CHEMICAL COMPOSITION OF THE PLANT *HELIANTHUS TUBEROSUS* L.

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Abstract. *In the article, the chemical composition and biologically active substances, macro- and microelement composition of the medicinal Jerusalem artichoke (Helianthus tuberosus L.), introduced in the conditions of old irrigated meadow-alluvial soils, were studied, as well as the elements in the root bark and root fruit of the Jerusalem artichoke plant using the neutron-activation method. the analysis results of the quantity are given. According to the obtained results, it has been proven that the root of this plant absorbs elements such as K, Ca, Fe, Na, Sr, Zn and Mn more than other elements, and on the contrary, it absorbs the toxic lead element in a very small amount.*

Keywords: *Helianthus tuberosus, macroelement, microelement, vitamin, root fruit, root bark, inulin.*

Introduction. Jerusalem artichoke *(Helianthus tuberosus L.)* is an annual plant belonging to the Astral family. Its rhizome varies from white, purple-red, to light brown, depending on the soil and climatic conditions. The shape of the root fruit is usually oblong oval or pear-shaped. In some varieties, the rhizomes form an uneven surface due to their dense growth. The average weight of the roots is from 10 to 100 g, most often from 30 to 80 g. This medicinal plant is distinguished from other root vegetables by its ability to accumulate inulin and protein substances consisting of 16 amino acids. Jerusalem artichoke plant protein is composed of glutamic and aspartic acids, which are acids that provide high-energy bonds closely related to carbohydrate metabolism [1].

According to Kochnev and Kalinichev, Jerusalem artichoke tubers contain (up to 4%) cellulose fibers and (for example, mg % of dry matter): potassium - 1382.5; calcium - 78.8; manganese - 44.0; magnesium - 31.7; sodium - 17.2; It is rich in mineral elements such as iron - 10.1. Jerusalem artichoke actively accumulates silicon from the soil up to 8 mg % [2].

According to scientific sources and foreign literature, Jerusalem artichoke tubers contain the following vitamins: (calculated by weight per 100 g of raw material): retinol (A) 2 mg, thiamin (V1) 0.07 mg, riboflavin (V2) 0.06 mg, pyridoxine (V6) 0.2 mg, folic acid (V9) 18.5 mg, nicotinic acid (RR) 1.3 mg, niacin equivalent (RR) 1.6 mg, ascorbic acid (C) 6 mg, tocopherol (E) 0.2 mg, β-carotene 0.012 mg [3].

According to G. V. Mamonova, Jerusalem artichoke tubers contain pyrocatechins, oxidolcinic acids and condensed tannins, total amount of polyphenolic substances is 125 mg/kg. A number of polyphenol substances (flavanones, catechins, leucoanthocyanins, anthocyanins) have R-vitamin activity. Jerusalem artichoke early ripening variety "Skorospelka", the chemical composition of the root is characterized by the following indicators (in %): dry matter - 22.0; organic matter - 20.8; crude protein - 2.2; crude oil - 0.2; raw fibers - 1.0; nitrogen-free extractives - 17.4; inulin - 16.7; calcium - 0.05; phosphorus - 0.04; iron - 3.6 mg; copper - 0.13 mg; zinc - 0.53 mg [4].

G.A. Kupin proposed combining Jerusalem artichoke and fruit-vegetable components to create new types of preserves. The author suggests the use of components with high acidity to activate the hydrolysis of inulin and the formation of fructose to improve the taste and functional properties of the finished product. A.L. Belousova proposed the technology of creating medicines based on Jerusalem artichoke. The author determined the technological indicators of obtaining ascorbic acid tablets from Jerusalem artichoke leaves and stems and rational methods of processing raw materials [5].

Research methods. The elemental analysis of the plant was carried out by the neutron-activation method in the "Ecology and Biotechnology" laboratory of the Research Institute of Nuclear Physics of the Academy of Sciences of Uzbekistan. The samples taken for analysis were taken mainly during the flowering phase of plant vegetation. The underground part, i.e., the root nodule, was excavated using a monolithic or trench method in 1 m^2 in quadrate form, on the basis of 3 returns, the soil was cleaned and the wet weight was measured.

The obtained samples were dried at room temperature and 50 and 100 mg were taken. The samples were wrapped in acetone-cleaned film bags and then in aluminum foils and placed in the reactor. In this case, the samples are $5*10^{13}$ neutrons/cm^2 sec in the atomic reactor. irradiated with a neutron stream, and their amounts were found based on the half-life periods of chemical elements.

Mathematical-statistical processing of the obtained results was carried out on the basis of the computer program of R.Koziev, G.Yuldashev, I.Akramov, created on the basis of B. A. Dospekhov's method.

Results and discussions. *In the above information, it can be seen that great attention is paid to the study of the organic composition of Jerusalem artichoke plant, which is used for medicinal and food purposes. It is known from many conducted studies that the study of biologically active substances included in the composition of medicinal plants, as well as the study of chemical elements under the influence of environmental factors, is of great scientific and practical importance. In addition, we aimed to determine the elemental composition of the Jerusalem artichoke plant from the point of view of evaluating the ecological purity of medicinal plants today, which requires special attention to the issue of ecological monitoring of the amount of heavy metals in medicinal plants and the implementation of hygienic standards.*

We determined the amount of macro- and microelements in Jerusalem artichoke roots using the neutron activation method, and 19 elements were found in the fleshy part of the root and 31 elements in the root bark (Table 1). These elements were studied by us into three groups: macroelements, microelements and toxic elements.

Jerusalem artichoke root bark contains potassium, calcium, magnesium, sodium and chlorine among the main macroelements; micronutrients include copper, zinc, rubidium, strontium, molybdenum, manganese, chromium, nickel, cobalt, and iron. The root fruit of this species contains sodium, potassium, magnesium, calcium and chlorine among the main macroelements; trace elements include iron, zinc, cobalt, nickel, chromium, molybdenum, manganese and copper. Among the toxic elements, only lead was detected in both the fleshy part of the tubers and the root bark.

The decreasing order of the composition of macronutrients for Jerusalem artichoke root bark is $K > Ca > Mg > Na$*. The content of macroelements in the root fruit decreases in the following order:* $K > Mg > Ca > Na$*. The amount of macronutrients in the root bark is relatively higher than the amount of macronutrients in the fleshy part of the root fruit. The highest amount of K* *element was observed in Jerusalem artichoke root bark, its value was 27900 µg/g, and the highest amount of K element in the fleshy part of root fruit was 22000 µg/g.*

From the information presented in the table, it is known that the order of reduction of microelement content of Jerusalem artichoke root bark is as follows: Fe > Zn > Ba > Mn > Cu > Cr > Mo > Ni > Co. Jerusalem artichoke. The composition of the main microelements for the fleshy part of the root of the plant decreased in the following order: Fe > Zn >Cu > Mn > Mo > Ni > Co. The root bark of Jerusalem artichoke contains the highest amount of iron among microelements, its amount is equal to 574 µg/g. The fleshy part of Jerusalem artichoke root has the highest amount of iron among micronutrients. Jerusalem artichoke root bark contains the lowest amount of samarium, lutetium, ytterbium, gold, tungsten, mercury, europium, antimony, bromine, terbium and tantalum trace elements. Common trace elements such as boron, fluorine, phosphorus, and silicon were not detected.

Elements such as samarium, gold, bromine, nickel, scandium, cobalt, europium, and antimony accumulate in the fleshy part of Jerusalem artichoke root. Common trace elements such as boron, fluorine, phosphorus, and silicon were not detected. It should be noted that toxic elements mercury and lead were not detected in the fleshy part of the root of the plant.

Table 1

Elemental content of *Helianthus tuberosus L.* root fruit and root bark samples, µg/g

№	Element	Amount of macro and micronutrients, µg/g		№	Element	Amount of macro and micronutrients, µg/g	
		Root bark	Root fruit			Root bark	Root fruit
1	Mg	4179	2280	**17**	W	0,553	***
2	Cl	1100	1060	**18**	Ce	1,16	***
3	Mn	28,3	3,98	**19**	Se	***	***
4	Cu	20,9	11,4	**20**	Hg	0,036	***
5	Na	462	120	**21**	Tb	0,0096	***
6	K	27900	22000	**22**	Th	0,212	0,0098
7	Sm	0,078	0,024	**23**	Cr	2,05	0,48
8	Mo	0,966	0,626	**24**	Hf	0,07	***
9	Lu	0,005	***	**25**	Ba	29,8	***
10	U	0,19	***	**26**	Sr	59,8	16,9
11	Yb	0,047	***	**27**	Ta	0,01	***
12	Au	0,0078	0,0046	**28**	Cs	0,09	***
13	As	0,215	***	**29**	Ni	0,5	0,04
14	Br	0,4	0,247	**30**	Sc	0,184	0,0136
15	Ca	5840	1190	**31**	Rb	10,1	7,54
16	La	0,685	0,390	**32**	Fe	574,0	61,5

**** - amount not specified.*

According to the obtained results, Jerusalem artichoke plant is a natural source of elements necessary for the vital activity of the organism, such as K, Ca, Fe, Na, Sr, Zn and Mn. Among the toxic elements, only lead was found in minimal amounts in the root bark and fruit of the plant. The total amount of macro- and micronutrients in the root bark is higher than in the content of the root fruit.

In summary instead, it can be said that the modern human lifestyle, the decrease in the level of immunity of the body, the degradation of the existing food products, that is, it is possible to use Jerusalem artichoke as a raw material for the creation of new products with functional properties, to increase the quality and safety of the product. Due to its high content of solids, unique carbohydrate content, functional activity and low calorie content, Jerusalem artichoke is very suitable for the modern concept of healthy nutrition. Taking into account the high nutritional and biological value, it is possible to produce natural food based on Jerusalem artichoke, functional products (pure, juices, drinks, etc.) and components (inulin) and to meet the population's need for them, the goal is to ensure comprehensive processing of tubers is appropriate.

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