

## LIPIDS OF MARINE MACROPHYTIC ALGAE.

## II. FATTY-ACID AND PHOSPHOLIPID COMPOSITION OF THE CHLOROPHYCEAE

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The fatty-acid composition of algae, including marine algae, has been studied by many workers [1, 2], but their phospholipid composition has been less studied [3]. We have previously [4] carried out an analysis of fatty acids and phospholipids in various species of eight algae belonging to the Rhodophyceae. Continuing these investigations, we have studied the fatty-acid and phospholipid compositions of seven species of green algae belonging to the Chlorophyceae (Ulotrichophyceae) gathered in the north-eastern part of the Black Sea. Their fatty-acid compositions are given in Table 1.

The fatty-acid compositions of the green algae vary extremely widely (see Table 12); nevertheless, characteristic fatty acids for them are the 16:0, 16:4, 18:1, 18:3, and 18:4 types. For two species of algae a high content of eicosapentaenoic acid was found: for *U. penicilliformis*, 11.5%; and for *U. rigida*, 18.3%.

The investigation of the phospholipid compositions of the green algae showed that their main phospholipids were phosphatidylglycerol (in various species its amount ranged from 21.3 to 28.0%) and phosphatidylethanolamine (from 9.6 to 14.3%) (Table 2).

When the phospholipids in the total lipid extracts of algae were analyzed, no phosphatidylcholine was detected in the class Ulotrichophyceae.

TABLE 1. Fatty-Acid Compositions of Green Algae (wt. %, GLC)

Fatty acid	<i>Enteromorpha prolifera</i>	<i>Enteromorpha linza</i>	<i>Urospora penicilliformis</i>	<i>Ulotrix flacca</i>	<i>Entocladia viridis</i>	<i>Ulva rigida</i>	<i>Ulva</i> sp.
14:0	0,9	11,1	—	0,6	1,1	1,0	0,7
15:0	0,6	—	—	0,7	—	0,5	—
16:0	24,3	24,8	18,4	23,5	19,6	16,9	29,2
16:1	1,1	—	19,6	8,4	11,4	3,8	6,1
16:2	—	—	—	1,8	2,2	—	—
16:4	17,8	23,1	6,6	7,7	9,8	8,6	5,7
18:0	2,0	—	2,3	3,9	4,2	1,9	0,4
18:1	7,9	7,8	18,1	8,5	13,7	14,7	44,5
18:2	1,3	4,7	2,4	9,3	5,1	0,5	9,8
18:3	26,7	7,6	5,6	14,4	12,1	14,9	1,1
18:4	13,1	5,1	7,4	9,3	10,7	10,1	1,6
20:4	1,0	5,5	5,6	3,8	2,0	2,1	0,9
20:5	1,2	3,6	11,5	5,0	4,6	18,3	—
22:5	1,3	6,7	1,7	3,1	2,5	3,4	—
22:6	0,8	—	0,8	—	1,0	1,3	—

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TABLE 2. Phospholipid Compositions of Green Algae

Class of phospholipids	Enteromorpha prolifera	E. linza	Urospora penicilliformis	Ulvetrix flacca	Entocladia viridis	Ulva rigida	Ulva sp.
Phosphatidylglycerol	28,0	26,6	25,4	22,1	23,5	25,0	21,3
Phosphatidylethanolamine	10,4	11,2	11,9	14,3	12,9	10,3	9,6
Phosphatidylinositol	12,2	10,2	7,2	9,6	10,3	5,4	4,9
Phosphatidylserine	9,4	8,9	9,3	13,6	10,1	8,3	7,7
Phosphatidic acid	4,0	3,8	4,2	2,2	1,3	—	—
Diacylglycerotrimethylhomoserine**	36,0 (24,2)	39,3 (32,5)	42,0 (66,7)	38,2 (29,3)	41,9 (55,1)	51,0 (111,4)	56,5 (108,0)
Phospholipids***	8,4	6,9	6,9	4,8	7,3	8,4	9,1
Total lipids****	0,8	1,2	2,3	1,6	1,8	2,6	2,1

\*The diacylglycerotrimethylhomoserine (DGTS) was determined from its nitrogen content and was recalculated as phosphatidylethanolamine (the sum of the phosphatidylethanolamine and DGTS was taken as 100%); the figures in parentheses are the amounts of DGTS in  $\mu\text{g/g}$  of the dry weight of the biomass.

\*\*In % of the sum of the total lipids.

\*\*\*In  $\text{mg/g}$  of the dry weight of the biomass.

The main phospholipids were phosphatidylglycerol and phosphatidylethanolamine. Among the polar lipids containing no phosphorus, which are characteristic exclusively for green algae, the main one was diacylglycerotrimethylhomoserine, the amount of which ranged from 24.2 to 111.4  $\mu\text{g/g}$  of dry weight of the biomass.

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