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## B R I E F  C O M M U N I C A T I O N S

# CARBOHYDRATES AND PROTEINS FROM *Helianthus tuberosus*

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Jerusalem artichoke (*Helianthus tuberosus* L.) is a perennial herbaceous plant of the Asteraceae family that is cultivated in many countries [1] including Uzbekistan. It is a source of inulin, possesses medicinal and prophylactic properties for sufferers of sugar diabetes, and acts as a biogenetic factor for the development of natural intestinal microflora after disbacteriosis [2].

We investigated carbohydrates and proteins of Jerusalem artichoke grown in Uzbekistan. The starting material was dried and ground tubers. The raw material was treated with alcohol (boiling) to extract colored and low-molecular-weight substances. Water-soluble polysaccharides (WSPS) were isolated by extraction of the remaining raw material with water at room temperature; pectinic substances (PS), by a mixture of oxalic acid and ammonium oxalate solutions (0.5%); hemicelluloses (HMC) A and B, by NaOH solution (18%). The polysaccharides were precipitated from the extracts by alcohol. The monoscaaharide composition of the polysaccharides was studied by total acid hydrolysis and analysis by paper chromatography (PC) using *n*-butanol:pyridine:water (6:4:3 by vol.) with urea developer.

Jerusalem artichoke tubers contain mainly WSPS (12.3%), PS (1.6%), HMC-A (1.2%), and HMC-B (0.8%).

WSPS are a white powder with a cream tint and are very soluble in water. The monosaccharide composition includes fructose and a small amount of glucose, i.e., the polysaccharide is a glucofructan. The IR spectrum contains absorption bands at 830, 890, and 935 $cm^{-1}$ that are characteristic of inulin fructans. The Jerusalem artichoke tuber is a source of D-fructofuranosides (9.3%). After precipitating WSPS, the mother liquor was evaporated to a syrup. PC using *n*-butanol:pyridine:water (6:4:3) and urea developer revealed glucose, fructose, saccharose, kestose, and a homologous series of D-fructofuranosides, each member of which corresponds to the empirical formula Glc*p*1→2Fruf1-$[2Fruf1]_n$. The homologous series of fructosans starts at the saccharose of the lowest homolog (for n = 0). Then the trisaccharide kestose and the tetrasaccharide follow. Each oligofructoside differs from the previous one by a fructose unit. The highest homolog of this series is inulin [3].

At present, citrus, apple, and beet pectins have been isolated from raw material and well studied. However, pectins from other types of plant material, in particular, from Jerusalem artichoke tubers, are also being studied.

After reprecipitation by alcohol, demineralization, and drying, the pectin is a white powder with a cream tint that is very soluble in water, forms a colloidal solution, has $[\alpha]_D$ +148° (0.5 N, NaOH), and contains uronic anhydride (51.0%) and $OCH_3$ (2.3%). The IR spectrum (ν, $cm^{-1}$): 3600-3200, 2500, 1640, 1350, 1265, 1230, 1100, 835, 720, is identical to those of PS from higher plants [4]. The pectin consists of galactose, glucose, rhamnose, arabinose and galacturonic acid units that form the main chain.

The hemicellulose is a light brown amorphous powder. Water soluble HMCs do not give a reaction for starch. Glucose, galactose, xylose, arabinose and traces of rhamnose and galacturonic acid were detected in the hydrolysate. Treatment of the plant with base probably extracts PS that are not soluble upon extraction by ammonium oxalate.

The tuber contains 0.86% (per dry mass) nitrogen. The protein content calculated by the Kjeldahl method [5] is 5.45%.

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The amino-acid composition of the protein determined after acid hydrolysis (5.7 N HCl for 24 h at 110°C in vacuum) on an amino-acid analyzer (AAA-400, Czech Rep.) detected 17 amino acids:

| Amino acid | % (wt.) | Amino acid | % (wt.) |
|---|---|---|---|
| Asp | 1.41 | Val | 1.30 |
| Thr | 1.26 | Met | 1.80 |
| Ser | 1.27 | Ile | 1.83 |
| Glu | 2.94 | Leu | 2.91 |
| Pro | 2.01 | Tyr | 3.07 |
| Gly | 0.96 | Phe | 2.18 |
| Ala | 0.97 | His | 1.34 |
| 1/2Cys | 1.63 | Lys | 2.51 |
| | | Arg | 1.87 |

It can be seen that the protein is rich in almost all essential amino acids such as Val, His, Ile, Leu, Lys, Met, Thr, and Phe. The food value of Jerusalem artichoke protein is due to not only the essential amino acids but also the good balance.

The amino-acid composition of Jerusalem artichoke protein typically has biological and high food value.

Thus, the chemical composition of Jerusalem artichoke tubers includes monosaccharides, fructooligosaccharides, inulin, PS, and proteins. Such a combination of components enables Jerusalem artichoke tubers to be proposed as a biologically active food additive.

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