POSITION SPECIFICITY OF THE FATTY ACIDS IN THE PHOSPHOLIPIDS OF THE COTTON PLANT VARIETY 108-F

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The main components of the total phospholipids of the seed kernels of the cotton plant of variety 108-F are phosphatidylcholines (PCs), phosphatidylinositols (PIs), and phosphatidylethanolamines (PEs) [1]. In the present paper we give the results of a determination of the position distribution of the fatty acids in the molecules of the PCs, PEs, and PIs obtained by column chromatography (silica gel) of the total phospholipids of the seed kernels of this variety of the cotton plant from the 1972 harvest. We used enzymatic hydrolysis with the aid of the phospholipase A of the venom of the Azerbaizhan kufi. The enzymatic hydrolysis of the phospholipids was performed in a tris buffer medium (pH 9.5) at 37-39°C. Under these conditions, the hydrolysis of the phospholipids took place at different rates, its time increasing in the sequence PCs–PEs–PIs. The products of enzymatic hydrolysis were separated by thin-layer chromatography on silica gel (system 1). The lyso products were subjected to alkaline saponification (10% KOH in methanol, 15-18 h, room temperature) [2]. The fatty acids from positions 1 and 2 were analyzed in the form of their methyl esters by GLC (Table 1).

The table permits the statement that the unsaturated acids in the phospholipid molecules predominantly occupy position 2, which is normal. In all cases the predominating acid among the saturated acids in palmitic and among the unsaturated acids linoleic. There is no stearic acid in position 2 of the PC and PE molecules, while in the PIs it is distributed uniformly. The PCs are characterized by a high specificity of the distribution of the fatty acids: 93.2% of the unsaturated acids are esterified in position 2 of the glycerol residue.

On the basis of the results of the position distribution of the fatty acids, using a known method [3, 4] we have calculated preliminary molecular compositions for the PCs, PEs, and PIs (%):

TABLE 1. Composition and Position Distribution of the Fatty Acids in the Phosphatidylcholines (PCs), Phosphatidylethanolamines (PEs), and Phosphatidylinositols (PIs)

Fatty acid	PCs			PEs			PIs		
	initial	position		initial	position		initial	position	
		1	2		1	2		1	2
10:0	—	—	—	—	—	—	6,1	—	11,2
12:0	2,0	2,5	1,8	2,2	1,8	4,6	5,4	4,8	3,0
14:0	0,9	0,9	1,7	1,3	1,9	3,0	5,4	3,7	2,2
16:0	22,2	42,7	3,3	31,3	59,3	6,2	29,0	55,6	4,3
16:1	1,5	2,6	1,6	2,0	3,1	2,9	4,4	5,6	2,7
18:0	1,7	4,0	—	1,0	3,2	—	5,5	9,3	2,5
18:1	23,7	18,9	30,5	14,1	7,1	19,8	10,0	9,9	9,7
18:2	48,0	28,4	61,1	48,1	23,6	63,5	34,2	11,1	64,4
Σ_S	26,8	50,1	6,8	35,8	66,2	13,8	51,4	73,4	23,2
Σ_{US}	73,2	49,9	93,2	64,2	33,8	86,2	48,6	26,6	76,8

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Type	PCs	PEs	PIs
Disaturated	3.3	9.2	17.1
including monoacid	1.4	3.9	2.8
Diunsaturated	47.6	29.2	20.4
including monoacid	23.4	16.5	1.1
Saturated–unsaturated	45.7	57.0	56.4
Unsaturated–saturated	3.4	4.6	6.1

In the PIs, the number of molecular types (56) is greater than in the PEs (39) and PCs (32), which can be explained by the presence of the acid 10:0 in the initial molecule and of stearic acid in position 2. In their quantitative fatty-acid compositions, the PCs and PEs are identical with one another, but the numbers of their molecular species are different, which shows a lower selectivity of the pairing of the acids in the case of the PCs.

In the PCs and PEs the disaturated species contained the 16:0 acid, and in the PIs the 16:0 and 10:0 acids.

EXPERIMENTAL

The following solvent systems were used for the preparative separation of the products of enzymatic hydrolysis: 1) chloroform–methanol–ammonia (65:35:5); and 2) chloroform–methanol–water (65:35:5). The fatty acids of the initial phospholipids and of their lyso products were isolated by Stahl's method.

The fatty-acid compositions were determined by the gas-chromatographic method on a UKh-2 chromatograph at 197°C with a column 2.5 m long. The stationary phase was poly(ethylene succinate).

Enzymatic Hydrolysis of the Phospholipids. A solution of 90 mg of phosphatidylcholines in 15 ml of ether was treated with 2.5 mg of snake venom dissolved in 0.3 ml of tris buffer (pH 9.5), and the mixture was stirred at 37-39°C. The reaction was monitored by TLC in systems 1 and 2. Hydrolysis took place completely in 15 minutes.

The same conditions were used for the hydrolysis of the PEs and PIs, but the reactions lasted 5 and 6 h, respectively.

SUMMARY

It has been shown by enzymatic hydrolysis with phospholipase A that it is mainly unsaturated fatty acids that are esterified in positions of the PC, PE, and PI molecules (93.2, 86.2, and 76.8%, respectively), which is normal for phospholipids.

From the results on the position distribution of the fatty acids we have calculated the possible molecular compositions of the PCs, PEs, and PIs.

LITERATURE CITED

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