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LIPIDS OF *Mentha spicata*

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The levels of lipids, pigments, and essential oil and the lipid and fatty acid compositions of individual organs of freshly gathered Mentha spicata *plants have been established. It has been found that the organs studied have a complex qualitative composition of the extractive substances but differ in their levels of individual groups of substances and components.*

Mentha spicata L. (spearmint, *M. crispa* L., *M. viridis* L., *M. crispata* Schrad. ex Willd.) is a wild and cultivated species of mint that is used in officinal medicine (Czech Republic, Slovakia, Mexico, Venezuela) [1] and folk medicine for diseases of the gastrointestinal tract, the liver, and the gall bladder, and as a spasmolytic. The essential oil of *M. spicata* possesses an antibacterial, antifungal, and anticonvulsive action and is suitable for food and cosmetic purposes [2]. The plant has been little studied in the chemical respect.

We have investigated the lipids of the inflorescences, leaves, and stems of cultivated *M. spicata* freshly gathered at the beginning of flowering. We determined the amounts of moisture and volatile substances, and, in the leaves and inflorescences, the essential oil. The lipids were extracted from the comminuted tissue by Folch's method (Table 1).

The plants gathered in this phase consisted of equal parts of leaves and stems, the leaves being enriched with extractive substances and essential oil. The inflorescences and leaves had the same levels of moisture and volatile substance.

The amounts of chlorophylls and carotenoids in the samples were determined spectrophotometrically. After the alkaline hydrolysis of the extracts, we isolated the total fatty acids (FAs) and the unsaponifiable substances (Table 2).

The inflorescences contained almost 3 times less and the stems 10 times less total chlorophyll than the leaves, and the chlorophyll *a*/chlorophyll b ratio in the inflorescences was far higher (10:1) than in the stems (1.9:1) and the leaves (1.5:1). Carotenoid pigments and FAs were concentrated in the inflorescences, and unsaponifiable substances in the stems.

The component composition of the lipids was established by the analytical TLC of aliquot samples under the conditions used for separating neutral lipids and glyco- and phospholipids. The extracts of all the organs studied had complex qualitative compositions. By comparison with known classes of lipids and with the literature, and with the aid of qualitative reactions, in the neutral lipids we identified paraffinic hydrocarbons, carotenoids, FA esters with phytosterols, with triterpenols, and with fatty and low-molecular-mass alcohols, triacylglycerols, free FAs, sterols, alkanols, triterpenols, triterpene acids, and chlorophylls and their derivatives.

In the extract of the inflorescences, compounds with chromatographic mobilities similar to those of the isolated essential oil and triacylglycerols but retaining them after alkaline hydrolysis of the extract were assigned to the terpenoids.

The glycolipids and phospholipids of the extracts consisted of a set of components characteristic for photosynthesizing tissues: mono- and digalactosyldiacylglycerols, steryl glycosides and their esters with FAs, sulfoquinovosylglycerols, N-acylphosphatidylethanolamines, phosphatidylglycerols, phosphatidylinositols, phosphatidylserines, and phosphatidic acids.

On chromatograms of an extract of the inflorescences the spots of terpene compounds, free FAs, esters of FAs with low-molecular-mass alcohols, digalactosyldiacylglycerols, phosphatidylcholines, and phosphatidylethanolamines predominated visually; in the leaf extract this applied to the spots of wax esters, FAs, digalactosyldiacylglycerols, and phosphatidylcholines; and in the extract of the stems to the spots of wax esters, triacylglycerols, FAs, monogalactosyldiacylglycerols, phosphatidylinositols, and phosphatidylserines.

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TABLE 1. Amounts of Volatile and Extractive Substances in Individual Organs of *Mentha spicata*

Organ	Mass fraction of the organ, % of the biomass	Content, %		Yield of extractive substances	
		moisture and volatile substances	essential oil	% of the crude biomass	mg/g a.d.w.
Inflorescences	8.7	75.3	0.08	2.1	85.0
Leaves	46.1	74.8	0.24	3.1	123.0
Stems	45.2	68.1	–	0.6	18.8

TABLE 2. Amounts of Pigments, Unsaponifiables, and Total Fatty Acids in the Biomass and Lipids of *Mentha spicata*

Organ	Pigments, mg/g a.d.w.			Total fatty acids	Unsaponifiable substances
	chlorophyll		carotenoids		
	a	b		% on the weight of the lipids	
Inflorescences	0.574	0.057	0.110	61.8	9.9
Leaves	1.136	0.762	0.026	53.0	5.2
Stems	0.125	0.067	0.007	27.3	14.3

TABLE 3. Composition of the Fatty Acids of Individual Organs of *Mentha spicata* (%, GLC)

Acid	Inflorescences	Leaves	Stems
10:0	1.7	1.2	4.6
12:0	6.3	9.3	14.2
13:0	1.7	3.6	7.8
14:0	1.4	1.7	1.7
15:0	Tr.	1.0	Tr.
16:0	16.7	17.5	18.7
16:1	3.7	3.9	2.1
17:0	Tr.	0.8	Tr.
18:0	8.9	15.4	15.4
18:1	7.3	4.8	6.9
18:2	20.0	7.3	9.7
18:3	32.3	29.5	12.3
20:0	Tr.	4.0	6.6
Σ_{sat}	36.7	54.5	69.0
Σ_{unsat}	63.3	45.5	31.0

The composition of the total FAs of the extracts, in the form of methyl esters, was determined by GLC (Table 3). The total degree of unsaturation of the FAs in the inflorescences was higher and was due to a high level of the 18:2 and 18:3 acids. In the leaves, the degree of unsaturation of the FAs was almost 1.5 times lower than in the inflorescences, and the main unsaturated acid was the 18:3 species. The stems were enriched with saturated acids, with more than a third of their weight consisting of components of medium molecular weight, 10:0-14:0 (28.3%) and 20:0. Consequently, with common qualitative lipid and fatty acid compositions, the individual organs of *M. spicata* differ with respect to the amounts of total lipids and the ratios of their components.

EXPERIMENTAL

The conditions for recording mass spectra and for the separation and identification of the neutral and polar lipids by CC and TLC have been described in [3, 4]. The quantitative estimation of pigments from IR spectra was carried out as in [5].

Plants cultivated in the Tashkent oblast were gathered in July, 1994, at the beginning of flowering. Lipids were isolated by Folch's method [6]. The essential oil was obtained from comminuted inflorescences and leaves by Clevenger's method [7]. The determinations of moisture and volatile substances, the alkaline hydrolysis of the extracts, and the isolation of unsaponifiable substances and FAs were carried out by standard methods [8].

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