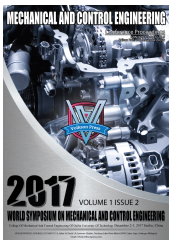
ISBN: 978-1-948012-06-5

Contents List available at VOLKSON PRESS

Mechanical and Control Engineering (MCE)

DOI : http://doi.org/10.26480/wsmce.01.2017.15.17



STUDY ON DRYING PROCESS OF CHINESE YAM

Liu Xiao[1], Luo Shiyong[1], Xu Wencai[1], Liu Shoujie[2], Zhang Yuyao[2], Huang Wei[2], Ma size[2]

[1]*School of Printing and Packaging Engineering, Beijing Institute of Graphic Communication, Xinghua street, Beijing, China*
[2]*Han Guang (Tianjin) Chinese medicine science and technology Co., Ltd.,* **Asia street***, Tianjin, China*
***Corresponding Author Email: luoshiyong@bigc.edu.cn**

ARTICLE DETAILS

Article History:

Received 02 october 2017
Accepted 06 october 2017
Available online 11 november 2017

Keywords:

Iron yam pills, Drying process, appearance color

ABSTRACT

In this study, the drying process of iron yam (produced in Henan Province, Thick skin) was studied by hot-air, vacuum, hot-air and vacuum combined drying method respectively. According to the appearance color, rehydration rate and drying rate of the dried yam pills, the study obtained the drying conditions of iron yam: drying the fresh yam pill at 60°Cuntil the surface is dried and then dried in a vacuum oven at 45°Cuntil the moisture content of the yam reaches the requirements of the Pharmacopoeia. This process under the conditions of dry iron yam pills have a good color and storage effect.

1. Introduction

Chinese yam is one of the agricultural products which have the same origin of medicine and food. The 2015 edition of the Pharmacopoeia pointed out that yam is the root of dioscorea, which is not only the use of nourishing health care products, but also the traditional Chinese medicine, rich in saponins, mucus, glycoprotein, a variety of trace elements (such as Zn, Fe, Mn, etc.) and major elements Ca and so on [1]. Saponins can prevent the occurrence of coronary heart disease and fatty liver; Amylase can promote the decomposition of starch in food, enhance the digestion and absorption of the body, is the first choice of nutritional supplements, such as weakness, indigestion, and many other diseases; active polysaccharides can stimulate and regulate the immune system to induce production of interferon and enhance immune function [2].

Because polyphenols (polyphenol oxidase PPO) in Chinese yam is easy to brown under oxygen oxidation, and fresh yam is easy to damage during transportation, so it is difficult to store. General yam as herbs will be dried, made of yam slices (irregular thick slices, wrinkled, white or yellow and white section, crisp, powder, gas micro, light, slightly acid), this dried yam tablets for long-term preservation [3]. However, during the drying process of yam, it will still be influenced by polyphenol oxidase. After the destruction of cells, the active substances will produce changes in color and smell under the action of oxygen and enzyme. Therefore, it is very important for the economic value of yam to remain white in the course of yam drying.

Yam drying method from the original dry, dry in the shade and other natural methods of drying to a more scientific and convenient controllable drying method. Chen Yanzhen of Henan University of Science and Technology of yam caused by polyphenol oxidase browning activity were studied, by preparing a color protecting agent and proper application of microwave vacuum drying method to get the color and smell good yam slices, but the dry method of energy consumption of large length between; Ye Xiaomeng of Shihezi University by microwave vacuum freeze-drying method combined dry dried yam [4]. This study can get white yam slices, the drying process is tedious, energy and time consuming [5]. Therefore, it has great significance to maintain the good appearance and color of dried yam slices and shorten the drying time for the economic benefit of Chinese yam as a kind of medicine and food homologous economic crop.

2. EXPERIMENTS

2.1 Materials

Material: iron yam (produced in Henan Province, thick skin).

2.2 Experimental equipment

Electronic counting balance (DT-200B, Changshu Golden Sheep Weight Instrument Co., Ltd. Jinyang balance instrument factory) Hot blast oven (101-1ES, Beijing Yong Guangming Medical Instrument Factory) Vacuum drying oven (DZF-6210, a constant Shanghai Science Instrument Co., Ltd.)

2.3 Drying

The yam slices with thickness of 5mm were laid on the paper after color treatment, then dried under different drying conditions, and got the yam slices with the water content of medicinal yam (no more than 12%). The experimental drying temperature, referring to a large number of literature, showed that the inhibition rate of polyphenol oxidase (PPO) in yam was the greatest when the drying temperature was 45 – 60°C [6].
In this experiment, three different drying methods were used to dry yam, and the steps were as follows:

2.3.1 Hot air drying

The thickness of the slices is 5mm, and the yam is drying 2h in a hot air-drying box at 60°C, and the surface moisture is almost dried, dried at 45°Cuntil the moisture content required by the Pharmacopoeia (thickness is about 3mm).

2.3.2 Vacuum drying

The thickness of the slice is 5mm. After the color treatment, the Chinese yam will remove and drain the surface moisture. On the paper (yam slices do not overlap each other), 2h is dried in the vacuum drying oven at 60°C and then the vacuum drying oven temperature is adjusted to 45°Cuntil the yam is baked to the water content range required by the Pharmacopoeia (thickness is about 3mm).

2.3.3 Combined drying of hot air and vacuum

The combination of hot air and vacuum drying was used as the third drying method, and the common advantages of hot air drying, and vacuum drying were combined. The yam slices with a thickness of 5mm were dried in a hot air oven at 60°C for 2h. After the surface of the yam was dried, the yams were dried in a vacuum oven at 45°C and dried until the desired water

content (about 3mm).

2.4 Test

2.4.1 Moisture content detection

The yam samples were placed in a hot blast oven, dried at 45℃ until constant weight, weighing yams before drying (G1) and mass after drying (G2), using the following formula Water content (W) is : [7]

$$W\% = \frac{G_1 - G_2}{G_1} \times 100\%$$

2.4.2 Sensory evaluation

The scores of the dried yam tissue, color and odor were evaluated from three aspects, and the sensory evaluation was carried out with the average value. The results are shown in table 1.

2.4.3 Determination of rehydration rate

The dried yam was soaked in water at room temperature for 1h, then the surface moisture was drained, and the quality changes were detected. The formula of rehydration rate is as follows: [8]

$$Rf\,(\%) = [(mf - mg)/mg] \times 100\%$$

Rf is the rehydration rate of the dried yam; mf is the weight of the dried yam after drying (g); mg is the mass of dried yam (g)

2.4.4 Drying rate calculation

In the process of yam drying, remove the timing weight, drying rate calculated according to the following formula: [9]

$$V(g/\min) = \Delta G / \Delta T$$

V - drying rate (g/min); G - fixed time period of yam quality change (g); Delta T - fixed time interval

2.4.5 Determination of drying curve

According to the above determination of the initial water content, the standard method of detecting the moisture of agricultural products is used for testing. The initial water content error of each group of test yams is not more than 1%. In the hot air-drying experiment, the quality of the yam was detected every 30min. In the vacuum drying experiment, the quality of the yam was detected every 60min. In the experiment of combined drying of hot air and vacuum, hot air drying 30min and vacuum drying 60min were used to remove yam and quickly detect the weight change until the moisture content of yam drying reached the required moisture. The drying curves of the obtained moisture content and drying rate with drying time and the drying rate curve of drying rate varying with water content are shown in Figure 2.

3 RESULTS AND DISCUSSION

3.1 Appearance color

Figure 1 is the iron yam slices obtained by three different drying methods after drying photos.

(A) hot air drying

(B) vacuum drying

(C) combined drying with hot air and vacuum

Figure 1: Photos of Chinese yam slices obtained by different drying methods

Sensory evaluation by Figure 1, analysis shows that the sensory quality of yams in the hot air drying, we can see the effect of yam tissue state is not very good, but also due to dry air oxygen in the long-term contact with more obvious Color changes, and it is easy to scorch; in the vacuum oven, you can see the dried yam tissue in good condition, the dried yam color can basically achieve the desired effect, and no smell; In the combined drying of hot air and vacuum, the tissue state after yam drying is almost the same as that of the vacuum drying box, and the color and lustre can also achieve good results.

3.2 Different drying methods on the rate of rehydration

According to the calculation of the above-mentioned rehydration rate, the iron yam under three drying conditions obtained yam tablets rehydration rate, as shown in Table 1 different drying methods of rehydration rate.

Table 1: Rehydration rate of different drying methods

Drying method	mg（mean value）	mf（mean value）	Rf
hot-air	4.17	7.11	70%
vacuum	4.40	8.04	82%
Combined drying of hot air and vacuum	4.51	8.69	92%

3.3 Drying rate

The drying curves were plotted by the above drying curves, and the drying curves were compared. The drying curves were as follows:

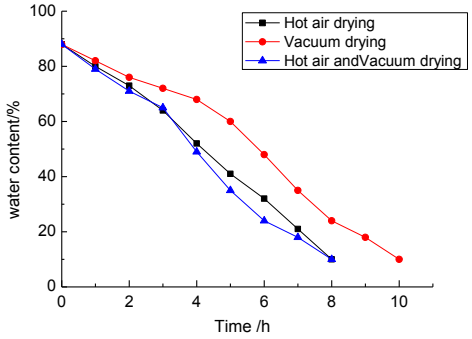


Figure 2: Drying curves of different drying methods

Hot air drying can timely monitor the surface temperature of the material to prevent overheating of the material, thus greatly improving the drying quality. According to the previous experience, the yam dried at 60 ℃ for 2h to dry the surface, and then at 45 ℃ for the final drying temperature. As can be seen from Figure 2 yam dried until the pharmacological requirements of the water content of the time it takes 8h. However, after the hot air-drying material quality cannot be guaranteed, the loss of more serious nutritional loss of yam, prone to the phenomenon of surface hardening of the tissue structure.

Vacuum drying technology is the use of low boiling water reducing principle, make the material in water evaporation at low temperature, can greatly reduce the loss of nutrients, so the product color, aroma and taste, provide favorable conditions for the drying of thermal sensitive material; one of the lower partial pressure of oxygen, both to prevent oxidative deterioration of materials, but also inhibit the production of certain bacteria reproduction. The yam according to the vacuum drying method, first at 60 ℃ temperature for 2h, and then dried at 45 ℃ to safe moisture. It can be seen from Figure 2 that the time required for drying to the Pharmacopoeia moisture content is 10 h.

Combined drying of hot air and vacuum, the yam first in a hot air oven at 60 ℃ temperature drying 2h, dried yam surface moisture, and then in a vacuum oven at 45 ℃ temperature to dry moisture. It can be seen from Figure 2 that the time required for drying to the Pharmacopoeia moisture content is 8h.

4. CONCLUSION

Chinese yam is an important economic crop with the same medicine and food. The Chinese yam which is used in pharmacopoeia is a kind of dried and good-looking mountain pill. Through the research of hot air and vacuum, hot air and vacuum combined with three kinds of drying methods on drying experiments of yam, obtained the iron yam (from Henan Province, thick skin) drying conditions: The fresh cut mountain tablets in the hot air-drying box under 60℃until the surface is dry, and then dried in a vacuum box 45℃under the condition of dry yam, until the moisture content to the requirements of Pharmacopoeia, iron yam tablets have good color and storage effect.

ACKNOWLEDGMENTS

This study is funded by the Key Science and Technology Project of Beijing Municipal Education Commission (KZ201610015015), and by the National Key Scientific Instrument and Equipment Development Project (NO. 2013YQ140517).

Author: Liu Xiao (1994-), female, Shaanxi province, graduate students, Printing and Packaging Institute, E-mail: 1040456492@qq.com,

Corresponding Authors: Luo Shi-Yong (1967-), Male, Sichuan province, Ph.D., Professor, Printing and Packaging Institute, E-mail: luoshiyong@bigc.edu.cn,

REFERENCE

[1] National Pharmacopoeia Committee. 2005. People's Republic of China Pharmacopoeia [M]. Two. Beijing: Chemical Industry Press, 65-78.

[2] Bing, B., Jing, L.M., Yong, W. 2008. Research on the composition of yam [J]. Chinese Journal of Chinese medicine, 33 (11), 1271-1274.

[3] Guohua, Z., Zhixiao, L. 2002. The immunomodulatory effect of yam polysaccharides [J]. Journal of nutrition, (4), 187-188

[4] Yanzhen, C. 2009. Study on microwave vacuum combined with dry yam [D]. Henan University of Science and Technology.

[5] Dream. 2014. Tiegun leaf freeze-dried [D]. study of microwave vacuums drying technology combined with Shihezi University.

[6] Zhaohui, L., Bifeng, Z., Anling, L. 2003. Determination of the main biochemical components in yam [J]. Journal of Shaoguan University (NATURAL SCIENCE EDITION), 24 (3), 67-69

[7] Jun, W. 1993. Comparison of the characteristics of hot air, external infrared and microwave drying [J]. Agriculture, animal husbandry and food machinery, 11 (6), 26-28.

[8] Linghong, N., Zhengxiang, N. 2002. Yam was developed using [J]. China wild plant resources, 21 (5), 17-19.

Jun, Z., Anjian, W. 2007. Study on microwave vacuum freeze-drying of yam chip preparation [J]. Food science and technology, (5), 89-90.