https://doi.org/10.29013/AJT-22-9.10-41-45

Rahmanberdiev Gappar,
professor, Tashkent chemical-technological Institute
Khusenov Arslonnazar,
professor, Tashkent chemical-technological Institute
Ibragimova Komila,
researcher, Tashkent Chemical – Technological Institute
Tilakov J. R.,
researcher, Tashkent Chemical – Technological Institute
Baltabaev Ulugbek Narbaevich,
associate, Tashkent chemical-technological Institute

ANALYSIS OF INULIN OBTAINED FROM THE POWDER OF TOPINAMBOUR TUBERS (HELIANTHUS TUBEROSUS L.)

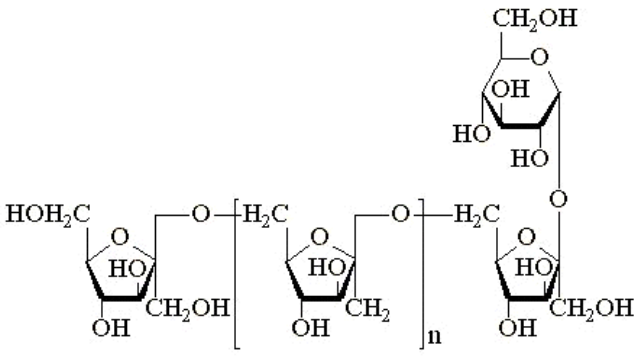
Abstract. Obtaining possibility of inulin from powders from topinambour tubers has been shown. Qualitative and quantitative analyses of the obtained product have been resulted. Results of researches have been showed that purified inulin contains more than 86% pure inulin.

Keywords: topinambour tubers, inulin, dissolves, spectrum, characteristic, fructose, glucose.

Introduction

Now in process of active studying of properties of topinambour in many countries of the world (Japan, the USA, Canada, Holland, Belgium, Germany, etc.) physicians manifest huge interest to it as to medical and dietary means. 100% of the concentrate of topinambour tubers contains high concentration of inulin. Inulin represents difficult carbohydrates, in many respects similar on structure with starch and cellulose, but it consists of fructose by 95%.

The purpose of our work is qualitative and quantitative analysis of inulin obtained the powder of topinambour tubers (Helianthus tuberosus L.) which has the following chemical formula:



The basic technological circuit design of obtaining inulin includes purification stages (peeling), cutting, drying, crushing, screening, dissolution, sedimentation, drying of a deposit, crushing, screening and packing [1].

At obtaining powder of topinambour tubers it is pleaded with a knife or the special apparatus. For this purpose at first the crude is washed out from mechanical pollution, then it is peeled, the purified raw materials are subjected to cutting and dried at

temperature 55–65 °C in a current of hot air or under vacuum at 1–5 mm of mercury column. The obtained product is subjected to crushing within 80 minutes in the ball mill, sieved through a sieve (C-10) with diameter of apertures 0,1 mm. The powder has from white to dark-cream colour with dark impregnations. Specific odor. Taste, as raw materials. pH of 0,1%-s' aqueous solutions has been defined by potentiometer method and equated 7–7.5 [2; 3].

The quantity of inulin has been defined on the solubility in water, in ethyl spirit and on optical density.

Polysacharide inulin (fructosane) dissolves in hot water well and does not dissolve in ethyl alcohol. Fructose and low-molecular fructoside dissolve both in water, and in ethyl alcohol. On the difference between fructoside and fructosane the quantity of inulin has been computed.

The amount of fructoside and fructosane has been defined on the method [4] in the following way.

About 1 g of raw materials was placed in a conic flask capacity of 200 ml, 60 ml of water was added and heated up on the boiling water bath with the reflux condenser within 45 minutes. Warm extraction was filtrated through cotton wool in a measured flask capacity of 200 ml so that raw materials corpuscles did not get on the filter. The flask was rinsed with 10 ml of water and filtrated in the same measured flask. Extraction was repeated by two more times (the first time 45 minutes with 30 ml of water heated up, second – 15 minutes with 30 ml of water). Both extraction were filtrated in the same measured flask and washed out the rest on the filter, using each time by 10 ml of water. Cotton wool with raw materials was squeezed.

2 ml of 10% of a solution of acetate of basic lead was added in to the obtained mixture, mixed and left for 10 minutes. Then 2 ml 5%-s' solution of phosphate sodium was added, mixed and left for 5 minutes. The volume of solution in the flask was led up to mark with water and mixed. Extraction was filtrated through the paper folded filter, the first 10–15 ml of filtrate was discarded. 2 ml of filtrate was placed in a measured flask capacity of 100 ml, the volume of solution was led up to mark with water and mixed (solution A).

5 ml of 0.1% alcohol solution of resorcin was placed into the measured flask capacity of 25 ml. Then 5 ml of the solution A (an analyzed solution) was added into the flask. The volume of solution was led up to mark of 30% with the solution of hydrochloric acid, then it was mixed. Flask contents were poured into a test tube and heated up on the water bath at temperature 80 °C during 20 min., then it was cooled at room temperature.

Optical density of the solution under test was measured by the spectrophotometer ("Genesis" of the USA wave length 190–1100 nanometers) at wave length of 482 ± 2 nanometers in a cuvette with thickness of a layer of 10 mm concerning a comparison solution.

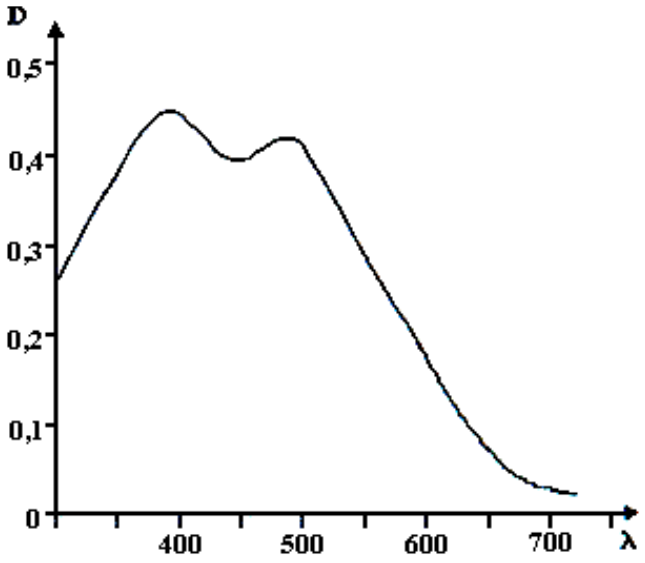


Figure 1. Absorption spectrum of reaction product of interaction of fructose with resorcin in the acid medium

The total content of fructosides and fructosanes in conversion on fructose and absolutely dry raw materials in percentage (X) was computed by the formula:

$$X = \frac{D \cdot 200 \cdot 100 \cdot 100}{95 \cdot 1 \cdot 2 \cdot m \cdot (100 - W)} = \frac{0.824 \cdot 200 \cdot 100 \cdot 100}{95 \cdot 1 \cdot 2 \cdot 1 \cdot (100 - 3)} = 89.4195\%, \quad (1)$$

where D – optical density of an analyzed solution; 95 – a specific absorption coefficient of a reaction product of interaction of fructose with resorcin in acid medium; m – weight of raw materials in gr; W – loss in weight at raw materials drying in%.

The quantity of fructosides was defined by the technique [4] as follows: about 1g raw materials was placed in a conic flask capacity of 200 ml, 60 ml of 95% of alcohol was added and heated up on the boiling water bath with the reflux condenser within 45 minutes. Warm extraction was filtrated through a cotton wool layer in a measured flask capacity of 200 ml so that raw materials corpuscles did not caught on the filter. The flask was rinsed with 10 ml of 95% alcohol and filtrated in the same measured flask. Extraction was repeated by two more times, (the first time heated up within 45 minutes about 30 ml of 95% alcohol, the second time – 15 minutes about 30 ml of 95% alcohol). Raw materials were transferred on the filter, the flask was rinsed, and then the residue was washed out on the filter, using each time on 10 ml of 95% alcohol. Cotton wool with raw materials was squeezed.

1ml of 10% of a solution of acetate of basic lead was added in to the obtained mixture, mixed and left for 10 minutes. Then 2 ml of 5%-s' solution of phosphate sodium was added, mixed and left for 5 minutes. The volume of solution in the flask was led up to mark with water and mixed. Extraction was filtrated through the paper folded filter, the first 10–15 ml of filtrate was discarded. 10 ml of filtrate was placed in a measured flask capacity of 100 ml; the volume of solution was led up to mark with water and mixed (solution A).

5 ml of 0.1% alcohol solution of resorcin was placed into the measured flask capacity of 25 ml. Then 5 ml of the solution A (an analyzed solution) was added into the flask. The volume of the solution was led up to mark with 30% of hydrochloric acid solution, and it was mixed. Flask contents were poured in a test tube and heated up on the water bath at temperature 80 °C during 20 min., and cooled at room temperature.

Optical density of the solution under test was measured by the spectrophotometer at wave length of 482 ± 2 nanometers in a cuvette with thickness of a layer of 10 mm concerning a comparison solution.

Preparation of a solution of comparison. 5 ml of 0,1% alcohol solution of resorcin was placed into the measured flask capacity of 25 ml. Then 5 ml of water was added into the flask. The volume of solution was led up to mark of 30% a hydrochloric acid solution, and it was mixed. Flask contents were poured into the test tube and heated up on the water bath at temperature 80 °C within 20 minutes, and cooled at room temperature. Optical density of the solution under the test was measured on the spectrophotometer at wave length of 480 ± 2 nanometers in a cuvette with thickness of a layer of 10 mm concerning a comparison solution.

The content of fructosides in conversion on fructose and absolutely dry raw materials in percentage (X_1) was computed by the formula:

$$X_1 = \frac{D \cdot 200 \cdot 100 \cdot 100}{95 \cdot 1 \cdot 10 \cdot m \cdot (100 - W)} = \frac{0.131 \cdot 200 \cdot 100 \cdot 100}{95 \cdot 1 \cdot 10 \cdot 1 \cdot (100 - 3)} = 2.8432\%, \qquad (2)$$

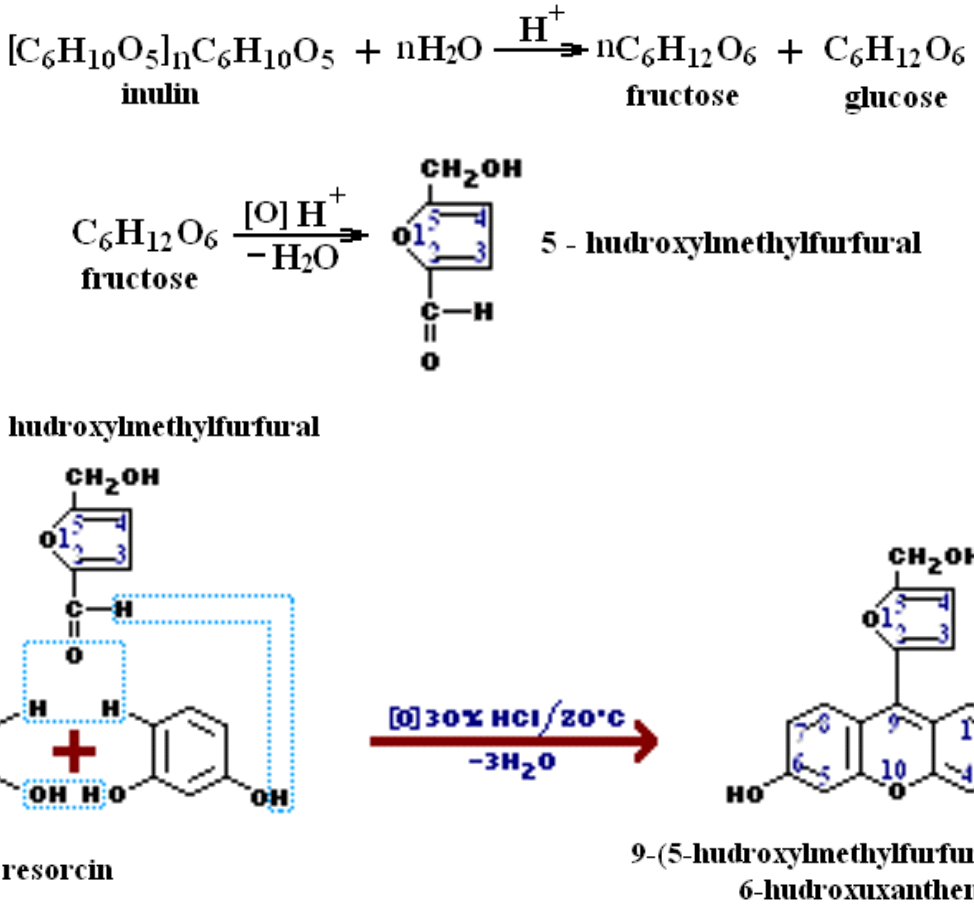
$$X_2 = X - X_1 = 86.5763\%$$

From the carried out researches it is possible to conclude that in powders obtained from topinambour tubers contains natural inulin polysacharide more than 86%.

Purified inulin has been obtained from the powder of topinambour tubers by dissolution last in hot water with the subsequent sedimentation of inulin from an aqueous solution with acetone addition in the ratio 1.0 : 1.0. In process of acetone addition (within 15–20 minutes) the white voluminous powder which to precipitated cooling at temperature 5–10 °C within 4 hours starts to fall out. Then the residue was separated by filtration, washed out with acetone, exsiccated, powdered and passed through a

sieve with diameter of apertures 0,1 mm. Obtained inulin was subjected to various physical and chemical analyses [5; 6].

Obtained easy-loose powder possesses humidity 7.0–8.0%, unlike starch it is not colored by an iodine solution, does not rebuild in Fehling liquid. Under resorcin effect and hydrochloric acid it is coloured in red colour (Selivanov reaction). In strong-acid medium inulin and polysacharide are completely hydrolyzed to monosaccharides. The generated fructose under the influence of temperature turns on 5 – hydroxymethylfurfural and it reacts in strong-acid medium with two molecules of resorcin. As a result of reaction the substance of red colour 9 – (5 – hydroxymethylfurfural – 2), 3 – ho, 6 – hydroxyxanthene [7], on the following mechanisms is produced.



At TCX (dissolvent – ethanol, developer – 20%-s' alcohol solution of thymol and the diluted sulphuric acid) on a plate after drying at temperature 100–105 °C a brown-red stain with Rf = 0.75, characteristic for inulin.

References:

1. Государственная фармакопея СССР.– X изд.– М.: Медицина, 1980.– 17 с.
2. Государственная фармакопея СССР.– XI изд.– М.: Медицина, 1987.– Вып. 1.
3. Кадиров О. Ш. и др. Стандартизация субстанции гликоинувита // Сб. тез. докл. науч. конф. молодых ученых, посвящ. 90-летию со дня рожд. проф. М. А. Азизова.– Ташкент, 2003.– С. 60–61.
4. Беляков К. В., Попов Д. М. Определение инулина в корневищах и корнях девясила высокого// Фармация.– № 1. 1998.– С. 34–35.

5. Багировой В. Л., Северцова В. А. Настойки, экстракты, эликсиры и их стандартизация / Под ред. В. Л. Багировой, В. А. Северцова / СПб.– Спец Лит., 2001.– 223 с.
6. Пономарев В. Д. Экстрагирование лекарственного сырья.– М: Медицина, 1976.– 204с.
7. Справочник химика.– Том 2. 1964.– С. 360–362.