A method to study and analyse the drying process of raw materials

T T Rakhmanova, Sh A Sultanova, Sunil Verma, J E Safarov, G T Dadayev

Tashkent State Technical University, 2, Universitet st., Tashkent, 100095, Uzbekistan

E-mail: t.raxmanova@yahoo.com

Abstract. This article gives a brief overview of Rosaceae and the vitamins it contains. Since the drying process was slow, an accelerated method was developed. To describe the process, this article describes the experimental conditions. However, the results of convective drying of Rosaceae fruit are presented in the form of tables and curves. In the study, Rosaceae fruits were bleached in a solution of plain water and citric acid. The drying temperature was selected as 65 °C.

1. Introduction

Rosaceae is a perennial shrub that blooms beautifully in early spring and ripens in late summer and early September. Among people, this plant is also called "wild rose". Tea made from Rosaceae syrup or fruit is a very effective drink in the cold season, especially when viruses are active and immunity is low. If this folk remedy is used regularly, it will be possible to avoid colds, speed up the healing process and recover faster after the illness.

This is especially important during pregnancy. Rosaceae tincture helps expectant mothers to overcome attacks of toxicosis, stimulate the formation of red blood cells or erythrocytes, increase hemoglobin and prevent the development of anemia.

The Rosaceae bush is up to 3 m high and consists of a collection of 8-12 branches of different ages and diameters. Rosaceae fruits contain up to 6% of vitamin C, vitamins B2, P, E and K, 12-27 mg /% of carotene, 29% of organic (citric, malic) acids, up to 18% of sugars, up to 4.5% of nutrients, in seeds there is oil. An average of 2.5-3 kg or 41.61 c / ha can be harvested from each bush if the Rosaceae plantation is cultivated in full compliance with agro-technical measures. This allows collecting 25-30 kg of natural vitamin C per hectare [1].

Although there are many guidelines for using Rosaceae as a healing agent, it can also have a negative effect on the human body. It is therefore advisable to read the available contraindications before using it.

It is not recommended to pray in any form in the following cases:
- Increased gastric secretion (increased acidity);
- A predisposition or disease to the development of gastritis has been identified;
- Presence of pancreatitis in the anamnesis;
- Predisposition to allergic (dermatological) conditions;
- Formation of thrombi in blood vessels, development of thrombophlebitis;
- Endocarditis (inflammation of the heart muscle).
In some cases, caution is recommended because:

- Accelerates the thinning of tooth enamel;
- The use of alcohol tincture can lead to high blood pressure;
- There is a possibility of developing obstructive jaundice;
- Slows down bile secretion;
- Causes constipation.

These warnings should not be ignored when using Rosaceae as a prophylactic and therapeutic tool.

Dried agricultural products are one of the unparalleled sources of the human body’s supply of essential vitamins and minerals in off-season. In particular, if they are dried naturally, they retain large amounts of natural vitamins and minerals. By its very nature, drying is a complex diffusion process, the rate of which is determined by the rate at which moisture diffuses (passes) from the product being dried to the environment. The rate at which moisture is removed from the raw material depends on both the drying method and the nature of the water in the material [2]. There are several methods of the drying process. The choice of method depends on what is being dried. For example, when drying a medicinal plant, it is advisable to determine the drying device and drying mode by studying the physicochemical properties of the plant.

2. Materials and methods

During the drying process, only the physicochemical and mechanical composition of the water is separated from the product cells. The moisture of the mechanical mixture is easy to evaporate. In large capillaries, moisture evaporates before drying. The moisture in the capillaries, which is stored by the adsorption force, hardly evaporates. Capillary moisture comes out as both a liquid and a vapor. They are called “free moisture”, the evaporation of which obeys the law of evaporation from the open surface of the liquid [3].

The main parameters of the drying mode are air temperature, air speed and humidity. They affect both the nature of the process and the properties of the material being dried. An increase in air temperature increases the drying rate, which, according to some authors, leads to an increase in the heat transfer coefficient between the body and the humid air [4-9]. However, the increase in temperature, as a rule, limits the sensitivity of most plants, fruits and vegetables to heat, which leads to an increase in the heat transfer coefficient between the organism and humid air. High temperatures can lead to irreversible changes in colloidal tissue components, as well as increased heat loss and a decrease in the overall efficiency of the system.

![Figure 1. The appearance of the dried product: a – blanched in a 1.5% citric acid solution; b – blanched in plain water.](image)

Convective drying - in which the drying conductor interacts directly with the wet material. Typically, heated air or smoke gases are used as the drying conductor.

In the study, 2 different means were selected for drying Rosaceae fruits: plain water at 65 °C and 1.5% citric acid solution at 65 °C. We discuss these drying processes below.

Before the blanching process, the fruits were washed and cleaned, blanched for 15 minutes at a
temperature of 65 °C in water, and dried in a desiccator heated with helio water.

During the blanching process in 1.5% citric acid solution, the berries were blanched for 15 minutes after washing and cleaning. The water temperature was 65 °C.

| Blanched in water (mass, gr) | Blanched in water (moisture, %) | Blanched in 1.5 percent citric acid (mass, gr) | Blanched in 1.5 percent citric acid (moisture, %) |
|-----------------------------|---------------------------------|-----------------------------------------------|-----------------------------------------------|
| 1009                        | 26,09                           | 1015                                          | 26,3                                          |
| 990                         | 25,6                            | 970                                           | 25,2                                          |
| 973                         | 25,1                            | 944                                           | 24,5                                          |
| 940                         | 24,3                            | 908                                           | 23,6                                          |
| 888                         | 22,9                            | 869                                           | 22,5                                          |
| 841                         | 21,75                           | 838                                           | 21,7                                          |
| 815                         | 21,0                            | 809                                           | 21,03                                         |
| 770                         | 19,7                            | 791                                           | 20,5                                          |
| 742                         | 19,1                            | 728                                           | 18,9                                          |
| 737                         | 19,06                           | 632                                           | 16,4                                          |
| 673                         | 17,4                            | 602                                           | 15,6                                          |
| 625                         | 16,1                            | 577                                           | 14                                            |
| 614                         | 15,08                           | 1015                                          | 26,3                                          |
| 585                         | 14,9                            | 970                                           | 25,2                                          |

3. Analysis of the drying process

When preparing vegetables and fruits for processing with boiling water or steam, short-term processing is called blanching. During the blanching process, the enzymes involved in the oxidation process (peroxidase and catalase) are broken down. However, the composition and amount of additives will change dramatically. It is known that oxidants turn into a dark color called flobafen when oxidized in air. Blanching breaks down the enzymes that lead to the oxidation of additives and their color does not change when the raw material is dried. During blanching, the number of microbes decreases sharply. In raw tissues, the amount of oxygen is partially reduced, so the amount of easily oxidized vitamins does not change much. As a result of blanching, some additives combine with protein compounds to form water-soluble compounds, thereby reducing the decomposition of the raw material. In general, the taste and aroma of many vegetables and fruits increase after blanching. However, the amount of dry matter in the raw material, especially carbohydrates and other water-soluble substances, decreases sharply. There is a loss of up to 20% when using boiling water and up to 5% when using steam. Therefore, steam blanching is more convenient.

It can be observed that the drying process is accelerated after the blanching process (Fig. 2).
Figure 2. Curves of the drying process: 1 – blanched in a 1.5% citric acid solution; 2 – blanched in plain water.

When the raw material is heat treated, there is a change in its structural mechanical, physicochemical and arganetic properties. The purpose of such changes is to soften the raw tissue, increase or decrease its mass and volume, increase cell permeability and stop the activity of enzymes, create the appropriate organoleptic properties in the product, increase its nutritional value.

4. Conclusion
When moisture evaporates from the surface of the material, a moisture gradient appears inside it, which ensures the subsequent movement of moisture from the inner layers of the material to its surface (internal moisture diffusion). During the drying period, the difference in humidity within the material is so large that the surface evaporation rate (external diffusion) has a limiting effect on the drying rate. However, once the surface moisture has dropped to a hygroscopic level and continues to decrease, i.e. during the drying period, the internal distribution of moisture becomes crucial for the speed of the process.

In conclusion, blanch-dried Rosaceae in 1.5% citric acid solution dried to 14% humidity in 500 minutes. Blanched in plain water at a temperature of 65°i, it dried to 14.9% humidity in 500 minutes.

References
[1] Kalogirou S A 2004 Progress in Energy and Combustion Science, 30. 231–295
[2] Kalogirou S 1997 Current status of technology and problems. Renewable Energy 10 107–12
[3] Yilbas B S, Patel F and Karatas C 2015 Laser Surface Engineering Waugh J.L.G. Woodhead Publishing 97-105
[4] Kalogirou S 2003 Appl Energy 76 337–61
[5] Safarov J E, Sultanova Sh A, Dadayev G T and Zulpanov Sh U 2021 IOP Conf. Series: Materials Science and Engineering. Dynamics of Technical Systems (DTS 2020) 1029 1-11.
[6] Sultanova Sh, Safarov J, Usenov A, Raxmanova T 2020 E3S Web of Conferences: Rudenko International Conference “Methodological problems in reliability study of large energy systems” 216 1-5
[7] Safarov J, Khujakulov A, Sultanova Sh, Khujakulov U and Sunil Verma 2020 E3S Web of Conferences: Rudenko International Conference “Methodological problems in reliability study of large energy systems” (RSES 2020) 216 1-5.
[8] Safarov J E, Sultanova Sh A, Dadayev G T and Samandarov D I 2019 International Journal of
Innovative Technology and Exploring Engineering 9(1) 4562-4565.

[9] Bernard F and Gaffet E 2001 Int. J. Self-Propag. High-Temp. Synth. 10(2) 109–132