

Cranberries are a rich source of many compounds, which have the anti-inflammatory, anti-allergic properties, properties that can slow down the aging processes and properties that prevent the development of diseases, including hypertension. Due to the seasonality of production and the high water content, cranberries are subjected to preservation using different methods of pretreatment and drying. The presence of native wax on the surface layer of cranberry fruits being a barrier for water, heat and mass transfer processes cause that their dehydration and preservation with use of standard methods is difficult and time-consuming. The high water content in fresh cranberry fruits and the presence of wax on the surface of fruits make that they are considered as difficult to dry. Therefore, the methods for effective removal of surface layer of fruits are continuously looking for. Lack of information on the effect of the new combinations of different methods of initial pretreatments and dehydration on the properties of material makes that there is a need to continuously improve and develop the knowledge in this field. The authors will undertake studies on the application of selected innovative methods of pretreatment of cranberry fruits before their drying, as well as innovative methods of drying using an alternative heat sources. It is expected that innovative unconventional methods of initial pretreatments will shorten the dehydration process, reduce the intensity of physicochemical changes in the dried material, and also allow to keep a high content and activity of chemical compounds. The authors intend to explain the impact of applied methods on the course of dehydration process and changes of physical and chemical properties of fruits. Justification for undertaking research problem is to explain phenomena occurring during: a) initial pretreatment, b) osmotic dehydration and c) drying.

The analyses will be conducted for:

1. Fresh fruits;
2. Fruits subjected to initial pretreatment;
3. Fruits initially pretreated and dehydrated in sucrose solution;
4. Fruits subjected to initial pretreatment and dehydration under hybrid processes (combined hot air and microwave-vacuum drying);
5. Fruits subjected to initial pretreatment and dehydration under hybrid processes (osmotic dehydration in sucrose solution, combined hot air and microwave-vacuum drying);
6. Fruits subjected to drying and rehydration.

The aim of the project is to explain the effect of different unconventional methods of pretreatment and hybrid dehydration of cranberry fruits on the changes in their parameters, such as: the micro- and macrostructure, morphological characteristics, optical, thermal and mechanical properties, the content, characteristics and antioxidant activity of selected chemical compounds and others, as well as an explanation of the effect of pretreatment on the course of reactions during the dehydration of fruits. The study also aims to determine the correlation relationship between selected properties of the fresh fruits and fruits at different stages of processing and correlation between parameters of pretreatment or hybrid dehydration and properties of cranberry fruits (for each stage of processing).

Methods of pretreatment of cranberry fruits include:

(i) Ultrasound treatment

Ultrasound pretreatment before drying, which consists of immersing of fruits in water bath treated with ultrasonic probe sending the high power and frequency sound waves.

(ii) Microwave-vacuum treatment

Short-term pretreatment of fruits using microwave-vacuum dryer by using low microwave power and pressure in the vacuum chamber to obtain predetermined water loss (about 5-20 % of initial value).

(iii) Cryogenic freezing

The freezing process carried out using liquid nitrogen. The measurements characterizing the process (changes in mass and temperature of the test material during the freezing and thawing leakage, which is part of again unabsorbed by the fruit tissues liquid, created during transition from the ice crystals to the liquid state) will be made.

(iv) Conventional freezing preceded by ultrasound treatment

The process of slow cooling at approx.  $-20^{\circ}\text{C}$  of cranberry fruits pretreated with ultrasounds.

(v) Conventional freezing preceded by microwave-vacuum treatment

The freezing process involving the slow cooling (at approx.  $-20^{\circ}\text{C}$ ) of cranberry fruits subjected to short-term initial treatments using microwave-vacuum dryer.

Dehydration techniques combine the following processes:

(i) Osmotic dehydration

The dehydration process carried out in a sucrose solution. The process will be carried out at the temperature of  $40^{\circ}\text{C}$ . During osmotic dehydration, changes in water content, changes in dry matter substance of cranberry fruits and sucrose solution will be measured.

(ii) Convective drying

The hot air drying of cranberry fruits will be conducted at the temperature of the drying air of  $80^{\circ}\text{C}$ .

(iii) Microwave-vacuum drying

Drying carried out using microwave-vacuum dryer at low microwave power and low pressure in the chamber.

Developed and tested in the project methods of determination of cranberry fruits properties can be used wherever it will be important to quickly and effectively obtain the information about the properties of biological material.

The knowledge acquired during the realization of the project will enable a better understanding of phenomena occurring during

the dehydration of berry fruits and predicting the effects of these phenomena.

Results of the project will be able to be used as a starting point for further research - for example on the modification of fruits properties using innovative methods of pretreatment and drying processes, finding solutions that reduce dehydration time, energy consumption for drying, and thus environmental protection.

The results of studies will allow for a wider range of use the hybrid dehydration techniques for preservation a high moisture content of biological materials.