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EXPERIMENTAL STUDY OF SUBLIMATION DRYING OF VEGETABLES BY APPLYING ULTRA – HIGH FREQUENCY ELECTROMAGNETIC WAVES

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Abstract: consists of developing the technology of sublimation drying of vegetables in an extremely high frequency electromagnetic wave. In the article, the description of the research object, convective and sublimated drying, the modes of the initial processing process and the standard requirements for drying objects are studied in the modes of studies when the sublimated drying process is carried out in the bath. Methods for determining the quality indicators of dried foods and requirements for the quality indicators of the products under study are organoleptic assessment, humidity, restorations, dry matter content, acidity, amount of dyes, amount of vitamin "C", as well as other indicators. Organoleptic evaluation was carried out according to the indications of appearance, consistency, smell and color. The practical significance of the results of the study is explained by the fact that the selection of regime parameters of the drying process, taking into account the characteristics of vegetables, is recommended an improved technology of sublimation drying with preliminary processing in the electromagnetic wave range of extremely high frequencies.

Keywords: vitamin, drying, sublimation, food storage, fruit and vegetable storage, taste, color, sugar, quality, technology, protein, convective, moisture, carbohydrate, ascorbic acid.

Introduction. Worldwide, the demand for dried fruits and vegetables, rich in natural vitamins, is increasing from year to year. At the same time, the reforms carried out to reduce the drying period in quality, low temperature and deep vacuum, evaporate convective drying back moisture, simplify technology, increase productivity are becoming relevant.

Scientific research is underway to dry fruits and vegetables on the basis of quality and energy-efficient technology. Particular attention is paid to the production of high-quality products with convective, low temperature and deep vacuum of drying, preliminary processing of the drying process by various methods, development and testing of its technologies.

Expanding the range and volume of competitive products in our country, it was considered an important source of biologically active substances grown in Uzbekistan. In this regard, it is important to introduce drying, which allows you to produce dried vegetables rich in micro - and macro elements, increase the efficiency of the convective drying process, shorten the drying period, use freezing in evaporating the initial moisture, reduce energy and capital consumption costs.

The development strategy of Uzbekistan sets out important tasks for "deepening structural changes and consistent development of agricultural processing potential, further strengthening the country's food security, expanding the production of environmentally friendly, high-quality products, significantly increasing the export potential of the agrarian sector. "The scientific significance of the work is explained by the fact that with the initial processing of the dried product, the optimal conditions for the processes of obtaining dried vegetables rich in natural vitamins, micro - and macro elements are determined.

The drying process, taking into account the characteristics of vegetables, is explained by the fact that the choice of regime parameters, improved technology of preliminary processing and drying is recommended. When drying in a convective bath in a sublimate way, freezing and vacuum drying are combined, in which the nutritional value, chemical composition and structure of the products are preserved. In dried vegetables, it was decided to choose head onions and soup beets as research objects due to the high demand in world markets.

Methodology & empirical analysis. The use of electromagnetic waves before the sublimation drying process accelerates the drying process. In the cyclic change of pressure, the drying process depends on the nature, condition and oscillation parameters of the product being dried, as well as the efficiency of cooling and vacuum systems.

The task of improving the technology of drying food raw material product consists in the development and implementation of the algorithm and methodology for managing incoming processes in the material that must be dried in order to obtain a high-quality product with certain organoleptic, physic-chemical and structural-mechanical indicators. The solution to the problem of removing moisture from the material should rely on the study of the properties of the material and the scientific justification of the parameters of the technological process.

Depending on the method of Energy Transfer, there are different ways to dry wet components. The choice of the mode of the process of dehumidification and the constructive features of drying equipment depends on the properties of the material being dried, as well as the technologies for its manufacture [1, 2, 3].

The power of the food ration must be able to compensate for the power consumed by the human body. It is necessary to ensure that the amount and ratio of the main nutrients consumed are in a scientifically based physiological proportion to each other.

The main obstacle in finding a solution to this task is the seasonal nature of the processing of agricultural products. In order to preserve the valuable properties of products, it is necessary to ensure a process that allows the maximum storage of

biologically active substances in the starting raw material.

Now in our country there are not enough effective technologies and special equipment for drying vegetable raw materials at low temperatures.

Non-productive loss of sugar in vegetables during the drying process is caused by melonoidin formation and caramelization reactions.

Based on the theoretical study of sublimation drying kinetics of agricultural products, the technological process of drying was divided into two stages:

- primary processing of moisture in food in the ultra-high frequency range;
- sublimation drying.

Expert research on improving the technology of drying vegetables by sublimation method was carried out on sublimation method drying laboratory devices "EYELA FDU-2110" and "Kemolo FD-10". Figure 1 shows the appearance of the devices.

The equipment consists of a vacuum-sublimation chamber with a contact (conductive) heat transfer system of products, pallets and the following systems:

- vacuum system consisting of vacuum pump, valves and pipe system;
- sublimation system consisting of sublimation, cooling machine and connecting pipes;
- valve, pump, trap.

The devices have the following advantages:

Allows you to freeze small samples, the vacuum speed and running time are simultaneously reflected on the control panel.

When operating in automatic mode, the cooling temperature of the drying chamber, the vacuum level are measured, and it is possible to place a sample in the drying chamber.

FDU-2110 FD-10

Figure 1. Appearance of devices.

It has a simple principle of operation.

To prepare for the timely replacement of the pump oil, it is possible to record the operating time of the pump in the timer function (to determine the energy consumption that went to drying).

The equipment works as follows. Vacuum and sublimation systems are deployed from the control remote, which independently bring the equipment into working condition and provide pressure, working temperature in the sublimation. After that, the raw materials are introduced into the sublimation chamber for drying, cooled in the form of frozen particles and dried in the sublimation chamber. The samples taken are taken every 3 hours and the weight is measured. This condition results in an intermediate after at least 4-5 experiments. In this case, it is required to be fully attentive to the process plans.

Sublimation drying technology involves the following processes: first treated with a etching range, then the samples are refrigerated and frozen samples are transferred to a vacuum-sublimation chamber. The chamber door is hermetically closed and the air-Draw system is started using a vacuum. The pressure in the chamber is set to close to 10-15 Pa. After that, the sublimation drying process goes in the chamber [4, 5].

After a certain period of time has passed, the pressure in the Chamber begins to decrease, depending on the mass of the product placed on drying. When the pressure reaches 10-15 Pa, the vacuum system is turned off and the camera is filled with a drying agent. When atmospheric pressure is reached in the chamber, the door is opened and the products in tray are released for research.

Table 1 lists the full specifications of the FDU-2110 as well as the FD-10 sublimation devices.

Table 1. Technical characteristics of the devices

Model:	FDU-2110	FD-10
Cooling aggregate temperature:	-80°C	-60°C
Drying chamber size:	3 l	10 l
Setting, display function	Has the icon of entering temperature, setting and assignment, time duration	
Security function	A device for normalizing current transfer failures, an automatic start-up feature, a refrigerant safety scheme, a self-diagnostic Control Panel, an automatic air release grillage from vacuum conditions	
Device working chamber vacuum discharge function	Automatic vacuum discharge valve	
Other functions	Automatic vacuum pump extinguishing function, vacuum chamber function and temperature control condensation function is an important control function	
Cooling agent:	R404A freon	
Vacuum display:	Digital display, 0,0 ~ 533,0 Pa	Digital display, 10,0 ~ 100,0 Pa
Overall dimensions of the device (mm):	700W x 550D x 935H	1900L x 1000W x 1800H

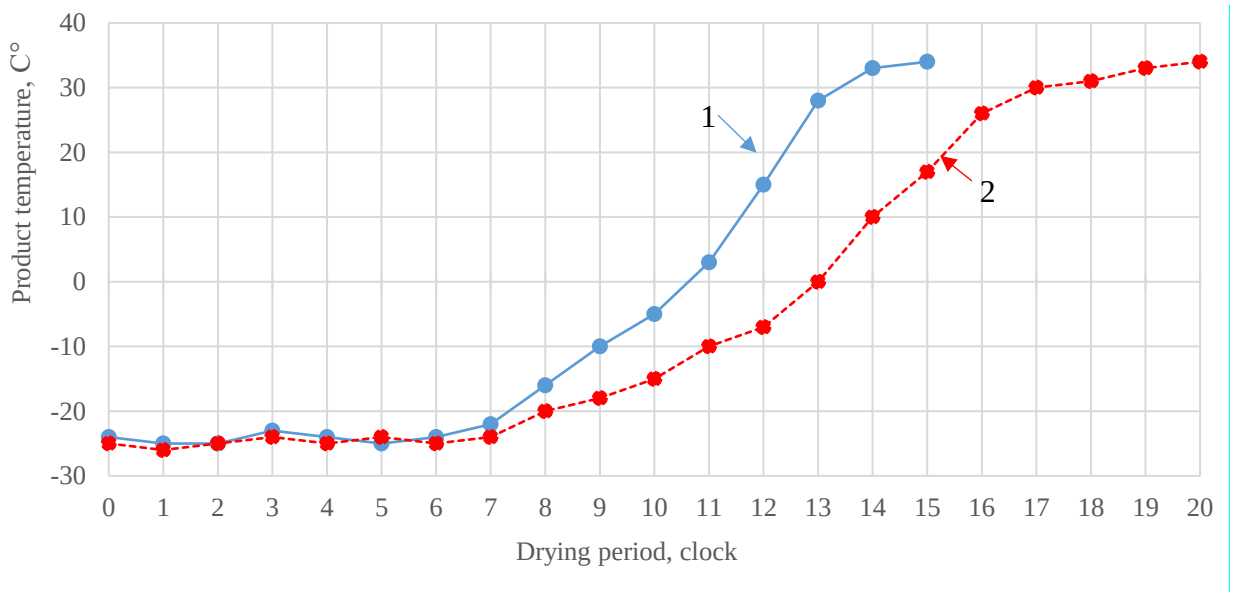
The weight of the device is:	140 k	1800 k
Power consumption:	2,4 kVt	6,6 kVt

Results. In the initial processing of onion samples taken for research into the product in the etching range as well as sublimation drying without preliminary processing, the temperature variation of the samples was researched (figure 2-3). In this case, when placing samples in the drying chamber, special temperature-transmitting sensor wires are attached to them, and it becomes possible to control the level of damage during the entire drying process. This process allows you to select temperature modes to accelerate the process while showing the Real temperature in the product.

Freeze-frying temperature of onions freeze-frying temperature of onions 8 hours - 25 °C stewing temperature 35 °C roasting temperature 35 °C roasting temperature 10% roasting temperature continued roasting (2-Fig.).

In onion samples, it was observed that the sublimation drying process by preliminary processing of the product in the etching range dries 5 hours faster than dried samples without preliminary processing. The reason for this is explained by the loss of up to 25% moisture during the initial processing of the product in the etching range to onion samples [6, 7, 8].

Freeze-frying temperature of onions freeze-frying temperature of onions 8 hours - 25 °C stewing temperature 35 °C roasting 10% roasting temperature continued roasting (2-Fig.).



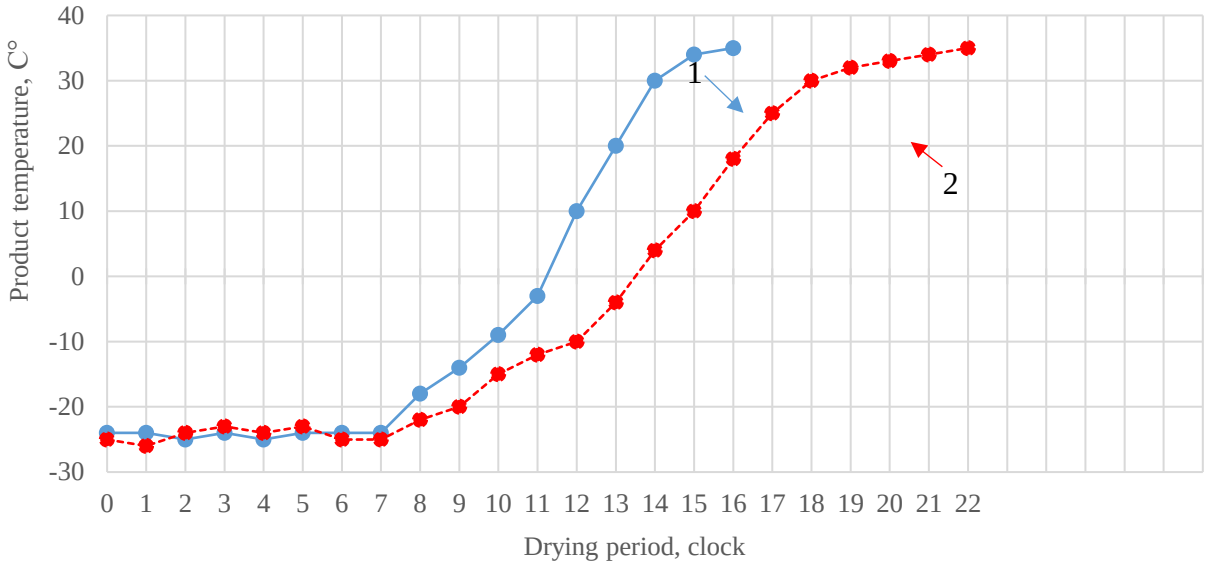
1-in the initial processing drying in the engraving range
2 - in drying without initial processing

Figure 2. In the primary processed and unprocessed method, sublimation is the change in temperature in the dried onion samples.

In onion samples, it was observed that the sublimation drying process by

preliminary processing of the product in the etching range dries 5 hours faster than dried samples without preliminary processing. The reason for this is explained by the loss of up to 25% moisture during the initial processing of the product in the etching range to onion samples [9, 10].

Similarly, in beet samples, there was a change in the level of desiccation of samples, with initial processing of the product in the etching range and sublimation drying without initial processing. During the sublimation drying process with preliminary processing of the product in the engraving range, the temperature of the beet samples was lowered to -25ºc in 8 hours, and then the temperature was gradually increased to 35ºC, the process continued until 10% residual moisture remained (Figure 3).



1-in the initial processing drying in the engraving range
2 - in drying without initial processing

Figure 3. Temperature fluctuations in beet samples when drying sublimation in the primary processed and untreated method.

Conclusions. Freeze-dried chicken paste containing 28% gacha kamaiganliga is a common freeze-dried method of cooking chicken paste with an interval of 6 hours. Bunda smokes a handmade brazier smokes a smoking chamber with a temperature of 0-5ºC during the day. The main chamber has a temperature of 10-15 Pa. Firing temperature The firing kinetics of the product is analyzed every 3 hours. For example, we need a quantity of 10% mold as much as citrile.

Sublimation-sublimation samples of onions and pita bread can be obtained in the frequency range of the product with a half-life of 20-25%.

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