

Improvement of dill freeze-drying technology

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Abstract. In this work, we studied the use of IR pretreatments before freeze drying of dill. The indicators of the drying period, the process of rehydration of different samples dried by the sublimation method with and without pretreatment are compared. Experimentally, data have been obtained that when using IR pretreatment, the drying process is reduced by about 4-5 hours. The main reasons for the shortening of the freeze drying period is to reduce the moisture content to 25-30% during pre-treatment. The data confirms a reduction in the drying period for freeze-dried dill, and also provides data on the dehydration of dried samples.

1 Introduction

Drying is the oldest food preservation method and one of the most common processes used to improve food stability, as it reduces the water activity of the food, reduces microbiological activity and minimizes physical and chemical changes during storage [1,2]. In addition to preserving nutrients, vitamins and minerals, this method significantly minimizes transportation and storage costs [3,4,5].

The development of new technologies for obtaining food products that satisfy the needs of the body is inextricably linked with the development of the microbiological industry, which currently produces a wide range of products that have found application in food technology, as well as in agriculture, medicine, and consumer services.

Many modern food technologists cannot do without the use of microbiological synthesis products. Therefore, in the development of processes and devices involved in production, their deep study, theoretical justification and practical analysis are required. This is especially true of the final stage of production - drying, where the product is exposed to the most dangerous influences. Drying is a very energy-consuming, complex, physicochemical and technological process, in which the phenomena of heat and matter transfer are interconnected. When drying products of microbiological synthesis, the main thing is to preserve and improve those properties that determine their further use. For example, for fodder yeast it is preservation of biological value, for enzyme preparations - their activity, microbiological plant protection means - preservation and survival of microorganisms, etc.

The use of sublimation dehydration for many thermolabile biological materials is the only

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acceptable method of obtaining them in dry form, since in this case, irreversible changes in the product are minimal, its regeneration is easy when moistened, the original properties of the material being dried are preserved, such as smell, taste, color, food and biological value.

Freeze drying as a technological process involves several successive stages, including material preparation, freezing, loading into a freeze drying chamber, freeze drying as such, unloading and packaging of the dried product.

Currently, the urgent problem in Uzbekistan is the processing of agricultural products with modern technologies. In Uzbekistan, the growing of dill and some types of vegetables is increasing due to potential demand. In 2019, Uzbekistan for the first time bypassed all competitors and became the largest supplier of fresh herbs to the Russian market.

At the end of 2019, 12.9 thousand tons of fresh herbs were already sent to Russia, which is 19% more than in the same period last year.

For many years in a row, Iran has been the leader in the supply of fresh herbs to Russia, but this year Iranian exports have dropped by 14% at once. The share of Uzbekistan reached 40% from January to August 2019 inclusive.

At the same time, problems arise during the storage and processing of large volumes of dill, due to the lack of logistics centers, even when exporting processed dill due to the poor quality of raw materials, which is disturbed during the heat treatment of the chemical composition of the product.

Based on this, our main goal is to dry dill using freeze-drying methods, which is responsible for the quality of the technological parameters. However, freeze drying is the most expensive drying method [6,7]. To do this, we used IR pretreatment prior to drying to ensure moisture release and to shorten the freeze drying period.

2 Objects and research methods

The temperature of pre-treatment with IR rays of dill seeds, which depends on the field strength in the material and the duration of treatment, is the main factor that has a stimulating effect on the seeds. Laboratory studies to study the effect of IR pretreatment modes were carried out on dill seeds of the Kibray variety.

For the experiment, dill seeds were moistened with water for 10 min, with a water temperature of 23 °C. After moistening with an HB-600 electronic balance, 1000 g of dill seeds were weighed for placement in the IR field (preliminary treatment). Pretreatment in the IR range was carried out at 60s, 120s, 180s. Pre-processing was carried out under an IR lamp with a power of 500 kW, 4 pcs. Pretreatment pallet area 0.25 m². The heat flux at IR pretreatment is 8 kW / m². After the pre-treatment, the dill weights were re-measured. The resulting samples were placed in the freezer for 6 hours, the frozen dill was placed on a freeze dryer.

The time, duration of freeze drying, the process of rehydration of dried dill, and the change in the ascorbic acid of dill were analyzed.

In the course of the experiments, the input parameters were measured: preliminary processing with a stopwatch. The results of drying and rehydration of dill seed samples were obtained [8].

3 Results and Discussion

The study took place at the 2nd stage. In the first stage, the prepared samples (after washing) were treated under IR rays for 1 minute, 2 minutes. Each sample was weighed after pre-treatment and checked for organoleptic parameters (color, smell, consistency). Dill samples after 1 min IR pre-treatment lose about 25-28% of their original weight. After IR pretreatment

for 2 minutes, the proportion of yellowish and brown parts of the leaf began to grow in the dill samples, and foreign tastes and odors appeared. After that, for further experiment, only the samples were selected that were treated with IR pretreatment for 1 minute. The IR-treated samples were placed in a freezer for freezing for 6-8 hours. After the freezing process, the samples were placed on a freeze dryer and the change in weight was checked every three hours. The control of the weight indicators of the dried samples was carried out up to the final moisture content of 14% of the dry sample, the total process duration is 20-22 hours [9,10,11].

Moisture contents

Interestingly, dill samples, after pretreatment for 1 minute, will lose about 20 to 28% of their original weight (most of all moisture). This directly affects the freeze-drying time.

As can be seen from the results obtained (Fig. 1), the use of IR pretreatment before freeze drying reduces the drying time by about 5-6 hours compared to the traditional one (without pretreatment).

In order to determine the quality indicator of dried dill, we checked the content of ascorbic acid, since during the pretreatment, loss of vitamin C is possible, as well as the process of rehydration of dried samples.

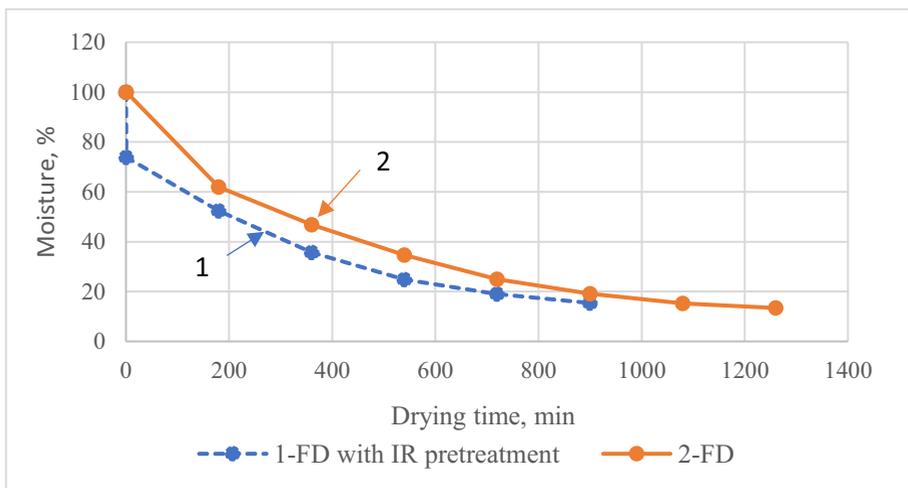


Fig. 1. Drying curves of samples of dill with IR pre-treatment and without by freeze drying

Ascorbic acid content

The dynamics of changes in the quantitative indicators of the content of ascorbic acid in dry matter, the curves of which are shown in Figure 2, make it possible to determine the loss of vitamin C in the process of short-term IR pretreatment of dill samples.

These graphs show that there is a slight loss of vitamin C in dill samples after using the treatment in the infrared electromagnetic field.

Rehydration

The rehydration factor was considered one of the important quality parameters for dried samples. The ratio of the rehydration coefficient of samples dried with IR pretreatment and without pretreatment is shown in Fig. 3.

Recovery from rehydration depends on different drying conditions and final moisture content, as shown in Fig. 3. The maximum water absorption capacity was for samples dried without pretreatment and for samples dried with IR pretreatment.

As shown samples of dried dill without pretreatment had a higher index of rehydration capacity, but the difference was not large between the samples dried with IR pretreatment and without.

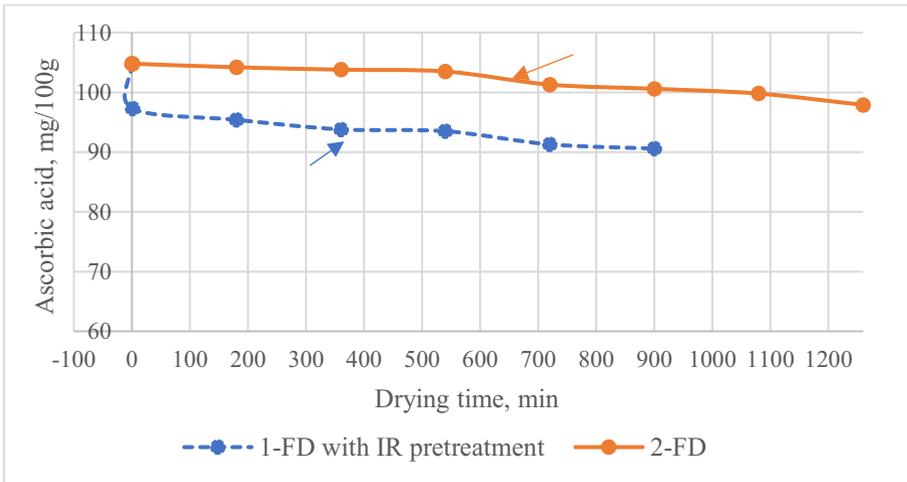


Fig. 2. The mass of ascorbic acid of dill samples during freeze drying with and without IR treatment.

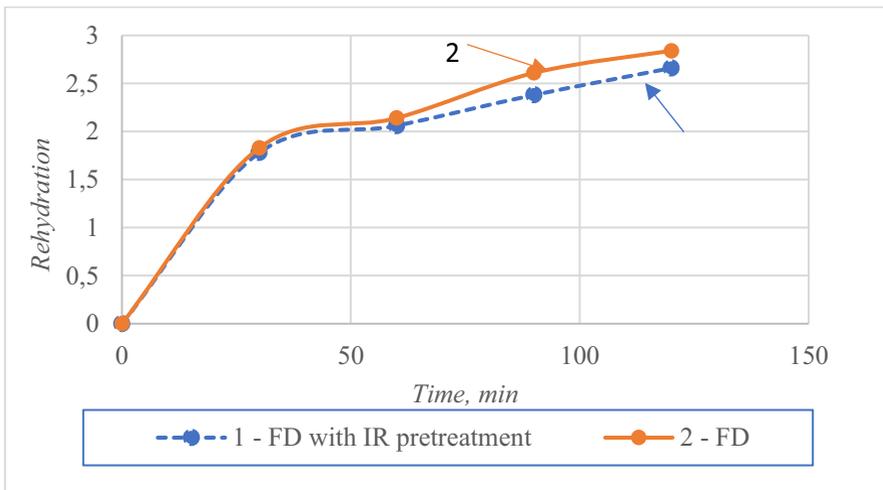


Fig. 3. Rehydration of dried dill samples by freeze-drying with IR pre-treatment and without treatment.

4 Conclusions

With the method of drying with IR, pre-treatment is carried out rather intensively than by the method without pre-treatment during drying. At the same time, the drying speed is increased by 1.3 times compared to traditional drying without pre-treatment. And this one concerns the costs of energy resources.

The results obtained show that short-term IR pre-treatment of dill before drying reduces drying time and energy costs. The research results are of practical importance, since freeze drying is the highest quality technology today, which preserves the organoleptic characteristics and chemical composition of almost 98% natural. Experimental data allows one to consider the use of IR pretreatments suitable for use in drying.

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