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Components of essential oil of *Veronica longifolia* L. leaves and flovers

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By means of chromatography-mass spectrometry the essential oil composition of *V. longifolia* L. had been studied for the first time. In the result of the study 63 compounds had been identified and quantified, of which 38 had been found in flowers, and 53 – in leaves, 57 compounds had been identified, 28 of the identified compounds had been found in both samples of herbal drugs, including aromatic compounds, terpenoids, sesquiterpenoids, fatty acids and their esters, carbohydrates. The amount of triterpenoid squalene was high in all studied samples.

Keyword: *Veronica longifolia* L., essential oil, chromatography-mass spectrometry.

1. Introduction

A critical analysis of scientific primary sources had shown that the chemical composition of *V. longifolia* L. (*Plantaginaceae*) [7] is studied poorly [1, 2, 3, 6, 13], what creates conditions for further in-depth phytochemical studies of this specie. *V. longifolia* L. is used in folk medicine as an expectorant, anti-inflammatory and anti-bacterial remedy for diseases of the upper respiratory tract [4, 5, 10, 11, 14], so it may be a promising species for use in official medicine [9]. Therefore, the study of different groups of biologically active substances of *V. longifolia* L. is urgent.

The **aim of our study** was the comparative study of essential oil composition of *V. longifolia* L. leaves and flowers.

The objects of the study were leaves and flowers of *V. longifolia* L., that have been harvested in the flowering stage in Kharkiv region, Ukraine, in 2012.

2. Materials and Methods: The essential oil had been obtained by the method of microsteam distillation with following processing of distillate by pure pentane, which enables to extract essential oil present in small amount.

The analysis of the essential oil of *V. longifolia* L. leaves and flowers had been performed using chromatography-mass spectrometer Agilent Technology HP6890 GC with mass spectrometric detector 5973N.

«Agilent» 22 ml vials had been used for distilling of essential oil. Volatile compounds had been washed from the condenser to vial by pentane and concentrated by blowing with nitrogen.

The analysis conditions: quartz and capillary chromatographic column HP-5MS. A length of column – 30 m, an internal diameter – 0.25 mm, carrier gas – helium, a speed of carrier gas 1 ml/min. The injection of 2 µl of sample was performed in a mode *splitless*. The temperature of detector and evaporators – 250 °C. Internal standard – tridecane, content of essential oil in total content had been calculated in relation to it.

3. Results and Discussion

The content of essential oil in leaves was 0.62% and 0.82% – in flowers.

Obtained spectra had been analyzed as based on general laws of fragmentation of organic compounds molecules under the action of the electron impact, as by comparing the results with the data from library: for each chromatographic peak the averaged mass spectrum had been calculated, which had been subtracted a background spectrum and standard spectrum.

The components of essential oil have been identified in the results of comparing mass spectra of chemical substances obtained during chromatographic research with data from the mass spectra library NIST02.

The total amount of terpenoids in amount of identified compounds of flowers essential oil was 22.35%, in leaves essential oil – 40.15%.

Chromatographic profiles of essential oils of *Veronica longifolia* L. flowers and leaves are shown in fig.1 and fig.2, respectively. The results of the research are shown in the following table 1.

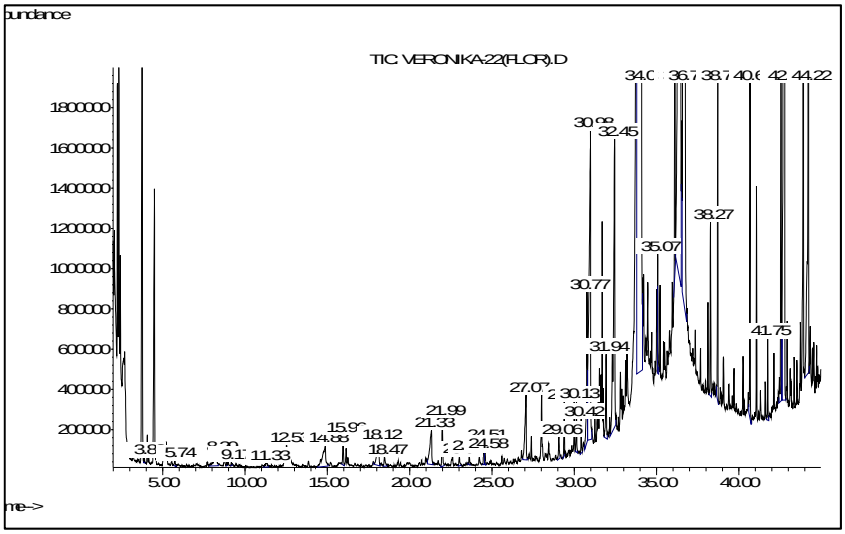

Fig 1: The chromatographic profile of essential oil of *Veronica longifolia* L. flowers

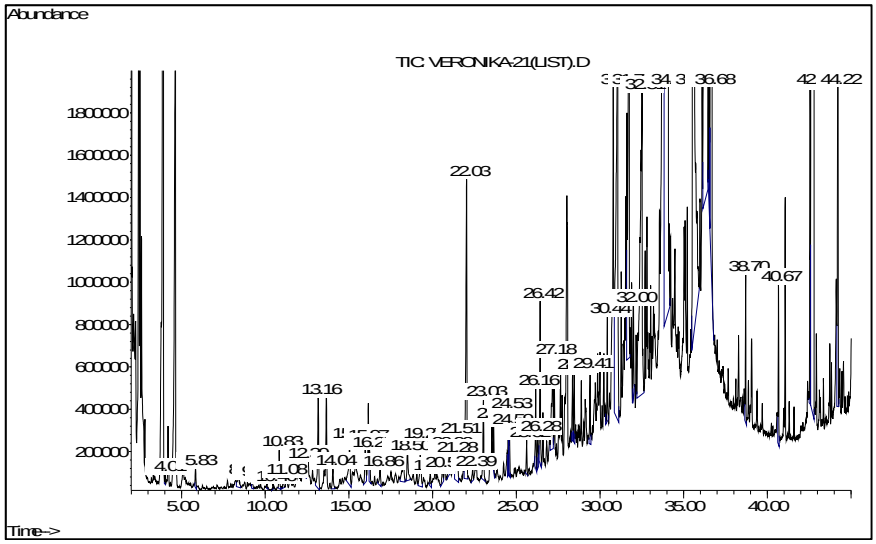

Fig 2: The chromatographic profile of essential oil of *Veronica longifolia* L. leaves

Table 1: Component composition of essential oil of *Veronica longifolia* L. leaves and flowers

№	The retention time, min	The name of compound	Content			
			Flowers		Leaves	
			mg/kg*	%**	mg/kg*	%**
1	2	3	4	5	6	7
1	4.01	Hexanal	1.9	0.05	2.0	0.05
2	5.83	Furfural	4.0	0.1	6.4	0.1
3	8.43	Caproic (hexanoic) acid	24.0	0.3	9.2	0.1
4	8.89	Limonene	1.7	0.05	-	-
5	9.21	Octanal	1.5	0.05	3.5	0.1
6	10.1	*cis*-2,4-Heptadienal	-	-	1.9	0.05
7	10.46	Not identified	-	-	1.5	0.05
8	10.83	*trans*-2,4-Heptadienal	-	-	12.5	0.2
9	11.08	*trans*-Linalool oxyde	-	-	4.2	0.1
10	11.32	Heptanoic acid	6.7	0.1	-	-
11	12.38	Not identified	-	-	7.8	0.1
12	12.52	Benzyl alcohol	12.6	0.2	-	-
13	13.16	Not identified	-	-	39.0	0.6
14	14.04	6-Methyl-3,5-heptadien-2-one	-	-	8.8	0.1
15	15.03	Caprylic acid	45.4	0.6	25.4	0.4
16	15.97	Decanal	15.7	0.2	16.8	0.3
17	16.22	α-Terpineol	-	-	11.8	0.2
18	16.86	*p*-Cymen-8-ol	-	-	7.6	0.1
19	18.27	Nonanoic acid	31.0	0.4	20.0	0.3
20	18.49	4-Vinylphenol	8.2	0.1	15.6	0.3
21	19.27	Carvone	-	-	22.9	0.4
22	19.85	Not identified	-	-	5.6	0.1
23	20.59	Carvacrol	-	-	6.6	0.1
24	20.98	2,4-Decadienal	-	-	11.6	0.2
25	21.27	Anis aldehyde	-	-	2.5	0.05
26	21.51	Capric acid	45.8	0.6	36.3	0.6
27	22.02	2-Methoxy-4-vinylphenol	27.8	0.2	135.1	2.2
28	22.39	Mirt-furanone	-	-	4.9	0.1
29	23.03	Eugenol	6.2	0.1	29.9	0.5
30	23.64	5-Pentyl-2(5H)-furanone	5.5	0.1	13.9	0.2
31	24.52	*p*-Methoxyacetophenone	11.1	0.1	21.6	0.3
32	24.59	Geranylacetone	7.0	0.1	15.7	0.3
33	25.61	Hexadecan	-	-	9.6	0.2
34	26.16	*β*-Ionon	-	-	22.7	0.4
35	26.28	Not identified	-	-	10.1	0.2
36	26.42	Epoxy-*β*-ionon	-	-	48.9	0.8
37	27.17	Lauric acid	57.3	0.7	51.5	0.8
38	28.36	Spathulenol	-	-	19.5	0.3
39	28.46	Caryophyllenoxyde	-	-	20.7	0.3
40	29.06	Tridecanoic acid	12.3	0.2	-	-
41	29.41	Dihydroactinidiolide	23.0	0.3	21.4	0.3
42	30.13	11-Methyltridecanoic acid	22.0	0.3	-	-
43	30.43	Dihydromethyljasmonate	12.9	0.2	25.0	0.4
44	30.79	Neophytadiene	74.8	0.9	49.3	0.8
45	31.05	Myristic acid	320.8	3.9	304.3	4.95

46	31.74	Hexahydrofarnesylacetone	-	-	352.1	5.6
47	31.93	12-Methylmyristic acid	41.9	0.5	-	-
48	32.00	Methylmyristic acid	-	-	24.3	0.4
49	32.51	Pentadecanoic acid	257.2	3.1	267.6	4.3
50	34.08	Palmitic acid	2553.5	31.2	1537.2	24.7
51	35.07	Heptadecanoic acid	35.1	0.4	-	-
52	35.52	Phytol	-	-	511.8	8.2
53	36.11	Eicosane	163.7	2.0	-	-
54	36.37	Oleic acid	893.3	10.9	472.8	7.6
55	36.53	Linoleic acid	-	-	76.4	1.2
56	36.68	Linolenic acid	860.3	10.5	250.7	4.0
57	38.27	Not identified	68.3	0.8	-	-
58	38.7	Pentacosane	106.9	1.3	30.4	0.5
59	40.66	Heptacosane	114.6	1.4	33.1	0.5
60	41.74	Methyltetracosanoate	25.5	0.3	-	-
61	42.55	Nonacosane	174.8	2.05	70.5	1.1
62	42.77	Squalene	1768.1	21.6	1378.4	22.1
63	44.21	Untriacontane	326.3	4.0	149.9	2.4
Total amount**:**			8168.7	100	6238.8	100

Note: «-» – compound was not found;
* – mg/kg in herbal drug;
** – % from amount of identified compounds of flowers and leaves essential oil

In the result of the research 63 compounds had been identified and quantified, of which 38 had been found in flowers, and 53 – in leaves, 57 compounds had been identified (Tab. 1). Among the identified compounds aromatic compounds, terpenoids, sesquiterpenoids, fatty acids and their esters, carbohydrates had been.

28 of the identified compounds had been found in both samples of herbal drugs – hexanal, furfural, octanal, 4-vinylphenol, decanal, 2-methoxy-4-vinylphenol, eugenol, 5-pentyl-2(5H)-furanone, *p*-methoxyacetophenone, geranylacetone, dihydroactinidiolide, dihydromethyljasmonate, neophytadiene, pentacosane, heptacosane, nonacosane, squalene, untriacontane, caproic, caprylic, nonanoic, capric, lauric, myristic, pentadecanoic, palmitic, oleic and linolenic acids.

A special meaning in understanding the pharmacological activity of essential oil terpenoids have, which are present in it. The total amount of terpenoids in flowers essential oil was 22.35%, in leaves essential oil – 40.15%. Aromatic terpenoids eugenol and carvacrol have an appreciable antibacterial activity. Sesquiterpenoid spathulenol has spasmolytic activity.

The triterpenoid squalene in herbal drugs' essential oil had been identified (in essential oil of flowers its content was 21.3%, in essential oil of leaves – 19.1%), which has cytostatic, antioxidant, immunomodulatory and hypoglycemic activity, and it is a biosynthetic precursor of many triterpenoids and steroids. Big amount of squalene in herbal drugs permits to consider the *V. longifolia* L. as a promising source of squalene.

The total content of leaves essential oil is more various. It includes 17 terpenoids: monoterpenoids were *trans*-linalool oxide, *α*-terpineol, carvone; aromatic terpenoids – *p*-cymen-8-ol, carvacrol, anisaldehyde, eugenol; sesquiterpenoids – spathulenol and caryophyllenoxyd; diterpenoid – phytol; triterpenoid – squalene; iridoid lacton C_{10}-type dihydroactinidiolide; and geranylacetone, *β*-ionon, epoxy-*β*-ionon, dihydromethyljasmonate and hexahydrofarnesylacetone.

6 terpenoids compounds are present in flowers essential oil: limonene (which had been found in small amount) is an original compound, aromatic terpenoid eugenol, geranylacetone,

dihydromethyljasmonate, triterpenoid squalene and iridoid lacton C_{10}-type dihydroactinidiolide.
The samples of *V. longifolia* L. leaves had more components than flowers samples: in particular, only in leaves *β*-ionon and its hydroxyl form – epoxy-*β*-ionon have been identified, and terpenoids such as: *α*-terpineol, *p*-cymen-8-ol, carvone, carvacrol, anis aldehyde, spathulenol and caryophyllenoxyd. The content of essential oil components in flowers quantitatively is higher due to biggest amount of fatty acids and their esters, carbohydrates.
In the result of the study of essential oil composition of *V. longifolia* L. flowers and leaves terpenoids, aromatic compounds, fatty acids and their esters, carbohydrates had been identified.

4. Conclusions

By means of chromatography-mass spectrometry the essential oil composition of *V. longifolia* L. had been studied for the first time. In the result of the study 63 compounds had been identified and quantified, of which 38 had been found in flowers, and 53 – in leaves, 57 compounds had been identified, 28 of the identified compounds had been found in both samples of herbal drugs, including aromatic compounds, terpenoids, sesquiterpenoids, fatty acids and their esters, carbohydrates.
2. The content of essential oil in leaves was 0.62% and 0.82% – in flowers. The total amount of essential oil in flowers was 22.35% and 40.15% – in leaves,
3. The amount of triterpenoid squalene was high in all studied samples (in essential oil of flowers its content was 21.3%, in essential oil of leaves – 19.1%), which permits to consider the *V. longifolia* L. as a promising source of squalene, which has cytostatic effect.
4. Studies indicate that the further in-depth research of *Veronica longifolia* L. can be considered promising.

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