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Research yakon tubers (*Polymniasonchifolia*) as the object of study

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ABSTRACT: Yacon is a valuable medicinal crop, as its root tubers contain a high percentage of inulin, a polysaccharide that is easily absorbed by the body and serves as a substitute for sucrose in the diet of patients with diabetes. When drying tubers, the sugar concentration in their composition increases to 65%. They also contain 6-7% protein, 0.4-1.3% fat and 4-6% fiber. In addition, vitamins (C, riboflavin, niacin and thiamine) and minerals and biologically active substances useful for the body are part of the icon, which makes it very useful in the treatment of various metabolic disorders.

KEY WORDS: yakon tubers, drying, powder, temperature, inulin.

I.INTRODUCTION

At present, a clear understanding has been achieved that in many respects human health and life expectancy determine the nature of its nutrition. Such attention of the world community to nutrition problems is associated with an understanding of the negative health consequences that result from a violation of the nutrition structure and the extremely low level of energy consumption. In addition, it is due to the success of biochemistry, physiology and other sciences in studying the role of biologically active substances (BAS), in human life as factors in the regulation of the functional activity of the body, as well as reducing the risk of developing a number of diseases. In addition to the main components of food - proteins, fats and carbohydrates, as well as vitamins and chemical elements - a large group of chemical compounds with antioxidant activity is vital for humans [1]. Currently, there is no doubt that a deficiency of antioxidants leads to a sharp decrease in the resistance of a living organism to adverse environmental factors due to disruption of the functioning of antioxidant defense systems, both of humans and plants. It is plant food that is for humans the main and most affordable source of exogenous antioxidants that function effectively in his body.

The problem of introducing vegetable plants with a high content of biologically active substances is relevant worldwide and is associated with a lack of these compounds in the diet of the population of many countries. In this regard, the assessment and selection of vegetable plants with a high content of antioxidants, the study of their composition are relevant and necessary for the subsequent use of knowledge in the creation of functional food products - products enriched with a variety of scarce micronutrients and nutritional nutrients.

Plants, which are a rich source of antioxidants, fructosan, inulin, polysaccharides, include yakon or osotoliumpolymy. Yacon (*Polymniasonchifolia*Poepp.&Endl. - a synonym for *Smallanthussonchifolia*) is a perennial plant from the Asteraceae family. The main distribution area of the icon is the middle latitudes of South America. To date, the yakon has been introduced in the United States, New Zealand, southern Europe, Iran, Japan, Moldova, the Czech Republic and Uzbekistan.

It is known that yacon is a valuable medicinal crop, since its root tubers contain a high percentage of inulin, a polysaccharide that is easily absorbed by the body and serves as a substitute for sucrose in the diet of patients with diabetes mellitus. Recently, scientists in many countries have proved the hypoglycemic properties of the yacon [2]. To date, the bulk of the work on the study of the medicinal properties of the yacon is aimed at studying its underground part, although a number of authors have shown that in addition to root tubers, the use of extracts from the leaves of the yacon plants also reduces blood sugar. Due to the content of chlorogenic, caffeic acids and other phenolic compounds, the leaves of the yacon also have antioxidant properties.



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First of all, this vegetable is valuable for its high content of easily digestible polysaccharides including up to 60% inulin. This poly-D-fructosan is used as a substitute for sucrose in the diet for diabetics. Raw fresh tubers of the yacon eaten in raw form contain about 70-80% of water, about 20% of sugars and 0.4-2.2% of protein. A similar composition led to the name of the plant - in the language of the Quechua Indians, yakku means fresh, and unu means water. That is, being a low-calorie this vegetable can be used to combat obesity.

When drying tubers, the sugar concentration in their composition increases to 65%. They also contain 6-7% protein, 0.4-1.3% fat and 4-6% fiber. In addition, vitamins (C, riboflavin, niacin and thiamine) and minerals and biologically active substances useful for the body are part of the icon, which makes it very useful in the treatment of various metabolic disorders.

The presence of selenium, chlorogenic and caffeic acid, as well as a number of phenolic compounds, determines the antioxidant properties of the yacon. In addition, it also has hypoglycemic properties. At the same time, a number of studies have shown that not only root tubers, but also extract from the leaves of the apple leads to a decrease in the concentration of sugar in the blood. That is, for medicinal purposes, you can use both the underground and ground parts of the plant.

The discovery of the beneficial nutritional and medicinal properties of the icon leads to an increase in its popularity and attempts at introduction (i.e., relocation beyond the borders of its natural range) in an increasing number of countries on different continents. However, studies have shown that with northward movement, the concentration of inulin in the composition of plants, unfortunately, decreases to zero.

How to use yacon in food. Usually it is eaten raw: root tubers, sweet and crispy, are good in any salads. They, as well as young shoots of the icon, are boiled, stewed and fried. During cooking, they remain sweet and slightly crispy. In the homeland of the plant, in the Andes, the tubers are wiped, squeezed juice from them and prepare a refreshing drink. Sometimes the juice is concentrated and dark brown fruit sugar is obtained.

Ancon root tubers are an effective antidiabetic product. Their consumption helps to lower cholesterol, helps regulate the functioning of the intestine, and other beneficial properties of the plant have been discovered. The root tuber protein contains all amino acids and is comparable in quality to a sideal protein. There are many vitamins in the tubers of the yacon, including vitamin C, thiamine, riboflavin and niacin.

Cultivation of the Yacon The native land of this representative of the genus Polymnia of the family Asteraceae (Astrov) is the eastern slopes of the Andes at an altitude of 900 to 2750 meters in the territory from Venezuela to southwestern Argentina. The ground part of the yacon growing in the natural range reaches a height of 2.0-2.5 meters, but in a colder climate in Ukraine and the European part of Russia, its height ranges from 0.7 to 1.8 meters. The leaves and shoots of the plant are annuals and die in the fall. But the thick fleshy rhizome formed at the base of the main shoot is perennial and dies only if the soil freezes. The last factor leads to the fact that the underground part of the icon we grow up in our country also becomes annual.

II. MATERIALS AND METHODS

Formation of root tubers of the ancon In the initial period of root growth, the roots of the ancon rhizomes are thin, but subsequently they thicken, acquiring a fusiform, oval or pear-shaped form. Since thickenings are formed during the growth of lateral roots and are formed only due to root tissues, they are called root tubers, thereby emphasizing the fundamental difference from root crops of potato or Jerusalem artichoke, which are similar to shoots.

At home, the yacon multiplies with the help of seeds or rhizomes. But in our cool climate it does not bloom at all and, accordingly, has no seeds. Therefore, it is propagated by seedlings obtained from the buds of rhizomes or cuttings. To obtain seedlings in late January or early February, disinfected rhizomes are placed in a moist environment - in flat containers with a moisture-intensive litter at the bottom, which is covered with glass or a film of polyethylene on top. Periodically, it is necessary to ventilate and moisten the litter.

After two weeks, shoots with a height of 1-2 cm develop from the kidneys. Now rhizomes must be cut into pieces so that each of them has a shoot and, if possible, with a root. Then, sprinkling the slices with charcoal, we plant shoots in peat pots measuring 25x30 cm filled with a soil mixture (1 part of turf soil + 2 parts of peat). Care for seedlings of the yacon is the same as for seedlings of tomatoes. After two months, seedlings can be planted in closed ground.

When propagating by cuttings, a section of the stem with one pair of leaves is used. Cuttings are placed in a soil mixture, covered with glass containers and moisturized intensively. Then they are placed in a greenhouse with an air temperature of +18 - +20 ° C and lighting for 16 hours a day.

Cultivation of the icon. Sprouted seedlings with an age of at least 2.5 months are planted in open ground according to a 70x70 cm pattern when the threat of frost passes.

The main pests of the icon in closed ground are whiteflies and spider mites. In open ground for plants, wireworm (the nutcracker larva) is a danger. Therefore, seedlings are not recommended to be planted in areas where solanaceous plants used to grow, this is especially true for potatoes. With an excess of moisture in the soil, the appearance and development of mucous bacteriosis on the root tubers is possible.

Yakon is especially unpretentious to lighting. From soils, it prefers having a lighter granulometric composition, in which it is easier for their roots to grow. That is, when planting in light chernozem or gray forest soil of light mechanical composition, the yield will be higher in the latter case.

After planting and watering, the plants are thoroughly mulched to prevent evaporation of moisture. With dry soil, the yakon needs additional watering. With excessive soil moisture, it must be loosened to avoid hypoxia of rhizomes. In summer, yakon bushes spud like potatoes.

Harvesting and eating the icon. Harvesting the yakonThe bushes of the yakon are dug up in late autumn before the start of frost. This operation must be carried out carefully, since juicy root tubers break easily and become unsuitable for further long-term storage. After this, tubers are separated from the rhizomes and the stems are cut, leaving a 2-3 cm section. Drying the leaves and stalks of the icon The upper part of the plant can be fed to livestock or leaves and cut stems can be dried in a well-ventilated room. In the future, they can be used for the preparation of therapeutic and preventive herbal teas that reduce blood sugar levels [3-4].

Preparation of rhizomes for storage Rhizomes after drying for two weeks in a dark and well-ventilated place are freed from the remnants of the earth, cut out rotted areas with dusting the place of cut with charcoal. They are stored in heated greenhouses, placing holes with a diameter of 30 cm and a depth of 30-45 cm and sprinkled on top with soil with humus. Tubers can be stored for a long time in the refrigerator, wrapped in paper and placed in a plastic bag. At the end of February, they are divided into 5-10 parts, with 2-3 kidneys each, treated with foundationazole, put in a container with wet paper and covered with a film on top. After the appearance of sprouts and the first roots, they are planted in pots with a fertile soil mixture.



Fig. 1. Yakon tuber (*Polymniasonchifolia*)

The meaty and juicy root tubers are tasteless for the first time after being extracted from the ground. To acquire the specific taste of a sweet apple with melon, the collected tubers must be kept for 3-5 days when illuminated in a dry and warm place until a wrinkled peel forms. At this time, they break down inulin into low molecular weight fructans.



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We select the least damaged tubers and place them in storage in boxes, pouring them over with disinfected (fried) river sand. The optimum temperature for long-term storage is +4 ° C. Tubers can also be stored in the refrigerator in plastic bags, periodically inspecting and removing spoiled ones.

Having removed a thin layer of the peel, the root tubers of the yacon according to many recipes for salads, desserts, etc. can be consumed raw, boiled or stewed. They also make syrups, preserves, sweeteners, candied fruits and juices. In addition to cooking, yacon is used in the manufacture of various cosmetic preparations.

Processing products of the tubers of the yacon normalize digestion, improve intestinal motility, maintain clarity of mind, prevent cardiovascular diseases, and have a beneficial effect on the nervous system.

However, the tubers of the yacon, having high humidity, due to the absence of a cork layer in the peel, quickly lose moisture during storage and are easily affected by rot. Therefore, it is advisable to prepare powdered semi-finished products from them, the use of which simplifies the technology for the production of bakery products for functional purposes with specified physicochemical and rheological characteristics.

In the powdered products of the processing of the tubers of the yacon, inulin and fructose are preserved in significant quantities, which allows them to be used in the technology of bakery products in order to give them preventive properties.

To obtain the powder, the tubers of the apple were washed at a temperature of water from 40 to 50 ° C, then they were cut in the form of “chips” and dried in IR heating for one hour to a residual moisture content of about 20%. Then they were dried in a convective way to a residual moisture content of 5% and subjected to cryo-grinding in liquid nitrogen to obtain a powder with a particle size of mainly from 130 to 180 microns.

Based on the obtained experimental data, we developed a method for the production of a bakery product, involving the preparation of light and dark dough. The following recipe components were introduced into the light dough: baking wheat flour of the highest grade, pressed baker's yeast, margarine, phospholipids, sugar, salt, vanillin and water. As a part of the dark dough, a mixture of flour obtained from yacon tubers and premium baking wheat flour was used in a weight ratio of 1: 5 to 1:13, pressed baker's yeast, margarine, sugar, salt and water.

Two types of dough were prepared in an unsupported manner. Kneading of each type of dough was carried out by loading the recipe components in the appropriate amounts in a dough mixing machine and mixing for 10-15 minutes until a homogeneous consistency was obtained. At an initial test temperature of 28-29 ° C, the duration of its fermentation was 20-40 minutes, and the final acidity reached 2.5-3 degrees. The fermented dough was divided into pieces and sent for preliminary separation for 5-7 minutes. Then, light and dark dough pieces were folded alternately and sent for twisting to a roller machine, where they were simultaneously shaped like a loaf, and 3-5 oblique cuts were applied. The preforms thus formed were laid on greased sheets and sent to the final separation for a duration of 60-90 min at a temperature in the bored chamber of 35-40 ° C and a relative humidity of 75-80%. The upset products were baked in an oven at a temperature of 200-220 ° C for 30-35 minutes to obtain the target product.

Comparison of the organoleptic properties of the finished product obtained by the described technology made it possible to establish that the experimental product has greater crumb elasticity and has a coffee tint of taste and aroma in the absence of coffee in the recipe. In addition, the protein-polysaccharide complexes formed during the preparation of the dough increase the water-holding ability of the products, which increases the yield of finished products by 6–8% and allows you to keep the product fresh for a longer time.

With a decrease in the relative content in the dark dough of flour obtained from the tubers of the yacon, coffee shades of taste and aroma disappear below the lower limit. With a decrease in the relative content of premium grade wheat flour in the dark dough below the lower limit, the porosity of the dark part of the target product decreases, which leads to heterogeneous consistency of the layers of the target product and its delamination during cutting.

The nutritional value of a bakery product containing flour obtained from the tubers of the yacon was calculated. It was found that the developed bakery products can be attributed to functional products, since the use of 100 g of the product



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prepared using flour obtained from yakon tubers covers the daily requirement of the body for dietary fiber - by 35%, iron - by 25-40%, selenium - by 33-44%. In addition, the developed product is enriched with potassium and calcium.

III. CONCLUSION

Thus, as a result of the studies, a method for the production of bakery products of functional purpose of improved quality with specific organoleptic properties with coffee shades of taste and aroma in the absence of coffee in the recipe was developed.

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