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FATTY-ACID AND PHOSPHOLIPID COMPOSITION OF LICHENS OF THE VOLGA BASIN

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The composition of the fatty acids and phospholipids of 16 species of lichens collected in the basin of the river Volga has been studied. The main phospholipid was phosphatidylcholine the amount of which ranged in the various species from 33.3 to 85.5% of the total phospholipids. Other phospholipids were also found: phosphatidylethanolamine, phosphatidylserine, phosphatidylinositol, and phosphatidylglycerol. The main fatty acids were the 16:0, 18:0, and 18:1 varieties.

The fatty acids (FAs) in phospholipids (PLs) of lichens have been little studied [1-7]. The lipids of lichens growing on the territory of the USSR, including the Volga basin, have not been studied previously. The main class of PLs in all the species studied was phosphatidylcholine, its amount ranging from 33.3 to 85.5% (Table 1). The highest concentrations of PCs were observed for the family Cladoniaceae. Phosphatidylinositol was found in 10 species of these studies (6.8-33.9%). Phosphatidylserine was detected in only five species, in small amounts except for Anaptychia ciliaris in which its amount was 13.9%. In the family Cladoniaceae, PC (9.9%) was found in only one species – Cladonia sp. 4. In seven

TABLE 1. Phospholipid Compositions of Lichens

Species	PI	PS	PC	PE	PG	X	L
Anaptychia ciliaria	—	13,9	61,1	16,7		8,3	18,6
Aspicilia transbaicalica	32,2	2,0	33,3	30,4		—	30 6
Diploschistes sp.	—	—	58,2	41,8		—	18,3
Evernia mesomorpha	24,6	—	59,4	13,3	2,7	—	16,5
Evernia prunastri	14,5	—	63,3	21,9		—	13,4
Hypogimnia physodes	13,9	4,7	46,6	18,6	16,2	—	15,8
Lassallia pensylvanica	6,8	4,1	47,9	16,5	13,7	11,0	10,7
Umbilicaria deusta	33,9	—	37,8	28,3		—	34,6
Cladonia sp. 1	—	—	85,5	9,7	4,8	—	33,6
Cladonia sp. 2	—	—	61,4	36,8		1,8	28,4
Cladonia sp. 3	20,6	—	44,1	22,1	13,2	—	30 2
Cladonia sp. 4	—	9,9	56,2	23,1	10,8	—	22,1
Cladonia sp. 5	—	—	73,9	12,3	13,8	—	24,8
Cladonia sp. 6	—	—	72,2	11,1	16,7	—	34,2
Cladonia sp. 7	—	—	80,8	19,2		—	20,9
Cladonia sp. 8	8,6	—	69,0	15,5	6,9	—	18,8

Abbreviations. PI) Phosphatidylinositol; PS) phosphatidylserine; PC) phosphatidylcholine; PE) phosphatidylethanolamine; PG) phosphatidylglycerol; X) unidentified polar PL; TL) total lipids, mg/g of dry tissue.

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TABLE 2. Fatty Acid Compositions of Lichens (amount, % by weight, GLC)

Species	14:0	15:0	16:0	16:1	17:0	18:0	18:1	18:2
Anaptychia ciliaris	3,5	—	53,0	1.7	0,6	13,3	21,3	6,6
Aspicilia transbaicalica [a]	6,5	5,9	43,4	2,2	3,1	16,1	13,2	3,3
Diploschistes sp. [b]	4,1	—	34,2	—	7,6	17,2	21,4	7,6
Evernia mesomorpha [c]	4,6	7,6	21,2	8,5	1,9	14,1	14,8	8,8
Evernia prunastri	7,6	—	42,0	5,3	—	27,3	14,0	3.8
Hypogimnia physodes [d]	—	30,2	2,5	5,9	16,7	2,4	18.4	3,9
Lassallia pensylvanica [e]	4,5	8,0	30,8	10,2	4,6	12,9	14,4	—
Umbilicaria deusta [f]	2,6	5,7	39 9	6 8	3,5	21,3	12,5	2,7

[a] C13:0 – 2.5%, C18:3 – 3.8%.
[b] iso-C16:0 – 7.9%.
[c] iso-C16:0 – 8.3%, C18:3 – 3.4%, C20:0 – 6.8%.
[d] iso-C16:0 – 12.6%, C18:3 – 7.6%.
[e] C13:0 – 5.6%, iso-C16:0 – 9.0%.
[f] C13:0 – 3.9%, iso-C16:0 – 1.5%, C20:0 – 2.5%.

TABLE 3. Fatty Acid Compositions of Lichens of the Family Cladoniaceae

Species	14:0	15:0	16:0	16:1	17:0	18:0	18:1	18:2	18:3
Cladonia sp. 1 [a]	6,40	5,09	25,45	6,59	—	23,33	12,20	5,14	6,98
Cladonia sp. 2 [b]	4,90	10,96	18,34	16,12	14,30	5,20	12.60	10,78	2,09
Cladonia sp. 3 [c]	—	—	39,68	13.15	—	17,67	19,56	7,32	1,35
Cladonia sp. 4 [d]	—	—	48.30	—	4,76	18,50	16,40	4,10	6,06
Cladonia sp. 5 [e]	—	—	38,04	—	—	19,70	27,80	10,37	3,27
Cladonia sp. 6 [f]	—	1,68	39,84	4,60	1,98	17,90	25,70	6,45	—
Cladonia sp. 7 [g]	5,11	9,29	17,89	14,19	10,40	7,67	20,17	2,14	4,06
Cladonia sp. 8 [h]	—	9,46	31,80	13,50	—	12,76	12,40	11.60	5,02

[a] C13:0 = 3.88%, iso-C16:0 – 4.94%.
[b] C13:0 – 2.49%, iso-C16:0 –1.20%, C20:4 – 1.02%.
[c] iso-C16:0 – 0.97%.
[d] iso-C16:0 – 1.88%.
[e] iso-C16:0 – 0.82%.
[f] iso-C16:0 – 1.85%.
[g] C13:0 – 2.99%, C14:1 – 4.55%, iso-C14:0 – 0.73%.
[h] iso-C16:0 – 3.46%.

lichen species, the amounts of phosphatidylethanolamine and phosphatidylglycerol were determined as the sum of these PLs. In these species of lichens, an unidentified phosphorus-containing polar lipid was detected which was not colored by the Dragendorff reagent. The complete chemical structure of the X-lipid has not been studied.

The compositions of the FAs of the lichens were not distinguished by great diversity (Tables 2 and 3). The main FAs were the 16:0 (from 2.5 to 53.0%), 18:0 (from 2.4 to 27.3%), and 18:1 (from 12.2 to 27.8%) varieties. For some species, odd FAs – 13:0, 15:0, and 17:0 – were found. The largest amount of these FAs was observed in the species Hypogymnia physodes: 30.2% of 15:0; 16.7% of 17:0, and also 12.6% of iso-16:0. The highest concentration of the odd 15:0 and 17:0 FAs in the family Cladoniaceae were found in Cladonia sp. 2, 7, and 8: more 10.96, 9.29, and 9.46% of the 15:0, and 14.30, 10.40, and 0% of the 17:0 acids, respectively (Table 3).

EXPERIMENTAL

The lichens were collected in July-August, 1988, in Samarskoe province. The extraction of the lipids and the quantitative determination of the PLs were carried out as we have described previously [8], and the FAs were converted into methyl esters and their amounts were determined by means of GLC as described in [9].

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NEW HYDROXY FATTY ACIDS OF Acanthopanax sessiliflorus

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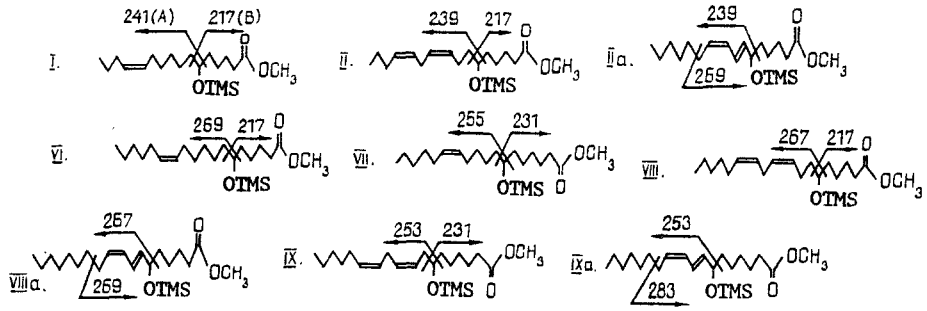
The structures of six new hydroxy fatty acids from the hydroxyacyldiacylglycerols of the fruit of Acanthopanax sessiliflorus (Rupr. et amaxim.) Seem. (family Araliaceae have been established as 6-hydroxyhexadeca-12Z-enoic, 6-hydroxyhexadeca-9Z,12Z-dienoic, and the isomeric 6- and 7-hydroxyoctadeca-12-Z-enoic, and 6- and 7-hydroxyoctadeca-9Z,12Z-dienoic acids and their quantitative amounts have been determined with the aid of spectral, chromatographic, and chemical methods of analysis.

We have previously studied the neutral lipids of the fruit of Acanthopanax sessiliflorus (Rupr. et Maxim.) Seem., a medicinal plant of the family Araliaceae [1]. The lipids contained hydroxyacyldicyglycerols (H-TAGs; 0.3% of the weight of the lipids) in which as the main hydroxy acids (HAs) were identified 12-hydroxyoctadecanoic (III) and the isomeric 12(9)-hydroxyoctadeca-9(12)Z-enoic (IV and V) and 9(13)-hydroxyoctadeca-10E,12Z(9Z,11E)-dienoic (X, XI) acids. The minor HAs were not characterized. In the present paper we give the results of a further structural analysis of the unidentified HAs.



When the mixture of methyl esters of the acids (HAMEs) was chromatographed in a thin layer [1], a mixture of overlapping spots was obtained, and of the spots those with the following average R_f values corresponded to known compounds: 0.42 – 12-OH-9Z-18:1; 0.40 – 13-OH-9Z,11E-18:2; 0.38 – 9-OH-10E,12Z-18:2; and 0.35 – 9-OH-12Z-18:1 [2]; three minor spots with R_f 0.33-0.28 belonged to unknown compounds. It was impossible to isolate the minor HAs in the pure form.

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