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Section 1
MECHANICAL ENGINEERING

RESEARCH DRYING CURVE OF MEDICINAL HERBS

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Abstract. *The article discusses medicinal herbs as a drying facility. The paper presents the process of drying grass motherwort (herba leoniri) infrared heating. It is noted that the constant rate drying period takes a lot larger than the period of the falling rate of drying. It tells about the intensity of the infrared heating drying. It is shown that the object of processing medicinal herbs is a low-temperature drying (not 30-50 ^{0}C) for a short time. The results of experimental studies confirming the presence in plants of biologically active substances.*

Key words: medicinal herbs, drying, infrared drying plant, the drying speed, drying curve.

INTRODUCTION

To plant resources are not only useful plants, but the whole plant cover, since no plants at all life on Earth. The study of natural plant resources, maintained a long and intense. The rich flora can give the national economy a huge number of products. However, the level of natural plant resources depends not only on the diversity of flora, but also on the degree of development of science and technology.

Currently, more attention is paid to the study of medicinal plants - priceless gift of nature. The use of medicinal plants and herbs to treat a variety of diseases and ailments provides lasting benefits. Therefore, treatment with herbs (herbal medicine) is widely used in traditional medicine as well as in non-traditional, folk medicine.

Every year, improved medical services for the population of our country. In this high-quality treatment of the population is only possible with the full satisfaction of human needs in effective medicines.

It is important not only in time to collect medicinal plants and herbs, but quickly and properly dried to preserve completely the active ingredients, as untimely, improper drying of medicinal plants reduces their useful properties.

Due to the nature of chemical and biological composition of medicinal plants in the drying of each of their species, and often require special temperature conditions. Efironosnye plants containing a considerable amount of volatile materials (resins, ethereal oils), dried at low temperatures. Parts of plants containing alkaloids, glycosides, may be dried at a temperature of 50-60 °C, vitamin-plant - at 70-90 °C. Keep in mind that at temperatures above 100 °C destroyed sugar and proteins.

Correctly chosen method of drying the raw material provides good quality and appearance of the material. His choice depends on the morphological structure of plants (different dried leaves, fruits, flowers, etc.), and they contain the biologically active substances.

Properly dried medicinal plant must meet the following requirements:

- to keep operating after drying medicinal substances;
- should not contain impurities other plant species;
- characteristic of the plant to keep the flavor, taste and color.

In the process of life in plants occur most complex biochemical processes. When collecting plants and wilting of the life processes gradually slowed down, but the activity of enzymes, which occur under the influence of numerous biochemical processes going on and sometimes even intensified since fever in the self-warming accelerates their action, and the cells in the withered plants lose the property of semi-permeability. To prevent destructive enzyme activity or reduce it to a minimum, should preserve the products, including the method of drying.

Motherwort - the name of the genus of plants of the family Lamiaceae. Botanical name - Leonúrus. Motherwort is a perennial plant in height from 30 to 100 cm, with square, densely pubescent, branched stems. The flowers are small, located in the leaf axils. Corolla two-lipped

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(diagnostic feature), pink. Fruit fractional, decays into four nuts. It flowers from June until autumn. Motherwort is growing in Europe, Central Asia, the Caucasus, Western Siberia. Motherwort name defines its habitat - the plant loves the wilderness, pastures, fallow, vacant lots, slopes, cliffs, deserted settlements [1-2].

The plant contains alkaloids (up 0.4%): leonurin, leonuridin, stahidrin; choline; sapononiny, flavonoids: quercetin, rutin, kvinkvelozid, kosmosiin, hyperoside, quercetin, quercetin glucoside izokvertsitin; iridoids: galiridozid, 8-atsetilgarpagid, ayugozid, ayugol, garpagid; essential oil (0.9%), which includes limonene, linalool, caryophyllene, α-humulene, α- and β-pinene; diterpenoids, steroid glycosides, caffeic acid glycoside, parakumarovaya acid, tannins (2.5%), bitterness marubin, colorants, resins, vitamin C, carotene; macro- and microelements. The main active ingredients grass motherwort is flavonoids, alkaloids and iridoids [3-6].

Herb motherwort has pronounced sedative (soothing) properties. Preparations plant has antispasmodic and anticonvulsant effect, slow down the rhythm and increase the strength of heart contractions, have a marked hypotensive and cardiotonic action. Motherwort has a beneficial effect on carbohydrate and fat metabolism, and decreases the level of glucose, lactic and pyruvic acids, cholesterol, total lipids in the blood, normalizes protein metabolism [4-10].

In the process of drying wet materials occur interrelated processes heat and mass transfer between the material and drying agent. External processes are characterized by an external mass exchange - evaporation of moisture, ie, movement of vapor from the surface of the material into the surrounding air space and an external heat exchange between the hot gas and the surface material. In the evaporation of moisture from the surface of disturbed balance. The inner parts of the product have a higher moisture content and correspondingly lower temperature than the surface layers. Due to the difference in the moisture content of the surface and inner layers there is a gradient of moisture content. This leads to a process of internal heat and mass transfer, at which the movement of moisture from the interior, the wetter the layers to the surface and from there occurs evaporation. Due to the moisture content gradient is a continuous decrease in moisture in the entire volume of the product to be dried [11].

Drying as a method of food preservation known since ancient times. This method is based on the dehydration of vegetable raw materials to its moisture content 8-14%, and a high concentration of solids.

For the development of micro-organisms need water: bacteria need to live at least 30% moisture for mold - 15%. Microorganisms used substances in the cell sap in relatively low concentrations, while in aqueous solutions are all the biochemical reaction. When you remove the moisture concentration of these substances is increasing and they are already inhibitors of microorganisms, which, though not killed, but because of unfavorable conditions do not develop.

For dried plant material, which retains all of its most valuable components and properties of great importance drying technology and its parameters. At the present time in the world practice the following ways of drying vegetable raw materials: Helio drying, convection, freeze, microwave drying, conductive, infrared and others. The most common methods are those in which the product to be dried is in direct contact with the coolant (hot air or superheated steam) and a contact method (the object to be dried comes into contact with the heated surface of the coolant).

Natural way. The simplest and oldest method of drying - natural drying. Existing methods, ways and means to remove moisture from the natural plant materials for energy consumption is quite low. This method is a traditional and currently used for drying in different branches of agriculture. The main raw material in agriculture, dried natural methods, of course, is hay, different kinds of grass, sloping and cooked to feed cattle in winter.

Helio dryer. Selection of drying method is determined by the scale of production, climatic features of the area, overlooking a dried material and the cost of energy consumed. Supply heat to the material from the drying agent can be carried out by convection or by radiation, respectively distinguish convective and radioactive dryers.

Freeze drying - drying foodstuffs, characterized ice phase change to steam under a high vacuum.

With this method, drying the material to be dried is no contact with oxygen. The basic amount of water (75-90%) is removed by sublimation of ice at a product temperature below 0 °C, and only the residual moisture is removed at a temperature of 40-60 °C. Complete freezing of moisture in the product can not be reached. A small amount of it is not freezes even at very low temperatures.

Products such drying are of high quality, well maintained and food ingredients, have increased reducing power, have little shrinkage, characterized by porous structure.

In vacuum with infrared heating. The drying process in vacuum infrared heating differs from conventional drying, at which the structural change and mechanical, technological and biochemical properties of the material, the ratio of ash and organic components. When using the process in question dehydration qualitative change occurs, the dehydrated material is different from the original only to the percentage of water, keeping the structure and the percentage of biologically valuable components [12-16].

STATEMENTS

At the Tashkent State Technical University the process of vacuum drying with infrared heat herb - motherwort (*herba leoniri*). Consider the generalized drying curve for different temperatures.

As can be seen from fig.1, the period of constant drying rate takes a larger portion than the period of the falling rate of drying. This indicates the intensity of vacuum drying with infrared heating.

The material temperature does not change during the period of constant rate of drying and the temperature is "wet" bulb, and the partial pressure of steam in the evaporation surface is equal to the saturation pressure at the temperature of "wet" bulb.

In the second period of drying kinetic patterns more complex, as is evident from the curves of drying speed. This period begins to retire bound water (fig.1). The partial pressure of water vapor on the surface of the material becomes less than the vapor pressure of pure water at the same temperature. During this period, the water vapor pressure is a function of the temperature and humidity of the material at the surface. The latter depends on the speed of movement of moisture in the material. Therefore, the drying rate during this period depends not only on moisture

diffusion into the surrounding air, but also on the hydraulic conductivity of the material. Thus, in the second period the drying rate is determined by the events related to the movement of moisture in the material.

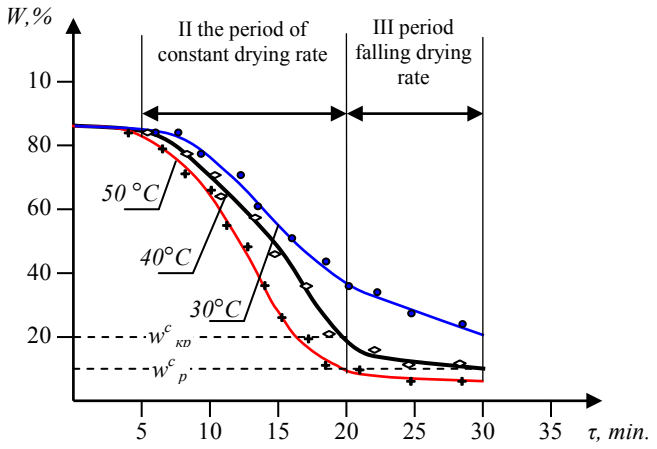

Fig.1. *The curve of drying herbs motherwort (herba leoniri)*

By drying curves define the drying rate at any time.

The critical moisture content of the material the more hygroscopic than greater than its thickness. The temperature of the material in the second period is continuously increased, tending to a temperature within the chamber, and the drying rate decreases continuously from its maximum value *dw/dt* to zero (Fig. 2). The drying rate becomes zero when the equilibrium moisture content w^s_{eq} pictures, which corresponds to a dynamic equilibrium in which flow of moisture from the material due to evaporation and flow of water to the surface of the material from the environment (condensation) are equal, i.e. amount of moisture in the material is constant with time.

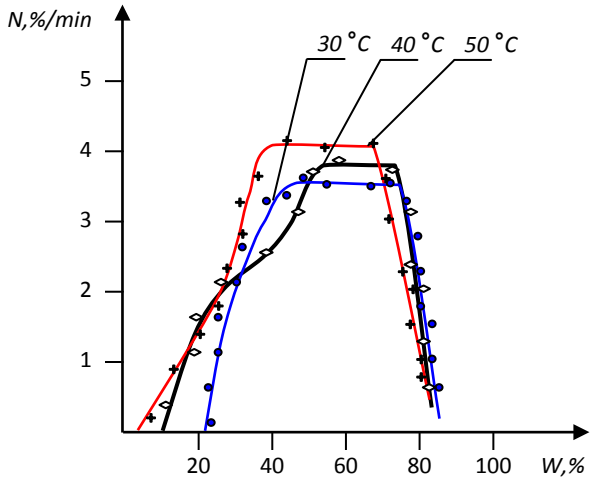

Fig.2. *Curve speed drying herbs motherwort (herba leoniri)*

The advantages of this technology must be added the fact that the evaporated water can condense and collect in baro capacitor in water storage. It can be used for drinking or industrial purposes. In baro capacitor it is possible to collect the volatile oils, which are then used in the food industry. Medicinal products after such a drying method, of course, have the status of organic products.

The empirical dependence of the critical temperature humidity W_{cr} *t* in the form W_{cr}=*46,5-0,5 t*. The critical moisture $W_{cr}=W_n - N_{\tau l}$ in relationships $W_i = W_n - N\tau_{1i} \le W_{cr}$ and $W_K = W_{cr} - e^{K\tau_{2i}} \le W_p$ obtained values of the dimensionless coefficients of *N* and *K*, depending on the temperature *t*,

$N=3+0,02\ t$ and $K=-0,267+0,0088\ t$.

This relationship is obtained by processing drying curve in the time interval τ_1 and τ_2.

CONCLUSIONS

The favorable temperature and high speed drying - the main technical advantages of the proposed technology dehydration useful components of medicinal plants.

Studies have shown that heating plants to temperatures above 50 °C enzymes work considerably weakened, and often stops altogether. In view of this, for best results, the drying should be generally faster and performed at a temperature of 40-50 °C.

Medicinal herbs that of thermo-physical properties are close to the grass Leonurus described similar curves. Therefore, this analysis technique allows to use it for other similar herbs.

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