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CHEMICAL COMPOSITION, PROPERTIES AND USE OF BIOLOGICALLY ACTIVE HANGERS OF THE LOCAL VARIETY OF JERUSALEM ARTICHOKE "FAIZ BARAKA"

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Abstract. This article presents theoretical information about biologically active substances of the local Jerusalem artichoke variety created in the Uzbek Research Institute of Plant Growing. Carbohydrates, proteins and lipids have been studied. As a raw material, air-dry crushed raw materials were used separately (leaves, stems and roots). The quantitative content of lipids, mono and oligosaccharides, water-soluble polysaccharides, pectin substances and hemicellulose was determined. The qualitative monosaccharide composition and physico-chemical properties were established, the amino acid composition was determined. Classes of neutral glyco and phospholipids and their fatty acid composition were determined. It has been shown that syrup from tubers exhibits hypoglycemic activity.

Keywords: Jerusalem artichoke, carbohydrates, proteins, lipids, hypoglycemic activity, chemical composition, mono and oligosaccharides

1 Introduction

In modern conditions, an important direction is the search for alternative annually renewable resources for the production of products in various industries. The currently existing technologies for processing plant raw materials are of crucial importance for solving food, fuel and energy, environmental and social problems.

The innovative economy of the Republic of Uzbekistan provides for the creation of new jobs, the production of import-substituting and export-oriented products from local raw materials based on domestic science-based and resource-saving technologies. Bearing in mind that more than 60% of the country's population lives in rural areas, the priority of the economy is innovation for rural areas, namely: providing employment through the cultivation of new types of crops and their high-quality processing in various regions of the Republic.

In this regard, one of the promising crops for

processing and production of various types of innovative products is Jerusalem artichoke-ground pear (Helianthus tuberosus L.). Various varieties of Jerusalem artichoke are widely distributed in the world and are used for various purposes [1].

Jerusalem artichoke tubers are suitable for food in fresh, fried, boiled and

served form, as they have medicinal properties in the treatment of many diseases: diabetes, weight loss, gastritis, loss of strength, decreased performance [2], dysbiosis, etc. [3].

The Jerusalem artichoke variety "Fayz Baraka", created in the Uzbek Research Institute of Plant

Breeding since 2006, has been included in the State Register of Varieties

of Agricultural Crops recommended for cultivation on the territory of the Republic of Uzbekistan [4] and a certificate for this variety has been issued (No. 220 of

09.02.2006). For the first time, the University of Economics has developed Technical Conditions for Jerusalem artichoke tubers of the Fayz Baraka variety (TSh-40-02072446-01:2009).

In comparison with foreign varieties, the variety "Fayz Baraka" is characterized by a good

adaptation to the soil and climatic conditions of Uzbekistan and has

increased content of inulin and other biologically active substances.

Extraction of free lipids of tubers was carried out with extraction gasoline (boiling point +60 ... +700 C). A mixture of chloroform and methanol (2:1 v/v) was used to extract common and SLB. Non-lipid components were removed with 0.04% aqueous $CaCl_2$ solution. Hydrolysis of lipids, isolation of fatty acids and their methylation were carried out according to the method [6]. The isolation and determination of the monosaccharide composition of carbohydrates was carried out according to the method [7].

2 Materials and Methods

The components of the separated substances were identified according to the data of specific qualitative reactions, chromatographic mobility in the adsorbent layer and in comparison with model samples [5]. GL was manifested by iodine vapor, 50% H_2SO_4. GL-α-naphthol. FL- reagents of Vaskovsky, Dragendorf and ninhydrin.

GC was carried out on the "Chrome-5" device, a column filled with 15% Reoplex on N-AW was used at a thermostat temperature of 190 °C and a nitrogen supply rate of 30 ml/min. The content of carotenoids was determined by the calorimetric method on the CFK device. TLC was carried out in the following solvent systems: 1, 2, 3) diethyl ether - gasoline (fr. 60-70 °C) 3:7; 5:5; 2:8, 4) heptanbenzene 9:1, 5) chloroform - acetone - methanol – acetic acid – water 65:20:10:10:3, 6) acetone - toluene - acetic acid - water 60:60:2:1, 7) chloroform - methanol- 28% NH_4OH 65:35:5, 8) chloroformmethanol acetic acid - water 14:5:1:1.

To determine the hypoglycemic activity of jerusalem artichoke syrup in

male rats weighing 140-150 g were used in experiments, both normal and experimental hyperglycemia caused by intraperitoneal glucose injection at a dose of 3000 mg/kg or subcutaneous alloxan injection at a dose of 150 mg/kg. The blood glucose content was determined by the orthotoluidine method[8]. Jerusalem artichoke syrup was administered orally to animals at a dose of 0.4 ml / 100 g (in preliminary experiments, this dose was established as the most effective). For comparison, well-known hypoglycemic agents were used: the herbal collection of arphazetine and the oral drug adebit (N-butylbiguanide) [9]. The first was also administered 0.4 ml / 100 g of body weight orally (in the form of a freshly prepared 2.5% infusion), the second - at a dose of 50 mg / kg. Statistical processing of the obtained material was carried out using the Student's t-test.

3 Results

Air-dry crushed raw materials of Jerusalem artichoke of the Fayz Baraka variety from plants grown in the Uzbek Research Institute of Crop Production of the Ministry of Agriculture of the Republic of Uzbekistan (leaves, stems and tubers separately) were used as feedstock. The study of lipids of functional ingredients of biologically active substances of Jerusalem artichoke was carried out according to the scheme (Fig. 1).

We carried out the extraction of common (OL), free (SL) and bound lipids (SVL) of tubers dried to a humidity of 7.6%. The amount of lipids extracted from OL, SL and SVL was 0.56; 0.39 and 0.36%, respectively.

The extracted total lipids had a light yellow color, contained carotenoid pigments, the amount of which was 34.7 mg%.

SVL was divided by preparative thin-layer chromatography (PTSH) into neutral (NL), glycolipids (GL) and phospholipids (FL), the yield of which was 29.9, 46.9 and 23.2%, respectively.

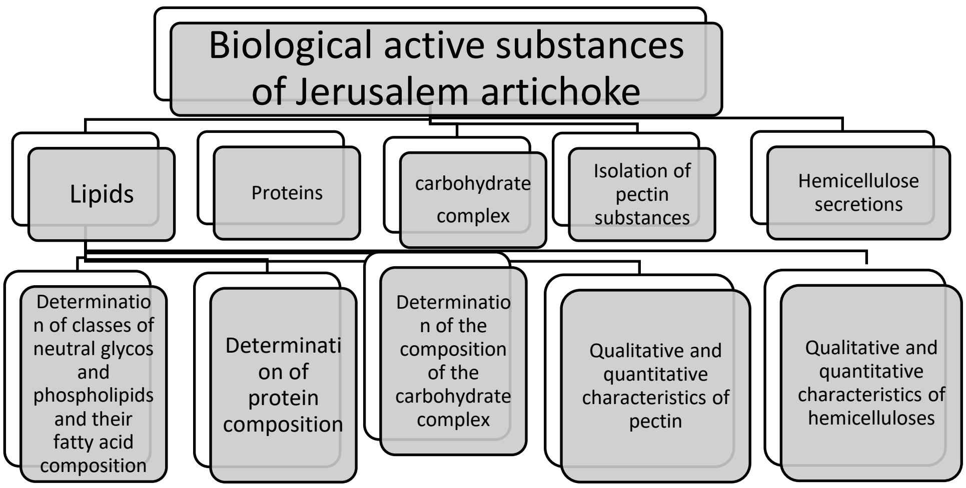

Figure 1. Study of the functional ingredients of Jerusalem artichoke.

SL, mainly consisting of NL, and neutral lipids isolated from SVL, were analyzed by TLC in systems 1-4. The following classes of NL were found: paraffin and olefin hydrocarbons, isoprenoid hydrocarbon squalene, tocopherol, triacylglycerides, free fatty acids, isoprenoid alcohols, triterpenols and sterols.

Phosphatidylinosites (PHI), phosphatidylcholines (PH), phosphatidylethanolamines (PE), phosphatidylglycerols (PH), phosphatidylglycerols (PH), and phosphatidic acid were identified in the composition of FL by two-dimensional TLC in systems 5 and 6.

When analyzing GL by TLC method, sulfolipids, digalactosyldiglycerides, sterolglycosides, cerebrosides, monohalactosyldiglycerides were found in systems 7 and 8. The main glycolipids were sterol glycosides and diga-lactosyldiglycerides. The composition of fatty acids NL, isolated from the fractions SVL, SL, GL and FL. GZHC was determined (Table 1).

As can be seen from the data in Table 1, the qualitative composition of fatty acids in all classes of lipids is the same and contains 10 acids, but they differ significantly in quantitative content. In polar lipids from saturated acids, 18:0 and 16:0 acids prevail. NL isolated from SVL contain a large amount of linoleic acid (53.0%) and low 12:0, 13:0 and 14:0 acids. The total amount of unsaturated fatty acids in them exceeds 70%.

Table 1. Composition of fatty acids SL, IL, from SLV, GL, and PL of tubers of Jerusalem artichoke variety "Fayz baraka".

Acid	СЛ	НЛ из СЛВ	ГЛ	ФЛ
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	11,60	2,5	5,3
Σ_{satiety}	45,8	26,4	62,9	50,8
$\Sigma_{\text{unsaturated}}$	54,2	73,6	37,1	49,2

Next, unsaponifiable substances (IR) of Jerusalem artichoke tubers, which were isolated from total lipids, were studied. Their yield was 5.2%, the amount of carotenoids in HB was 46.9 mg%. The amount of HB was divided by PTLC on silica gel plates in system 1 into separate fractions, in which%: hydrocarbons were 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 NV contain a significant amount of biologically active substances: isoprenols, triterpenols and sterols.

Alcohol-soluble sugars of Jerusalem artichoke tubers consisted of fructose, glucose and fructoolisaccharides (the main component). As can be seen from Figure 1, polysaccharides are distributed differently in different organs of the plant. In quantitative terms, VRPS (7.7%) prevail in tubers, and PV (9.1%) and HMC (14.7%) dominate in leaves. There is no starch in Jerusalem artichoke, and in terms of nutritional value it is inferior to potatoes, but it has 1.6 times more digestible protein than potatoes (Solanum tuberosum L.).

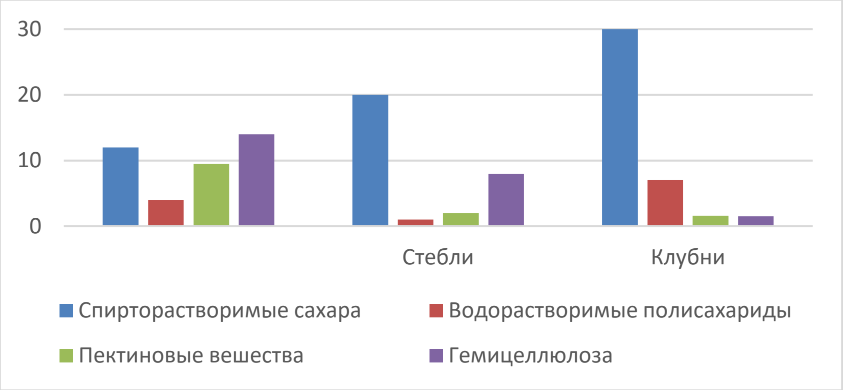

Figure 1. The content of carbohydrates and polysaccharides in various organs of the Jerusalem artichoke variety "Fayz baraka".

The tubers contain 0.86% nitrogen by dry weight. The protein content determined by the Keldahl method [5] is 5.4%, in which the amino acid composition was determined (Table 2).

Table 2 shows that Jerusalem artichoke protein contains essential amino acids (*), and non-essential amino acids are well balanced, which determines its high nutritional value. Lysine, serene are growth factors and are necessary for the development of living organisms. Phenylalanine, leucine and isoleucine play an important role in the function of the thyroid gland and adrenal glands, the function of the gonads is associated with the presence of arginine. Histidine and arginine are not synthesized in the child's body. Therefore, to maintain a normal metabolism, it is necessary to supply all amino acids not only in sufficient quantity, but also in optimal proportions.

Table 2. Amino acid composition of the tuber protein of the Jerusalem artichoke variety "Fayz baraka".

Amino acid	Content,% of sample weight	Amino acid	Content,% of sample weight
Asp	1,57	*Ile	0,2
***Thr**	0,7	*Leu	1,5
Ser	1,0	Tyr	0,8
Glu	3,6	*Phe	0,8
Pro	1,0	*His	0,8
Gly	1,1	*Lys	0,6
Ala	1,0	*Arg	1,4
***Val**	0,7		Σ 16,77

No tryptophan determination (Trp)

The powerful preventive and therapeutic effect of Jerusalem artichoke is determined by its biochemical composition.

Inulin and pectin substances stand out as the main functionally active ingredients of Jerusalem artichoke. Among other vegetable crops, Jerusalem artichoke is distinguished by a high content of inulin in tubers up to 35%, the amount of which depends on the variety, environmental conditions and methods of cultivation, as well as storage of tubers [6].

Inulin is a fructose-based polysaccharide that is easily hydrolyzed in the stomach into fructose and fructooligosaccharides. Inulin is the only known natural reserve polysaccharide consisting of 95% fructose. Inulin hygroscopic, freely soluble in hot water and slightly soluble in cold water [7].

Inulin is known to have a beneficial effect on the entire body.
person. Once in the gastrointestinal tract, inulin is cleaved by hydrochloric acid and enzymes into individual fructose molecules and short fructose chains [8]. The remaining unsplit part of inulin is excreted, binding with it a large number of substances harmful to the body (heavy metals, radionuclides, cholesterol crystals, fatty acids, etc.), as well as pathogenic microbes that have entered the body with food or formed in the gastrointestinal tract. In addition, inulin stimulates the contractility of the intestinal wall, which leads to an increase in the cleansing of the body from toxins, indigestible food, and harmful substances [9, 10].

The study of pectin One of the valuable products of vegetable raw materials processing is pectin. In industry, pectin is obtained from citrus fruits, apple pomace, beet pulp; at the same time, technologies for obtaining pectin from other types of plant materials are being developed. Jerusalem artichoke tubers can serve as a potential raw material for obtaining pectin [11].

At present, apple and beet
pectin. Similar data on the release of pectin from Jerusalem artichoke were not found in the literature.

We obtained pectins from various organs of Jerusalem artichoke (Table 3).

Table 3. Physicochemical characteristics of pectins isolated from various organs of the cultivated variety of Jerusalem artichoke "Fayz baraka".

plant organs	Viscosity n rel.. C 0,5 % H_2O	Molecular mass	Titrimetric data			
			Number of free carboxyl groups, % Кэ	Number of methoxylated carboxyl groups, % Кэ	Total amount of carboxyl groups , K_0	Degree of Ethirification, L
Leaves	1,70	15000	10,8	10,8	21,6	50,1
stems	6,80	86000	12,6	6,6	19,2	34,5
tubers	1,36	9000	6,3	3,6	9,9	36,3

Types of pectins:						
apple		32000				
citrus		26600				
sugar beet		26800				

HP is characterized by a low degree of esterification; 50.1%-
leaves, 34.5% stems and 36.3% tubers. This makes it possible to attribute them to the group of low-
co-esterified pectins. Structural polysaccharides of Jerusalem artichoke,
included in the cell walls: PV range from 4.0 to 9.1%, and HMC fluctuates
from 2.7 to 14.7%.

Pectin is an amorphous powder of white and gray-brown color, odorless, sour mucous in taste, soluble in water, practically insoluble in organic solvents. Pectin is isolated from solutions in the form of a colloidal precipitate with the addition of alcohol, acetone, and polyvalent metals. In the product of acid hydrolysis of pectin, galacturonic acid and neutral sugars were found. Molecular masses were determined according to the method [12], and the calculation was carried out according to the equation [h] = K*V*1.1*10-5 MW/22. The titrimetric method [13] gives the characteristics of pectin, which are given in Table. 3.

Jerusalem artichoke is a promising bioenergy crop.
Ethanol from Jerusalem artichoke is not produced in Uzbekistan, but there is a scientific
backlog for its production by enzymatic hydrolysis. The presence of distilleries in Uzbekistan simplifies the testing and implementation of the development in the production of alcohol from Jerusalem artichoke.
Fructooligosaccharides are a mixture of short chains of fructose and glucose.
Fructooligosaccharides are utilized by most strains of bifidobacteria, as well as some cultures of lactobacilli. With the use of fructooligosaccharides in the intestine, the microbial status is normalized with an increase in the adsorption of calcium and magnesium ions from the intestine. Fructooligosaccharides have a low calorie content and therefore can be recommended for people suffering from diabetes and obesity [14].
Thus, a valuable integral part of Jerusalem artichoke
is fructose. Its content may vary depending on the time.
no collection, harvest, storage duration, etc., but it is formed from inulin as a result of biochemical processes occurring in tubers. Thus, when studying the chemical composition of Jerusalem artichoke tubers, the presence of lipids,

monosaccharides, fructooligosaccharides, inulin, pectin substances, proteins and hemicellulose was noted, which opens up promising areas in the field of biotechnology, food and other sectors of the national economy.

Hypoglycemic activity of Jerusalem artichoke

The pronounced hypoglycemic effect of Jerusalem artichoke syrup was also determined under conditions of alloxan hyperglycemia and alloxan diabetes. In the first case, the syrup was given 72 hours after the injection of alloxan, i.e. at the height of the peak of secondary hypertemia (rats with initial blood glucose levels in the range of 200-250 mg% were used). The results obtained are presented in Table 4.

Experiment conditions	Blood glucose mg %						
	Baseline	After 1 hour		After 2 hour		After 3 month	
		Мг %	% Exodus	Мг %	% Exodus	Мг %	% Exodus
Control	210,6±9,4	206,0±8,2	-2,2	205,0±8,4	-2,7	201,3±8,0	-4,4
Jerusalem artichoke syrup	228,0±9,6	183,3±9,5	-19,6	153,3±11,4	-32,8	141,0±11,5	-38,2
Arphazenite	224,0±10,5	205,0±8,8	-8,5	187,7±10,1	-16,2	172,0±8,6	-23,2
Adebit	227,0±10,4	191,6±4,0	-15,6	160,0±5,2	-29,5	141,6±4,8	-37,6

4 Discussion

Thus, Jerusalem artichoke syrup at the studied dose both in normal animals and in animals with hyperglycemia caused by glucose
load or alloxan (as in alloxan diabetes), had a pronounced hypoglycemic effect, while its effect is more pronounced. What is the corresponding action of arfazetin. In experiments on normal animals, the hypoglycemic properties of Jerusalem artichoke syrup were also manifested to a greater extent than in adebite; in experiments on animals with hyperglycemia, their effect was generally equivalent.

5 Conclusion

For the first time the biological active substances of the local variety of Jerusalem artichoke "Fayz Baraka" were studied. Carbohydrates (mono-oligosaccharides, water-soluble polysaccharides, inulin, pectin substances, hemicellulose), proteins and lipids have been isolated and studied.

Their content, physicochemical properties, monosaccharide composition, amino acid composition have been determined. The protein is well balanced in amino acid composition.

Stages of successive isolation of biologically active substances have been developed.

This combination of components (carbohydrates, proteins, lipids, etc.) makes it possible to offer Jerusalem artichoke tubers as a biologically active food supplement.

It was revealed that the tuber syrup is low toxic and has a pronounced hypoglycemic activity.

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