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Method for Drying Fruits of Rose Hips

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Abstract: ***The article discusses a new vacuum infrared equipment for drying fruits of rose hips with preservation of ascorbic acid. We have studied the drying process of rose hips in various ways (solar, convective and vacuum IR drying), to determine the rational version of the drying process to check the preservation of the vitamin composition of the fruit, mainly ascorbic acid. Special plants designed and manufactured for the production of dry powders from rose hips using low-vacuum and low-temperature infrared drying have been developed and manufactured. The vacuum drying unit consists of: a vacuum chamber, an electrical system for IR irradiation and instrumentation. During the drying process, the operating temperature was maintained at 65 ° C, the pressure inside the chamber was -0.8 atm and the drying time was 4 hours. With these parameters, the dogrose is dried effectively and vitamins are well preserved in its composition. In appearance, you can determine that the color and taste have not changed. Laboratory experiments were also carried out aimed at chopping and separating rose hips. Continue drying, setting the operating parameters depending on the parameters of the object. After setting the parameters of drying and its implementation, wild fruits rose hips is dehydrated to a moisture content of 12%, while the preservation of vitamins is provided in the fruit composition. As a result of an experimental study of the influence of vibration on the drying process, it has been established that the efficiency of dehydration increases to 4-5% under continuous heating conditions – at a certain frequency and amplitude. It is shown that the preservation of ascorbic acid in the composition of the pulp of the fruits rose hips with vacuum infrared drying is up to 0.77 mg%. The optimum thickness of the product layer is about 1-1.5 cm, the optimal wavelength is 3 microns, while the dehydration time of the products is an acceptable value, and the temperature of the fruits does not exceed 65 °C, the vacuum is -0.8 atm.***

Keywords: fruits of rose hips, drying, vacuum, infrared.

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I. INTRODUCTION

Fruits rose hips are rich in vitamin “C”, the most valuable part of this plant is the pulp of its fruits, namely it contains organic acids, tannins, pectin and dyes, micro- and macroelements (phosphorus, potassium, magnesium, iron, silicon, manganese, copper), and other vitamins. Fruits rose hips is especially rich in vitamins of group P, B, E, K, carotene acid. The most valuable and rich in the amount of vitamins is fruits rose hips, collected in mountainous and relatively cool places, where it has a greater amount of ascorbic acid and multivitamins [1-2].

Drying fruits rose hips can be carried out in several ways [3-16]: on the Sun (not highly recommended due to the large loss of vitamin C in the final product), in the convective, in the air, etc. Since these fruits are relatively large and hard, dehydration is in progress drying fruits rose hips is a complex process. Dry fruits rose hips in convective conditions at elevated temperatures (100 ºC). In such conditions, the rind of the fruit instantly seizes, forming a hard crust, while the middle of the berry will still remain wet and will, no doubt, rotting during further storage [17-19].

The aim of the work is to reduce the duration of the drying process with maximum preservation of ascorbic acid in the composition of the hips. The maximum preservation of ascorbic acid in the composition of fruits rose hips in the first method of drying plays a big role. In the work R.Pace [20] research herbals: at the forefront of testing and certification.

II. RESEARCH DRYING EQUIPMENT

The authors have developed a new equipment designed for the production of dry powders from fruits rose hips using low-vacuum and low-temperature infrared drying technology (Fig.1) [21-23].

1. The drying equipment consists of:
– vacuum drying chambers;
– mobile drying cabinets with infrared emitters;
– moisture condensation devices (barocondenser);
– vacuum-ring pump;
– control panel with instrumentation and automation;
– pallets for processed raw materials (complete with mesh and solid pallets) of stainless acid-resistant material;
– carts for withdrawables (on the rail way);
– body vacuum chamber;
– doors;
– temperature, pressure sensors;
– electrical equipment.

2. The moisture condensation device should consist of:
– heat exchanger housing with cooling water connections;
– condenser casing for collecting and cooling evaporated moisture;

– pipe for supplying evaporated moisture from the vacuum-drying chamber;
– a branch pipe of the exhaust gas to the vacuum pump;
– vertical glass tubes for visualization of the internal movements of moisture in the barocondenser.

1-door vacuum chamber; 2-locking doors; 3-gauge; 4-case vacuum chamber; 5-steam outlet pipe; 6-post

Fig. 1. Drying equipment for drying fruits rose hips

3. A water-ring pump shall consist of:
– frame;
– vacuum ring pump;
– electric motor;
– couplings.

The pallet for the processed raw materials must be assembled with mesh and / or solid bottoms of stainless acid-resistant material.

Technical characteristics of the electrical cabinet

1. Power supply – 380/220 V;
2. Frequency – 50 Hz;
3. Maximum power consumption – 6 kW;
4. Total effective usable area module loading – 8 m^2;
5. Productivity: on electricity consumption for stripping 1 liter water based on product type, temperature and humidity environment– 0,6 kW h/l;
6. Number of cabinets – 1 pcs.;
7. Number of pallets in one cabinet – 8 pcs.;
8. Operation manual – 1 pcs.

III. EXPERIMENTAL PART

At the beginning of the experiment, raw rose hips were prepared. Then the total volume was equally divided into 4 samples and at the same time the experiment was started (Fig. 2).

The first sample was left for verification.

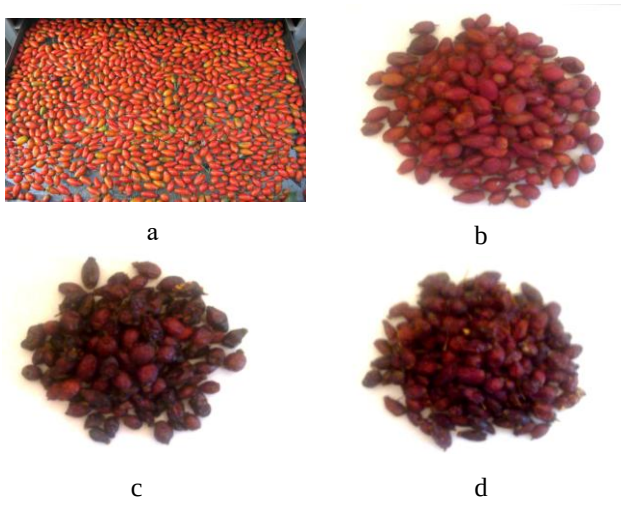
The second sample was prepared for drying in a vacuum-infrared installation. Set the temperature to 65 ºC and dried for about 3-4 hours. Fruits should remain red and bright, without acquiring a brown, burnt color; break, but do not crumble to powder.

The third sample was prepared for drying in a convection unit. Set the temperature to 90 °C, then dried for a duration of 9-10 hours.

The fourth sample prepared for drying on the sun. Were dried for a period of 1 month.

The obtained dried fruits rose hips were tested for the presence of ascorbic acid. Laboratory tests were conducted at the Accredited Testing Center of the Institute of Chemistry and Plant Substances named after Academic S.Yu.Yunusova Academic Sciences of the Republic of Uzbekistan.

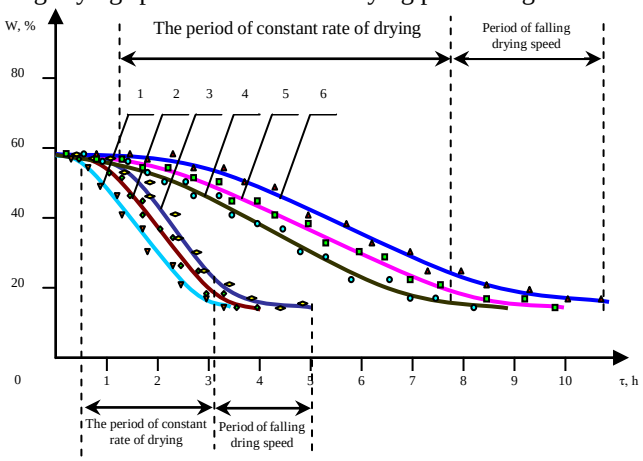
The results of laboratory studies have shown that the safety of ascorbic acid in the composition of the fruits rose hips when drying the vacuum-infrared methods is 0.77 mg%, in a convective way 0.12 mg%, in a natural way 0.15%.



a-raw materials; b-as a result of vacuum drying with infrared heating; c-as a result of drying by the convective method; d-as a result of natural drying

Fig.2. Fruits rose hips drying processing

The period of constant drying rate continues until the critical moisture content w_{scr} (Fig.3), at which the intra-diffusion and external diffusion resistances are equal. At this point in time, on the surface of evaporation, the moisture content of the material is either hygroscopic or less, and in the center it is much more hygroscopic. Therefore, the critical moisture content can be defined as the average integral moisture content of the material, in which the hygroscopic moisture content is reached on the surface and the period of falling drying speed or the second drying period begins.



1-vacuum drying with infrared heating (drying temperature 80 °C; vacuum -0.8 atm.); 2-vacuum drying with infrared heating (drying temperature 65 °C; vacuum -0.8 atm.); 3-vacuum drying with infrared heating (drying temperature 50 °C; vacuum -0.8 atm.); 4-convective drying (drying temperature 100 °C; no vacuum); 5-convective drying (drying temperature 90 °C; no vacuum);

6-convective drying (drying temperature 80 °C; no vacuum)

Fig. 3. Fruits rose hips drying curve

IV. RESEARCH RESULTS

Continue drying depending on the object and regime drying parameters.

The authors determined the optimum temperature and time for fruits rose hips drying. The optimum thickness of the product layer is about 1–1.5 cm, the optimal wavelength is 3 microns, while the dehydration time of the products is an acceptable value, and the temperature of the fruits does not exceed 65 °C, the vacuum is -0.8 atm. Dried fruits rose hips can be crushed to obtain a powder.

With the specified mode of the drying process, its duration is 4 hours. Continue drying, setting the operating parameters depending on the parameters of the object. After setting the parameters of drying and its implementation, wild fruits rose hips is dehydrated to a moisture content of 12%, while the preservation of vitamins is provided in the fruit composition.

Table 1. The safety of ascorbic acid in the composition of the fruits rose hips

Types of drying	Mass fraction of ascorbic acid (not less than 0.2%), mg%
Vacuum infrared drying with a reflector: – drying temperature – 65 °C; – vacuum – (-0.8 atm)	0.77
IR drying: – drying temperature – 80 °C	0.71
Convective drying: – drying temperature – 90 °C; – without vacuum	0.12
Gelio drying	0.15
Fruits rose hips powder (with the method of a quantity producer)	0.59
Untreated raw materials	0.67 (1.17 at 12% moisture)

V. CONCLUSION

1. Based on the results of a study of the properties of the products to be dried, the permissible temperature and drying time were found and, on this basis, the option of a vacuum drying unit with an infrared energy supply was selected.

2. The results of experimental studies of the process in a laboratory setup developed the basis for calculating an industrial vacuum drying plant with infrared energy supply.

3. As a result of an experimental study of the influence of vibration on the drying process, it has been established that the efficiency of dehydration increases to 4-5% under continuous heating conditions – at a certain frequency and amplitude. It is shown that the preservation of ascorbic acid in the composition of the pulp of the fruits rose hips with vacuum infrared drying is up to 0.77 mg%. As part of the same fraction of fruits rose hips, ascorbic acid is contained in the vacuum infrared drying to 4.0 mg%.

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