KINETICS OF THE LEVEL OF LIPIDS IN A COTTON PLANT OF VARIETY 6524 S DURING MATURATION

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The composition and amount of lipids in the seeds and leaves of the cotton plant of variety 6524 S over the vegetation periods have been investigated. The rate of biosynthesis of neutral lipids in cotton seeds in the 20-day period after flowering to the moment of maturation increases by a factor of 1.6 while the amounts of phospho- and glycolipids decrease by factors of 3.9 and 4.3, respectively. The fatty acid compositions of the neutral lipids and of the phospho- and glycolipids of the seeds and leaves have been determined.

The study of the lipids of various organs of higher plants during their maturation has been the subject of numerous investigations [1-4], and these have extended to the cotton plant [5-8]. A considerable role in the biosynthesis of lipids is played by the polar lipids (PLs) and, particularly, the glycolipids (GLs), which accumulate in large amount at an early stage of their development.

In the present paper we give the results of an investigation of the lipid classes in maturing 20- and 40-day seeds and leaves of a cotton plant of variety 6524 S grown in the Tinchlik kolkhoz [collective farm] in the Yangiyul' region. The lipids were extracted from the leaves in the period of mass fruit formation.

In the period of the ripening of the cotton seeds, the amount of moisture in them fell sharply, while the amount of lipids rose and then remained constant to the end of the vegetation period (Table 1). During the 20 days from the moment of flowering, the phospholipids (PhLs) and glycolipids accumulated, their combined amount being 41% of the total lipid content of the seeds. At the end of seed ripening, the proportion of PLs had fallen to 10%, and the bulk (90%) was made up of neutral lipids. In the leaves of the cotton plant, the PLs amounted to 45.7%, but, according to S. D. Yunusova et al., in the phase of the formation of 3-4 leaves on the bush their amount was 67.1% [5].

We investigated the GLs isolated by CC on silica gel as described in [5]; solvent systems 1-3 were used for TLC. The glycolipids were identified by qualitative reactions, chromatographic mobilities, and comparison with model specimens. In all the samples TLC revealed seven GLs, which differed in amount. As the seeds ripened, the amount of monogalactosyldiglycerides (MGDGs) and digalactosyldiglycerides (DGDGs) decreased and the amount of sterol glycosides (SGs) increased. Such a change is connected with the fact that in ripe seeds there is a thickening of the lipid bilayer of the biomembranes due to the SGs [10]. The glycolipids of the leaves, in contrast to those of the seeds, consisted mainly of MGDGs. They contained an insignificant amount of DGDGs, sulfolipids, and SGs.

The fatty acid compositions of the lipids of the ripening seeds and leaves of the cotton plant differed considerably, as can be seen from Table 2. In the early-ripe seeds, linolenic acid was present in all the lipid fractions, but most of all in the PLs. In the 40-day seeds the PLs contained about 3% of the 18:3 acid while in the other classes of lipids its synthesis had ceased, and in the ripe seeds it was present only in the phospholipid fraction. In the leaves, the 18:3 acid was the predominant one (63.4%) in the glycolipid fraction, while smaller amounts of it were present in the NLs and PhLs.

The lipid extracts of the samples studied had different colors, pigments of the gossypol, carotenoid, anthocyan, and chlorophyll groups being present.

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TABLE 1. Quantitative Change in the Lipids of Ripening Cotton Seeds

Days after flowering	Moisture content, %	Total lipids, %	Lipid fractions, %		
			NLs	PhLs	GLs
Seeds					
20	86,0	5,5	59,1	21,8	19,1
40	65,5	12,8	87,0	6,7	6,3
Matured	7,9	26,2	89,7	5,8	4,5
leaves after 40 days	59,8	2,1	54,3	14,7	31,0

TABLE 2. Fatty Acid Compositions of the Lipids of the Maturing Seeds and Leaves of a Cotton Plant

Specimens	Fatty acids, mole-%										
	10:0	12:0	14:0	15:0	16:0	16:1	18:0	18:1	18:2	18:3	Σunsat
20-day seeds											
NLs	0,2	0,9	1,1	Tr.	23,1	1,1	2,8	16.0	48,6	6,2	70,8
PhLs	Tr.	0,5	0,4	Tr.	29,0	1,4	2,1	10,8	28,7	27,1	66,6
GLs	Tr.	0,8	0,8	0,4	25,2	0,6	2,4	14,9	32,1	22,8	70,2
40-day seeds											
NLs	0,2	0,3	0,6	Tr.	20,5	2,8	2,0	16,5	57,1	Tr.	76,4
PhLs	0,4	1,0	1,3	Tr.	28,1	1,5	3,6	25,2	36,0	2,9	62,1
GLs	0,2	0,7	1,9	1,0	28,3	1,9	6,2	22,5	34,8	Tr.	71,6
Ripened seeds											
NLs	Tr.	0,2	0,8	0,2	22,9	1,4	1,6	17,1	55,8	Tr.	74,3
PhLs	Tr.	0,7	1,2	1,5	23,4	1,0	2,4	18,5	49,8	1,5	70,8
GLs	Tr.	1,5	2,1	1,1	26,4	1,3	5,0	28,0	34,6	Tr.	63,9
40-day leaves											
NLs	0,7	1,9	5,1	0,5	24,8	4,0	3,7	9,9	16,5	32,9	63,3
PhLs	1,7	1,3	1,0	Tr.	34,7	8,6	4,2	6,2	20,6	20,8	56,2
GLs	1,3	0,5	1,4	Tr.	18,3	1,9	2,3	3,8	5,4	63,4	74,5

The total lipids of the 20-day seeds contained 0.03% of gossypol, while the 40-day and ripened seeds and leaves contained 1.27, .49,* and 0.22%, respectively. Some workers [11] have reported that the maximum amount of gossypol was detected on the 40th day after flowering and then diminished sharply as maturation proceeded. Our results have shown that the synthesis of gossypol pigments is completed at the stage of ripening of the seeds.

Pigments of a crimson color were isolated from the 40-day seeds and leaves of the cotton plant, and their UV spectrum had identical absorption maxima at 230, 260, and 370 nm, which are characteristic for the anthocyans [12] and flavonoids that are present in many plants of the Malvaceae family [13, 14]. The yellow pigment from the leaves had maxima at 418, 445, and 470 nm, which are characteristic for carotenoids.

The investigations performed show that, during the maturation of cotton plant, interconversions take place not only between fatty acids but also between whole groups of lipids, as a consequence of which the possibility appears of an accumulation of certain reserve lipids that are characteristic of the ripe seeds.

EXPERIMENTAL

The total lipids were isolated from the samples with a 2:1 mixture of chloroform and methanol.

The cottonplant leaves were treated with hot isopropanol for 3 minutes to inactivate enzymes. The compositions of the fatty acid methyl esters were determined by GLC on a Chrom-4 instrument using a column filled with Chromaton NAW DMCS impregnated with 15% of Reoplex. The following solvent systems were used for TLC: 1) chloroform—acetone—methanol—acetic acid—water (65:20:10:10:3); 2) acetone—toluene—acetic acid (60:60:2); and 3) chloroform—methanol—7 N ammonia (60:30:4).

*First digit(s) illegible [translator].

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