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CONTENT OF LIPIDS ACCOMPANYING FAT  
IN SUNFLOWER SEEDS

A number of compounds such as phospholipids, sterols, tocopherols and pigments called oil-accompanying substances are converted into oil during its extraction from sunflower seeds. Each of these compound groups consists of several or many components which are often very close in structure but differ in the part played in the metabolism of vegetative organism and in the biological activeness. The concentration of by substances in market oil depends both on oil separating method and undoubtedly on their qualitative and quantitative content in seeds.

To study accompanying substances thinly ground seeds have been extracted successively by hexan and a chloroform - methanol mixture in the 2:1 ratio (by volume). Isolated lipids have been separated from nonlipid substances, weighed and dissolved in chloroform.

Phospholipids. Sunflower seeds (nuclei) contain 0.7-1% of phospholipids the bulk of which are more or less firmly connected with the seed gel material.

To determine certain forms phospholipids were separated from nonpolar lipids and divided in a thin layer of silica gel with gypsum, using the chloroform-methanol-water mixture as a solvent in the ratio of 65:24:4 respectively (by volume). Quantitative calculation of phospholipids was made according to Lowry.

Our studies showed that phospholipid faction content in ripening sunflower seeds has undergone a comparatively small change. Phosphatidyl cholines are predominant among certain phospholipid fractions, to be followed on terms of quality by phosphatidyl ethanolimines (kephalins) or phosphatidyl inosits. High-oil-variety Pere-

dovik differs from low-oil rough-husk variety Kruglik A-41 in the ratio of some forms of phospholipids (Table 1).

It has been established that lecithins are more firmly connected with the substances of the gel part than are phosphatidyl inosits and kephalins.

Unlike market oil the phospholipid complex of seeds contains phosphalitic acids in very small quantities. There is no doubt that strict technological treatment of seeds to obtain oil in production conditions brings about a sharp increase raised of undesirable products - phosphatic acids as a result of partial collapse of phosphatids, mostly lecithins. Oil can be enriched by lecithins, which a valuable technical product and foodstuff, through protecting lecithins from destruction and their fuller extraction.

According to fat acidic content phosphalipids differ considerably from triglycerides. Their characteristic feature is a higher content of palmitic and linoleic acids. Most phospholipid forms have a considerable quantity of highly molecular saturated acids with 22 and 24 carbon atoms - behenic and lysergic acids. They have phosphatidyl inosyts and kephalins in sufficient quantities, these being practically absent from lecithins.

Sterols. The quantitative content of sterols was determined by the colorimetric mode according to the Sperry and Veb methods that was modified. The general sterols content was determined in unsaponifiable lipid fraction with the aid of gasoliquid chromatography and a use of silanizing chromatons as a solid carrier and of SE-30 as the liquid phase of silconic elasotmer.

The quantity sterols of in sunflower seeds changed, depending on a variety, within the limit of 0.23-0.34% or in terms of the oil content, 0.40-0.55% (Table 2).

Table 1

Phospholipid Content in Sunflower Seeds  
(Nuclei)

Krasnodar, 1973

Variety	% of lipids in absolutely dry		% of phospho- lipids in ab- solutely dry seeds		Phospholipid forms, % of total			
	ache- seeds	ness	leci- thins	kepha- lins	phos- phati- dyl	phospha- tidic acids	inosyts	
Peredovik	51.2	65.2	0.80	42.3	15.7	36.6	5.2	
Kruglik								
A-41	34.7	56.8	0.77	44.7	29.4	19.8	6.0	

Table 2

Proportion of Sterol and Oil in Sunflower  
Seeds of Competitive Strain Testing (in %  
per Absolutely Dry Material)

Krasnodar, 1971

Varieties	Oil	General sterols	Non-etherified sterols	Etherified sterols
<u>Middle ripening</u>				
Armavirsky 14	62.4	0.33	0.28	0.05
14	61.7	0.32	0.26	0.06
33 832				
Armavirsky 3497	61.3	0.30	0.25	0.05
VNIIMK B 931	61.2	0.30	0.24	0.06
Peredovik	59.9	0.28	0.21	0.07
<u>Early ripening</u>				
Chernyanka 66	61.8	0.34	0.25	0.09
<u>Quick ripening</u>				
Salyut	60.1	0.26	0.22	0.05
Armavirets	59.2	0.28	0.24	0.04
Enisey	57.2	0.23	0.20	0.04

The bulk of sterols are in the free state or weakly connected with materials of seed gel phase.

The overwhelming quantity of sterols in ripening and matured sunflower seeds are in the non-etherificated form (74-87% from the sum). The rest of the sterols are represented almost exclusively by ethers with fat acids. The proportion of sterol glycosides is small (1-2% of the total).

The sterols include  $\beta$ -citosterols, stigmasterol, campesterol and cholesterol with  $\beta$ -sitosterol prevailing (75% of the total). The sterols of the high-oil variety contain more  $\beta$ -citosterol and less campesterol than the low-oil variety (Table 3). This is clearly seen in ripening seeds.

Tocopherols. The forms of tocopherols were determined in the lipid unsaponifiable fraction using uromatography in a thin layer of silica gel. Tocopherols were calculated by the Amery-Angel method.

Tocopherols are easily extracted with oil from seeds while extracted by weak polar solvents or at pressing. The oil of modern sunflower varieties developed by the VNIIMK as a rule contain 60-80 mg/% of tocopherols.

The characteristic features of tocopherols involve their E-vitamin activeness and anti-oxidation action, owing to which fat is to a considerably extent prevented from oxidation. A few tocopherol isomers are known of which  $\alpha$ -tocopherol possesses the highest E-vitamin activity and  $\epsilon$ -tocopherol possesses maximum anti-oxidation action.

We have established that during the whole ripening period  $\alpha$ -tocopherol prevails in the seed tocopherols and  $\alpha$ -tocopherol also predominates among the tocopherols matured sunflower seeds of different varieties (80-90% of the total).  $\beta$  +  $\gamma$  tocopherols occupy the second place in terms of quantity and sometimes  $\delta$ -tocopherols are observed.

Table 3

Proportion of Sterols in Sunflower Seeds  
Krasnodar, 1974

Varieties	% of oil in absolutely dry achenes seeds	% of sterols in absolutely dry seeds	Forms of sterols, % of the total				
			$\beta$ -cito- sterols	stigmaste- rol	campe- sterol	chole- sterol	
Peredovik	51.5	62.5	0.36	72.9	13.5	12.6	1.00
Kruglik							
A-41	36.9	56.6	0.31	70.7	14.5	14.3	0.96

A comparative study of tocopherols of a new and an old varieties which differ very much in seed oil shows a conspicuous difference in the proportion of tocopherols (Table 4).

Table 4

Proportion of Tocopherols in Sunflower Seeds

Krasnodar, 1974

Varieties	Total of tocopherols in oil, mg/%	Tocopherol forms, % of the total		
		$\alpha$	$\beta + \gamma$	$\delta$
Peredovik	57.6	76.8	20.4	2.8
Kruglik				
A-41	49.2	82.2	17.8	Traces

Pigments. The quantity of carotenoids and pigments of the chlorophyl I group was determined by the spectrophotometric method. Carotenes were separated from xanthophylls on the column of activated aluminium oxidizing.

Our studies showed that pigments in mature sunflower seeds are represented by carotenoid-carotenes and xanthophylls.

Their total content is 0.12-0.16 mg/% (Table 5). In ripening seeds (till physiological ripening) chlorophylls "a" and "b" and products of their breakdown - pheophytins "a" and "b" - are observed alongside the carotenoids.

Table 5

Proportion of Carotenoids in Sunflower  
Seeds (mg per absolutely dry substance)

Krasnodar 1970

Varieties	% of oil in abso- lutely dry seeds	Sum of carote- noids	Caro- tenes	Xantho- phylls
<u>Average ripening</u>				
VNIIMK 8931	62.2	0.156	0.073	0.083
309-10	63.2	0.130	0.094	0.036
Pere- dovik	63.0	0.127	0.082	0.045
Armavir- sky 14	63.5	0.141	0.088	0.053
Armavir- sky 3497	63.4	0.112	0.052	0.060
Smena	62.4	0.532	0.082	0.050
<u>Early ri- pening</u>				
145-8883	61.9	0.122	0.079	0.043
Chernyanka 66	63.4	0.119	0.100	0.019
<u>Quick ri- pening</u>				
Salyut	61.8	0.152	0.052	0.100
Enisey	58.8	0.0119	0.089	0.030