014, 3(2): 659-663.
14. *Gongabc, HY., et. al.* Analysis of essential oils of *O. vulgarefrom* six production areas of China

and Pakistan. Revista Brasileira de Farmacognosia. 2014, 24 (1) Curitiba Jan./Feb.:241-249.

15. *Gottumukkala V. R., et. al.* Chemical constituents and biological studies of *O. vulgare* L. // Pharmacognosy Res. 2011, 3 (2):143–145.

16. *Horváth H., et. al.*Evaluation of selected *O. vulgare* subsp. *hirtum* (Link) Ietswaart clones, by "electronic nose". // J. Acta Horticulturae. 2002, 576:61-64.

17. *Ietswaart JH.* A taxonomic revision of the genus *Origanum* (Labiatae), Leiden Botanical series, Leiden University Press, The Hague, Leiden.1980, 4:266-269.

18. *Kizil S., et. al.* Effect of different developing stages on some agronomical characteristics and essential oil composition of *Oregano* (*Oregano onites*). // New Zeland Journal of Crop and Horticultural Science. 2010, 36/1:71-76.

19. *Kokkini S.* Taxonomy, diversity and distribution of Origanum species. Oregano. // Proceedings of the IPGRI International Work ship on Oregano. CIHEAM, Italy, 1996:2-12.

20. *Koukoulitsa C., et. al.* Polar constituents from the aerial parts of *O. vulgare* L. ssp. hirtum growing wild in Greece. // J. Agriculture Food Chemistry. 2006, 54 (15):5388-5392.

21. *Kulisic T., et. al.* Antioxidant activity of herbal tea infusions. Food Technol. Biotechnol. 2006, 44 (4):485-492.

22. *Lukas B., et. al.* Phytochemical diversity of *O. vulgare* L. subsp *vulgare* (Lamiaceae) from Austria. // Biochemical Systematic and Ecology. 2013, 50:106-113.

23. *Martinis N., et. al.* Decoction, infusion and hydroalcoholic extract of *O. vulgare* L.: Different performances regarding bioactivity and phenolic compounds. // Food Chemistry, 2014, 158(1):73-80.

24. *E. Mancini, I. Camele, et. al.* Chemical composition and biological activity of the essential oil of *O. vulgare* ssp. *hirtum* from different areas in the Southern Apennines (Italy). // Chemistry & Biodiversity, 11 (4), Apr. 2014:639-651.

25. *Modnicki D. et. al.* Estimation of total polyphenols contents in *O. basilicum* L., *O. vulgare* L. and *T. vulgaris* L. commercial samples. // HerbaPpolonica. 2009, 55 (1):36-42.

26. *Mechergui K., et. al.* Essential oils of *O. vulgare* ssp. glandulosum (Desf.) Ietswaart from Tunisia: chemical composition and antioxidant activity. // J. Science of Food and Agriculture. 2010, 90 (10):1745-1749.

27. *Mjellma H., et. al.* Analysis of volatile compounds of O. *vulgare* L. growing wild in Kosovo. J. of Essential Oil Bearing Plants. 2014. 17(1):48-157.

28. *Mitchell T. C., et. al. O. vulgare* L. Essential oil as inhibitor of potentially toxigenic Aspergilli. // J. Ciência e Tecnologia de Alimentos. 2010, 30 (3):389-394.

29. *Mockute D, et. al.* The essential oil of *O. vulgare* L. ssp. *vulgare* growing wild in Vilnius district (Lithuania) // Phytochemistry. Elsevier, 2001, 57(1): 65-69.

30. *Novak I., et. al.* Effect of the drying method on the composition of *O. vulgare* L. subsp. *hirtum* essential oil analysed by GC-MS and sensory profile method. // Acta Alimentaria. 2011, 40 (Suppl.13):130-138.

31. *Prathyusha P., et. al.* Pharmacognostical and phytochemical studies on *O. vulgare* L.(Lamiaceae) Ancient Science of Life. 2009, 29 (2):17–23.

32. *Russo M., et. al.* Essential oil chemical composition of wild populations of italian oregano spice (*O. vulgare* ssp. *hirtum* (Link) Ietswaart): A Preliminary Evaluation of Their Use in Chemotaxonomy by Cluster Analysis. 1. Inflorescences.// J. Agricultural and Food Chemistry. 1998, 46(9):3741-3746.

33. *Shayista Chishti et. al.* Medicinal importance of genus Origanum. J. of Pharmacognosy and Phytotherapy. 2013, 5(10):170-177. DOI: 10.5897/JPP2013.0285 ISSN 2141-2502

34. *Szabó K., et. al.* Can glandular hair density be a breeding marker for *O. vulgare* subsp. *hirtum* with high essential oil content? // Natural Product Communications. 2010, 5 (9):1437-1440

35. *Souza E. L., et. al.* Sensitivity of spoiling and pathogen food-related bacteria to *Origanum vulgare* L. (*Lamiaceae*) essential oil. // Braz. J. Microbiology. 2006, 37 (4):527-532.

36. *Spiridon I., et. al.* Antioxidant capacity and total phenolic contents of oregano (*Origanum vulgare*), lavender (*L. angustifolia*) and lemon balm (*M. officinalis*) from Romania. // Nat. Prod. Res. 2011, 25 (17):1657-1661.

37. *Teixeira B., et. al.* Chemical composition and bioactivity of different oregano (*O. vulgare*) extracts and essential oil. // J. Sciences Food Agric. 2013, 61(6):1189-1195.

38. *Tuttolomondo T., et. al.* Biomolecular characterization of wld sicilian oregano: phytochemical screening of essential oils and extracts, and evaluation of their antioxidant activities. // Chemistry & Biodiversity. 2013, 10(3):411-433. doi:10.1002/cbdv. 201200219

39. *Tuttolomondo T., et. al.* Essential oil characteristics of wild *S. oregano* populations in relation to environmental conditions. // J. of Essential oil Research. 2014, 26:210-220. doi:10.1080/10412905.2014.882278.

40. *Vale-Silva L., et. al.* Correlation of the chemical composition of essential oils from *Origanum vulgare* subsp. virens with their in vitro activity against pathogenic yeasts and filamentous fungi. //J. Medical Microbiology. 2012, 61(2):252-260.

41. *Vazirian M., et. al.* Chemical composition and antioxidant activity of *Origanum vulgare* ssp. *vulgare* essential oil from Iran. Research J. of Pharmacognosy. 2015, 2(1):41-46

42. *Veres K., et. al.* Investigation of the composition and stability of the essential oils of *O. vulgare* ssp. *vulgare* L. and *O. vulgar*e ssp. *hirtum* (Link) Ietswaart.// J. Chromatographia, Springer. 2003, 57(1-2-):95-98.