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LIPIDS OF *Helianthus tuberosus*

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The content and composition of lipids, pigments, and fatty acids in leaves, stems, and tubers of Helianthus tuberosus *were established. The studied organs of this plant have identical qualitative compositions of lipids but differ in content of some components.*

Key words: *Helianthus tuberosus*, lipids, fatty acids, pigments.

Jerusalem artichoke (*Helianthus tuberosus*, Asteraceae) is a valuable food, industrial, and commercial tuber-bearing plant. It is cultivated in the USA, France, Great Britain, Russia, and other countries [1].

We investigated lipids of leaves, stems, and tubers of the plant collected during ripening.

Total lipids from air-dried and ground specimens were extracted by the Folch method [2]. The pigment content in the lipids was determined spectrophotometrically [3].

Fatty acids and unsaponifiable substances were isolated after alkaline hydrolysis of lipids according to the literature [4].

Table 1 shows that the lipid content is highest in leaves. Lipids isolated from leaves and stems are dark green; from tubers, light brown.

The chlorophyll content of lipids from leaves is greater than that from stems. Carotinoid pigments are present in equal amounts in leaves and stems. Fatty acids isolated after saponification of lipids dominate in tubers; unsaponifiable substances, in leaves.

After removal of pigments using activated carbon, lipids were separated by preparative TLC over silica gel (systems 1 and 2) into neutral (NL), glyco- (GL), and phospholipids (PL). Their contents were determined as:

Lipids	Leaves	Stems	Tubers
NL	51.4	58.3	49.6
GL	37.6	35.2	43.1
PL	11.0	6.5	7.3

It can be seen that NL dominate in all organs whereas GL are greater in tubers than in other organs; PL, in leaves.

The qualitative composition of lipids was established using analytical TLC in systems 3, 4, and 5. Lipids were identified using chromatographic mobility, qualitative reactions, and comparison with authentic samples.

Lipids of the studied organs, with few exceptions, were identical in qualitative composition.

NL contained hydrocarbons, carotinoids, fatty-acid esters with phytosterols and triterpenols, triacylglycerines, free fatty acids, triterpenols, 4-monomethylsterols, sterols, and chlorophylls. GL were represented by the usual assortment of components: mono- and digalactosyldiacylglycerines, sterolglycosides and their fatty-acid esters. The PL contained phosphatidylethanolamines, phosphatidylcholines, phosphatidylinosites, and phosphatide acids [5].

The fatty-acid composition of the lipids was found using GLC (Table 2). Lipids of the studied organs consist of seven fatty acids. Their contents vary.

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TABLE 1. Properties of Leaves, Stems, and Tubers of *Helianthus tuberosus*

Property	Leaves	Stems	Tubers
Organ mass, %	33.9	47.8	18.3
Content, %:			
moisture and volatiles	70.5	56.8	34.8
lipids	2.7	1.2	1.7
Acid number of lipids, mg KOH	7.5	5.8	4.0
Pigment content, mg/g of lipid mass:			
chlorophyll a	28.6	11.2	-
chlorophyll b	9.6	4.6	-
total carotinoids	1.8	1.6	Tr.
Content, % of lipid mass:			
fatty acids after saponification of lipids	37.1	30.3	47.1
unsaponifiable substances	19.9	16.1	15.2

TABLE 2. Fatty-Acid Composition of Lipids from Various Organs of *Helianthus tuberosus* (%, GLC)

Acid	Leaves	Stems	Tubers
12:0	0.7	-	0.1
14:0	0.7	1.5	0.4
16:0	42.2	45.0	30.3
18:0	1.3	0.9	1.6
18:1	4.7	2.3	1.2
18:2	30.8	9.8	54.5
18:3	19.6	40.5	11.9
$\sum_{sat}$	44.9	47.4	32.4
$\sum_{unsat}$	55.1	52.6	67.6

Unsaturated fatty acids in lipids of tubers and leaves are dominated by 18:2. The 18:3 acid accumulates in stems and is less in tubers. Therefore, the general qualitative lipid and fatty-acid compositions of the separate plant organs differ in the amount of total lipids and their ratios.

EXPERIMENTAL

GLC was performed on a Chrom-4 apparatus with a flame-ionization detector using a stainless-steel column (2000×4 mm) packed with PEGS (17%) on chromaton at 198°C with source temperature 250°C and N_2 carrier gas.

Analytical and preparative chromatography was carried out on washed and activated (110°C) silica gel L 5/40 (Chemapol, Czech Rep.) with 10% $CaSO_4$.

Solvent systems were $CHCl_3$ (1); $(CH_3)_2CO$ (2); C_6H_{14}:$(C_2H_5)_2O$, 7:3 (3); $CHCl_3$:CH_3OH:$(CH_3)_2O$:CH_3CO_2H:H_2O, 65:20:10:10:3 (4), $CHCl_3$:CH_3OH:NH_4OH (25%), 65:35:5 (5). Lipids from pigments were purified using activated carbon by the previous method [6].

UV spectra of pigments were recorded on a Hitachi spectrophotometer in acetone.

Plants were grown on the experimental plot of the institute.

Total lipids were obtained via extraction of air-dried plant using $CHCl_3$:CH_3OH (2:1, v/v). Nonlipid components were removed by aqueous $CaCl_2$ (0.05%).

Neutral and polar lipids were separated and identified as before [2]. Moisture content, alkaline hydrolysis, isolation

of unsaponifiable substances and fatty acids, and determination of the acid number were carried out by the literature methods [4]. Fatty acids were analyzed by GLC as the methyl esters.

REFERENCES

1. *Flora of the USSR* [in Russian], Moscow (1959), Vol. 25, p. 544.
2. M. Kates, *Techniques of Lipidology: Isolation, Analysis, and Identification of Lipids*, Elsevier, New York (1973).
3. V. V. Polevoi and G. B. Maksimov, *Methods of Biochemical Analysis of Plants* [in Russian], Leningrad (1978).
4. *Handbook of Study Methods, Mechanochemical Control, and Production Accounting in the Oil-Fat Industry* [in Russian], VNIIZh, Leningrad (1967), Vol. 1, Book 2.
5. W. W. Christie, *Lipid Analysis, Isolation, Separation, Identification and Structural Analysis of Lipids*, Pergamon Press, Oxford (1972), p. 86.
6. H. T. Khor, *J. Chromatogr.*, **179**, No. 1, 225 (1979).