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WHEAT GERM OIL

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In continuation of research on lipids and lipophilic constituents of nontraditional sources of oil-containing raw material [1], we studied lipids and lipophilic components of wheat germ (*Triticcum vulgare*, Gramineae), which is a multi-ton waste of flour production and typically has a high content of oil [2–4] that is enriched in essential fatty acids. Furthermore, the germ contains vitamins B_1, B_2, B_6, PP, D, and other biologically active compounds [5]. The oil has a beneficial effect on the immune and endocrine systems, stimulates reproductive functions, accelerates wound and burn healing, reduces the cholesterol level in blood, and exhibits antisclerotic and cardioprotective properties [5].

The oil comprises a broad array of biologically active compounds and a variety of pharmacological properties. It is a unique oil for fabricating fatty food products and biologically active additives (BAA), as evidenced by the creation based on it of several BAA [3].

The biological effectiveness of oils is estimated from the degree of balance of their fatty-acid composition [6, 7] and the ratio of ω-3:ω-6 acids [8]. Blending of different oils is widely used at present in order to obtain the optimal balance of fatty acids [6, 7].

Therefore, we studied wheat germ oil produced at Karshi flour mill (Uzbekistan) during processing of local wheat varieties.

Total neutral lipids (NL) were isolated by benzine extraction (bp 72–85°C) in a Soxhlet apparatus. Bound lipids were isolated from the remaining pulp using the Folch method [9].

Polar lipids were isolated from bound lipids by CC over silica gel. Glycolipids (GL) were eluted by acetone; phospholipids (PL), by MeOH. The yield of NL was 9.30%; GL, 0.70; PL, 0.85 of the air-dried germ mass. The NL composition was established after separation into individual classes using a chromatographic column of silica gel and solvents hexane:Et_2O (10:1, 4:1, 7:3, 1:1, and 0:10). Lipids were assigned to individual classes using TLC on silica gel and the aforementioned solvent systems and comparison with model compounds. The content of the classes was estimated gravimetrically.

The NL composition was as follows (mass % of extract): hydrocarbons, 0.27; esters of aliphatic and cyclic alcohols with fatty acids, 0.24; triacylglycerides, 78.85; free fatty acids, 18.40; free aliphatic and cyclic alcohols and tocopherols, 2.24.

It can be seen that the NL were dominated by TAG.

Glycolipids were analyzed using TLC on silica gel and solvents $CHCl_3$:$(CH_3)_2CO$:MeOH:H_3CCO_2H:H_2O (65:20:10:10:3).

The developers were α-naphthol and $HClO_4$ solutions [10].

The GL contained monogalactosyldiglycerides, digalactosyldiglycerides, sterolglycoside esters, and sterolglycosides. The last constituents predominated.

The PL contained mainly phosphatidylcholines, phosphatidylethanolamines, and phosphatidylinosites. This was established by two-dimensional TLC on silica gel using solvent systems $CHCl_3$:MeOH:NH_4OH (25%) (65:35:5) and $CHCl_3$:MeOH:H_3CCO_2H:H_2O (14:5:1:1).

PL were developed using Vaskovsky and Dragendorff's reagents and ninhydrin solution [9].

The fatty-acid compositions of NL, GL, and PL were determined by GC using a column packed with Reoplex 400 (5%) and Inerton N-AW. Hydrolysis, isolation of fatty acids, and their methylation were performed as before [10].

Table 1 presents the results.

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TABLE 1. Fatty-Acid Composition of Lipid Classes from Wheat Germ (GC, mass %)

Acid	NL	GL	PL	Acid	NL	GL	PL
10:0	0.3	3.6	2.3	18:1	34.2	29.2	32.4
12:0	Tr.	5.8	0.4	18:2	27.1	4.7	0.6
14:0	0.2	1.6	0.8	18:3	0.6	1.2	2.4
16:0	35.6	48.7	59.1	$\Sigma_{sat.}$	37.6	64.9	63.6
16:1	0.5	Tr.	1.0	$\Sigma_{unsat.}$	62.4	35.1	36.4
18:0	1.5	5.2	1.0				

Tr.: traces.

It can be seen that the total amount of unsaturated acids dominated the NL (62.4%) whereas the contents of saturated fatty acids were practically the same in PL and GL.

The main saturated acid in all lipid classes was 16:0. Oleic acid predominated among unsaturated acids in GL and PL whereas the content of 18:2 was insignificant, its mass in the latter not reaching 1%. The main unsaturated acids in NL were oleic (34.2%) and linoleic (27.1%), which is ω-6 acid.

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