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LIPIDS OF *Helianthus tuberosus* TUBERS

T. V. Chernenko, A. I. Glushenkova, and D. A. Rakhimov

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Free and bound lipids from Helianthus tuberosus *tubers were investigated. Neutral, glyco- and phospholipid classes and their fatty-acid compositions were determined. The composition of unsaponified substances was established.*

Key words: *Helianthus tuberosus*, neutral lipids, glyco- and phospholipids, fatty acids.

Helianthus tuberosus (Jerusalem artichoke) is an herbaceous plant of the Asteraceae family that is used to treat sugar diabetes and to normalize intestinal microflora during disbacteriosis. Tubers of this plant contain carbohydrates, vitamins, and trace elements (iron, potassium, manganese, iodine, zinc, etc.) [1]. Furthermore, protein from Jerusalem artichoke is rich in many essential amino acids and contains inulin, monosaccharides, fructooligosaccharides, and pectinic substances [2].

Lipids from an unknown species of Jerusalem artichoke have been previously studied [3]. The low moisture content (33.8%) of the tubers was consistent with prolonged storage of them.

We studied lipids from *H. tuberosus* tubers, variety Fais-barak, grown at the Scientific Research Institute of Plant Cultivation of the Republic of Uzbekistan.

The average mass of tubers varied in the range 46.0-63.1 g. The moisture content was 77.5%.

Total lipids (TL), free lipids (FL), and bound lipids (BL) were extracted from tubers that were dried to 7.6% moisture content. The amounts of extracted lipids were 0.56, 0.39, and 0.36% for TL, FR, and BL, respectively.

The TL were light-yellow and contained carotinoid pigments that amounted to 34.7 mg %.

The BL were separated by PTLC into neutral (NL), glucolipids (GL), and phospholipids (PL), the yields of which were 29.9, 46.9, and 23.2%, respectively.

The FL, which consisted mainly of NL, and NL were isolated from the BL and analyzed by TLC using systems 1-4.

We observed the following classes of NL: paraffinic and olefinic hydrocarbons, the isoprenoid hydrocarbon squalene, tocopherols, triacylglycerides, free fatty acids, isoprenoid alcohols, triterpenols, and sterols.

The PL were analyzed by two-dimensional TLC using systems 5 and 6. Phophatidylinositols (PI), phosphatidylcholines (PC), phosphatidylethanolamines (PE), phosphatidylglycerines (PG), and phosphatidic acid were identified.

Analysis of GL by TLC using systems 7 and 8 detected sulfolipids, digalactosyldiglycerides, sterolglycosides, cerebrosides, and monogalactosyldiglycerides. The main GL were sterolglycosides and digalactosyldiglycerides. Table 1 lists the fatty acids of NL isolated from BL, FL, GL, and PL as determined by GC.

Table 1 shows that the qualitative composition of the fatty acids in all lipid classes is the same and consists of 10 acids. However, they differ significantly quantitatively. The 18:0 and 16:0 acids dominate the saturated acids from polar lipids. The NL isolated from BL contain a large amount of linoleic acid (53.0%) and small amounts of 12:0, 13:0, and 14:0 acids. The total amount of unsaturated fatty acids in them is greater than 70%.

Next we investigated unsaponified substances (US) from Jerusalem artichoke that were isolated from the total lipids. The yield was 5.2%. The amount of carotinoids in the US was 46.9 mg %.

S. Yu. Yunusov Institute of the Chemistry of Plant Substances, Academy of Sciences of the Republic of Uzbekistan, Tashkent, fax (99871) 120 64 75. Translated from Khimiya Prirodnykh Soedinenii, No. 1, pp. 3-4, January-February, 2008. Original article submitted November 19, 2007.

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TABLE 1. Fatty Acids of FL, NL from BL, GL and PL From *Helianthus tuberosus*, % GC

Acid	FL	NL from BL	GL	PL
12:0	0.8	0.2	1.9	0.3
13:0	3.0	0.1	6.2	3.9
14:0	3.2	0.5	3.4	3.1
15:0	1.0	0.6	1.6	1.2
16:0	28.3	22.6	39.1	36.2
16:1	3.8	1.9	2.7	2.3
18:0	9.5	2.4	10.7	6.1
18:1	18.9	7.1	7.8	7.0
18:2	25.3	53.0	24.1	34.6
18:3	6.2	11.6	2.5	5.3
Σ_{sat}	45.8	26.4	62.9	50.8
Σ_{unsat}	54.2	73.6	37.1	49.2

The total US were separated by PTLC over silica gel using system 1. Separate fractions were collected (%): hydrocarbons, 8.2; isoprenols + triterpenols, 17.9; triterpenols, 9.6; sterols, 13.2; unidentified components I, 19.4; unidentified components II, 31.5. It can be seen that the US contain a large amount of biologically active substances such as isoprenols, triterpenols, and sterols. However, the US contained nonlipid components with low R_f values of 0.21 (I) and 0.02 (II) when separated using system 1. Compound I turned bright orange after spraying the chromatogram with H_2SO_4 (50%) and heating the plate. We did not further investigate these components.

EXPERIMENTAL

GC was carried out on a Chrom-5 instrument using a column packed with Reoplex (15%) on N-AW at a thermostatted temperature of 190°C and N_2 flow rate 30 mL/min. The content of carotinoids was determined by calorimetry in a KFK instrument. TLC was performed using the following solvent systems: diethylether:hydrocarbons (flash point 60-70°C) (3:7, 5:5, 2:8; 1, 2, 3), heptane:benzene (9:1, 4), $CHCl_3$:$(CH_3)_2CO$:CH_3OH:CH_3CO_2H:H_2O (65:20:10:10:3, 5), $(CH_3)_2CO$:$CH_3C_6H_5$:CH_3CO_2H:H_2O (60:60:2:1, 6), $CHCl_3$:CH_3OH:NH_4OH (28%) (65:35:5, 7), $CHCl_3$:CH_3OH:CH_3CO_2H:H_2O (14:5:1:1, 8).

Components of separated substances were identified using specific qualitative reactions, chromatographic mobility on adsorbent layers, and comparison with authentic samples.

NL were developed using iodine and H_2SO_4 (50%); GL, α-naphthol; PL, Vaskovsky method, Dragendorff reagent, and ninhydrin.

FL were extracted from tubers by hydrocarbons (bp 60-75°C). Total lipids and BL were extracted using $CHCl_3$:CH_3OH (2:1, v/v). Nonlipid components were removed by aqueous $CaCl_2$ solution (0.04%). Hydrolysis of lipids and isolation and methylation of fatty acids were carried out as before [4].

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