International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 08, 2020
ISSN: 1475-7192

EXPERIMENTAL STUDY OF THE DRYING PROCESS OF MEDICINAL PLANTS

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***ABSTRACT**--On a solar-water convective drying oven, experimental studies were performed and curves of the duration and temperature of the drying process of medicinal plants were obtained. Based on the results of experimental studies of the dehydration process at the installation, an engineering methodology has been developed for calculating the design and technological parameters of an industrial solar-water convective installation.*

***Key words**--drying, biological active substances, medicinal plants.*

I. INTRODUCTION

In the world, the development of the pharmaceutical industry pays great attention to the study of the process of preparation and processing of medicinal herbs. In this regard, applying advanced modern technologies of processes and apparatuses for processing medicinal plants, devices have been developed for producing high-quality pharmaceutical raw materials and biologically active substances, energy-saving drying techniques and technologies have been introduced into the industry for drying raw materials, and a drying plant for drying medicinal plants developed on the basis of scientific evidence. At the same time, it is of great scientific and practical importance to create a rational design of a drying plant that works without electricity and to use innovative methods to preserve the medicinal properties of plants, taking into account the thermophysical properties of raw materials.

Based on our theoretical studies, we performed laboratory and experimental work on the dehydration of our selected objects as drying.

The obtained samples during experimental work on the dehydration of medicinal plants such as peppermint (Mentha piperita), plantain (Plantago) and zizifora (Ziziphora) in a solar-water convective drying plant were investigated to preserve their composition. For this purpose, samples of materials were numbered in the following order:

1. «Option 1» - drying in a natural way;
2. «Option 2» - drying in a water heating convective drying unit;
3. «Option 3» - products of domestic manufacturers;

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Received: 02 Jan 2020 | Revised: 12 Feb 2020 | Accepted: 17 Mar 2020

4. «Option 4» - the feedstock.

Dried plants, peppermint and zizifora were studied at the Institute of Plant Chemistry at the Academy of Sciences of the Republic of Uzbekistan for residual moisture, ash and extractives, plantain for plant polysaccharides. All types of laboratory tests were performed according to the State Pharmacopoeia [1-2].

The method for determining moisture is based on the determination of mass loss due to hygroscopic moisture and volatile substances when drying the raw material to an absolutely dry state.

According to the Global Fund of the 11th edition, in the pharmacopeia analysis, ash refers to the residue of inorganic substances, which is obtained by burning medicinal substances or medicinal plant materials and subsequent calcining to constant weight.

Extractive substances of medicinal plant materials are conventionally called a complex of organic and inorganic substances extracted from plant materials with an appropriate solvent and quantified as a dry residue. Extractive substances have a strong physiological effect.

Polysaccharides are most important for the human body for two reasons: they are long digested and absorbed (unlike simple carbohydrates); contain many useful substances, including vitamins, minerals and proteins. Unlike other plant objects, studies of plantain leaves showed that they contain more polysaccharides, including mucus. For this reason, laboratory tests were performed for the presence and amount in percent of this substance.

The results of laboratory studies led to the following. As can be seen from the table. 1, the amount of extractives dried in a solar-water convective drying plant, show 23.30% i.e. 2.5-3% more than other samples. In the initial embodiment, extractive substances in this plant were 23.2%. This indicates that the author of the solar-water convective drying plant and the developed technology give the most effective results [3-4].

Table 1: Test results for determining moisture in a medicinal plant Peppermint (Mentha)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective,%	Products of domestic manufacturers, %	Feedstock, %
1	5,32	5,33	5,34	68,5
2	5,38	5,36	5,26	68,0
3	5,44	5,43	5,23	66,1
4	5,47	5,40	5,20	69,0
5	5,39	4,98	5,21	67,0
Results of the mean value	**5,4**	**5,3**	**5,25**	**68**

Also, when examining the ash content in a dehydrated plant on a solar-water convective drying plant, the peppermint and the original version dominated by the variant dried on a solar-water heating convective drying plant are a natural way and the product of domestic manufacturers of medicinal plants (Table 2).

Received: 02 Jan 2020 | Revised: 12 Feb 2020 | Accepted: 17 Mar 2020

Table 2: The results of the tests to determine the ash content in the medicinal plant peppermint (Mentha)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective, % (no more than 10%)	Products of domestic manufacturers, (no more than 10%)	Feedstock, % (no more than 10%)
1	5,90	6,33	5,34	6,9
2	5,92	6,36	6,58	6,0
3	5,94	5,86	5,91	5,89
4	5,91	5,97	6,19	6,0

The content of extractives in medicinal plant raw materials is an important numerical indicator determining its benignness, especially for those types of raw materials in which the active substances are not quantified. In a dehydrated plant, peppermint in a solar-water convective drying plant contained extractives of at least 23.30%, that is, by 2-3% more than other samples (Table 3).

Table 3: The results of the tests to determine the extractives in the medicinal plant peppermint (Mentha)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective, % (no more than 20%)	Products of domestic manufacturers, % (no more than 20%)	Feedstock, % (no more than 20%)
1	20,72	23,33	21,54	23,13
2	20,71	23,26	21,58	23,20
3	19,94	23,26	21,51	23,70
4	19,91	23,27	21,59	23,10
5	20,79	23,38	21,58	23,10
Results of the mean value	**20,3**	**23,30**	**21,56**	**23,2**

Conducted laboratory tests on the medicinal plant of zizifora (Ziziphora) to determine the moisture content, extractives and ash content showed the following results (Table 4-6).

Table 4: The results of analyzes to determine the moisture content in a medicinal plant of ziziphora (Ziziphora)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective, %	Products of domestic manufacturers, %	Feedstock, %
1	6,1	6,32	6,1	58,99
2	6,3	6,32	6,0	58,80
3	6,2	6,34	6,0	58, 90
4	6,2	6,30	6,1	58,90
5	6,1	6,32	5,99	58,91
Results of the mean value	**6,2**	**6,32**	**6,0**	**58,9**

Table 5: The results of the tests to determine the ash content in the medicinal plant of ziziphora (Ziziphora)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective, % (no more than 10%)	Products of domestic manufacturers, % (no more than 10%)	Feedstock, % (no more than 10%)
1	7,1	7,02	7,1	7,22
2	7,3	7,0	7,5	7,28
3	7,2	7,1	7,3	7, 25
4	7,2	6,99	7,2	7,24
5	7,1	7,0	7,3	7,26
Results of the mean value	**7,2**	**7,0**	**7,3**	**7,25**

Table 6: The results of the tests to determine the extractives in the medicinal plant of ziziphora (Ziziphora)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective, % (no more than 15%)	Products of domestic manufacturers, % (no more than 15%)	Feedstock, % (no more than 15%)
1	17,5	19,18	16,50	17,01
2	17,9	19,20	16,60	17,00

3	17,8	19,19	16,54	17, 02
4	17,6	19,16	16,55	16,98
5	17,7	19,22	16,56	16,99
Results of the mean value	**17,7**	**19,19**	**16,55**	**17,0**

The results of analyzes of the plantain plant also showed in favor of the option of drying a solar-water convective drying plant which was dehydrated by the developed plant (Table 7-8).

Table 7: The results of tests to determine the humidity in a medicinal plant plantain (Plantago)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective, %	Products of domestic manufacturers, %	Feedstock, %
1	6,1	6,01	6,1	62,00
2	6,3	6,0	6,0	62,3
3	6,5	6,1	6,0	61, 99
4	6,6	5,99	6,1	62,00
5	6,0	6,0	5,99	62,01
Results of the mean value	**6,3**	**6,0**	**5,9**	**62**

Table 8: The results of tests to determine the ash content in a medicinal plant plantain (Plantago)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective, % (no more than 10%)	Products of domestic manufacturers, % (no more than 10%)	Feedstock, % (no more than 10%)
1	6,3	6,41	6,28	6,5
2	6,3	6,43	6,30	6,4
3	6,2	6,40	6,30	6, 1
4	6,01	6,44	6,28	6,2
5	6,1	6,42	6,29	6,3
Results of the mean value	**6,3**	**6,42**	**6,29**	**6,3**

The content of the mass fraction of polysaccharides in the variant “Drying in a solar-water convective drying equipment” exceeds the other variations (Table 9).

Table 9: The results of the analyzes to determine the mass fraction of polysaccharides in the medicinal plant plantain (Plantago)

The frequency of the repeat analysis	Naturally dried,% (no more than 10%)	Drying in a solar water heating convective, % (no more than 10%)	Products of domestic manufacturers, % (no more than 10%)	Feedstock, % (no more than 10%)
1	13,00	13,40	12,50	12,90
2	13,20	13,60	12,60	12,94
3	13,10	14,00	12,70	12, 91
4	12,99	13,80	12,55	12,93
5	13,30	13,70	12,65	12,92
Results of the mean value	**13,1**	**13,7**	**12,6**	**12,92**

According to the results of the analysis on the drying of medicinal plants, it can be concluded that dried plants in a water-heating convective drying plant contain more biologically active substances than when dried by other methods [5-7].

II. CONCLUSIONS

A comparative analysis of the behavior of the constituent extractives of peppermint and zizifora, plantain polysaccharides, as well as the ash content and final moisture content of medicinal plants under various drying methods was carried out. Reliable data have been obtained on the preference of direct-flow organization of flows, from the point of view of the uniformity of the conditions for the drying process of plant medicinal materials on pallets.

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