THE EFFECT OF SUBLIMATION DRYING CONDITIONS ON PRODUCT QUALITY INDICATORS IN A DRYING DEVICE FOR ALBION VARIETY STRAWBERRIES

Nusratova Nigina Rustamovna
Master student, Tashkent state technical university,Republic of Uzbekistan, Tashkent nusratova.nigina .17@gmail.com
Samandarov Doston Ishmukhammat son
PhD, Tashkent state technical university, Republic of Uzbekistan, Tashkent ishmukammedovich@mail.ru

Аннотация: *В данном состоянии изучено влияние процесса сублимационной сушки на качество плодов клубничного сорта Fragaria × ananassa. shower V khode sukki проанализировано содержание влаги, показатели цвета (L*, a*, b*), текстура, сохранение витамина С и антиоксидантная активность. Результаты исследований показывают, что сублимационная сушилка при низком давлении и температуре обеспечивает высокую эффективность в сохранении формы, цвета и биоактивных веществ. Данный метод является перспективным для производства функциональных продуктов и пригоден для экспорта.*

Ключевые слова: *сублимационная сушилка, клубника, вакуум, качество пищевых продуктов, антиоксиданты, лиофилизация*

Abstract: *This article investigates the effect of the freeze-drying process on the quality characteristics of Fragaria × ananassa Duch. strawberry fruits. During drying, changes in moisture content, color parameters (L*, a*, b*), texture, vitamin C retention, and antioxidant activity were analyzed. The results indicate that freeze-drying at low pressure and temperature ensures high efficiency in preserving the shape, color, and bioactive compounds of the fruit. This method is promising for functional food production and export purposes.*

Keywords: *freeze-drying, strawberry, vacuum, food quality, antioxidants, lyophilization*

INTRODUCTION

Strawberry (Fragaria × ananassa Duch.) fruits not only delicious , maybe antioxidants , vitamin C , flavonoids and phenolic compounds with wealth because of functional food is considered high . But humidity level (about 90%) and sensitive structure because of fast is broken . Therefore fruits storage and packaging for effective technologies necessary [1].

Sublimation drying (lyophilization) the product in advance freeze , then low pressure and at temperature water straight away gas to the state to turn and evaporate This process is based on of the product structure and food substances maximum at the level save stay opportunity gives .

In the study sublimation Albion variety in the dryer strawberry The device is frozen . product from −40°C to +25°C was at temperature , pressure ~20 Pa under sublimation to do opportunity The dryer features fruits and vegetables high quality with drying opportunity gives [2].

Materials and methods

Experience for Uzbekistan under the circumstances cultivated Albion variety clean , healthy and one kind in size strawberries selectively Fruits 12 hours at −40°C during in advance frozen(fig 1) .

In the study used device modern laboratory type sublimation (lyophilization) dryer It is a fruit. and other nutritional of products high quality save stay opportunity Freeze process at −40°C done increased , this and of the product structure without breaking it , in the content liquid ice to the state transfer opportunity gives . Drying process and the temperature is +25°C and ~20 Pa pressure under done increased , from the product of water complete sublimation provided . This parameters based on sublimation drying duration approximately 7.5 to 8 hours it happened , this of fruit quality indicators high at the level to keep opportunity gave[2] .

Figure 1. Sublimation drying device

Evaluation Methodology: Dried samples quality indicators assessment for one row scientific methods applied . Humidity amount in determining gravimetric from the method was used , in which samples clear in weight pulled , then designated temperature and time during dried , last weight measured . This method humidity amount high accuracy with determination opportunity gives and in the product water amount clear shows [3].

Product color change assessment for colorimeter to L*, a*, b* color parameters using measurements These parameters are of color luminance (L*), red-green (a*) and yellow-blue (b*) color shades changes to determine service does and of the product external in the form of quality assessment for important are indicators [4].

Texture in the analysis penetrometer method used , the product hardness level measured . This method of the product physicist structure and hardness indicators determination for is used , as a result sublimation drying process product to the structure impact is determined[5] .

Vitamin C amount determination with 2,6-dichlorophenolindophenol for titration method This chemical method high accurately measure vitamin C concentration measurement opportunity gives and in the product bioactive of substances preservation level in evaluation important importance has .

Antioxidant activity while DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging method using analysis This was done . method in the product antioxidant of the substances free to radicals against fight ability to determine opportunity gives and his/her health for useful features in evaluation main indicator is considered [6].

Results and Analysis : Humidity decrease Drying at the beginning in strawberries 8 hours if humidity is ~90% during this amount up to 4.5% decreased[7]. Drying speed in 3–4 hours the most high to the point reached , and then slowed down(fig 2) .

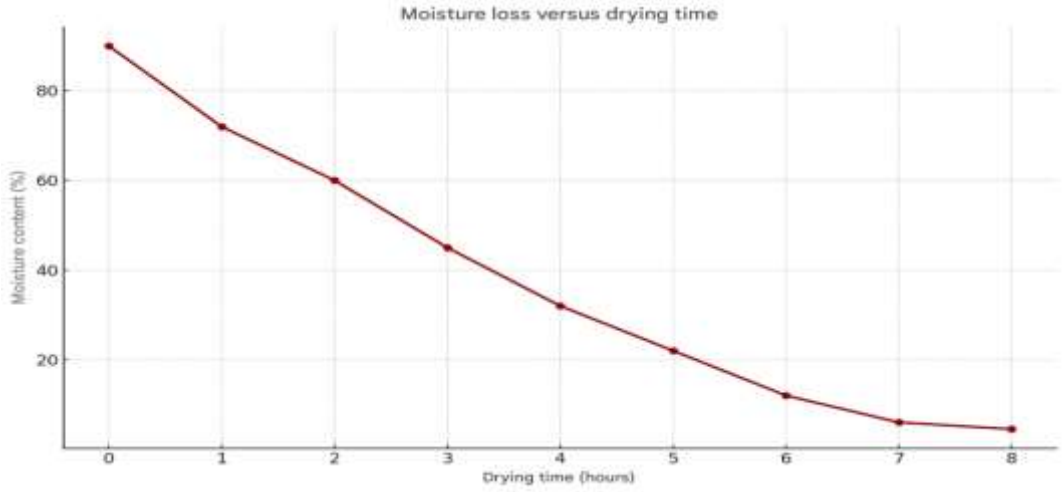

Figure 2. " Humidity amount drying on time relatively decrease "

Table 1

Color of parameters preservation[8].

Parameter	Elementary value	From drying after
L*	35.5	43.2
a*	26.8	30.1
b*	14.2	16.3
ΔE	-	<5

From the table visible drying from the process then in the color settings light changes face Minimum Δ E (<5) value product external appearance save the rest means(table 1)

Vitamin C and Antioxidants : Ascorbic acid acid retention 82 % organization In the DPPH assay antioxidant activity level is 75% preserved left(fig 3)[9] .

Figure 3. Freeze dried strawberry fruit

Product own shape good save left , internal cellular structure uncooked . Without blanching dried in fruits hardness higher it happened , this and smoothness provided.

Received results international research with suitable For example , in the works of Ratti (2001) and Mujumdar (2007) lyophilization in the process food of substances high at the level preservation record modern laboratory sublimation dryer Low temperature in the device and pressure in the product enzymatic reaction and oxidation reduces[10] .

Other styles with compared (for example , convective or microwave drying), sublimation drying in food more organoleptic and biological properties It also saves energy . expense higher although , consequential product quality this the flaw covers [11].

Conclusion

Albion variety strawberries modern laboratory sublimation dryer on the device sublimation in a way drying product quality , nutritional value and external appearance in storage high result Lyophilization product for export designed , functional food as to use suitable is , Uzbekistan food in the industry wide current to be possible .

This technology industry at the level automation , energy efficiency increase and other fruits and vegetables in types application according to promising research necessary .

LITERATURE:

1. Nusratova NR, Samandarov DI, EXPERIMENTAL STUDY OF FREEZE DRYING OF STRAWBERRY FRUITS// universum : teknicheskie Science No. 4(133).DOI - 10.32743/UniTech.2025.133.4.19863

2. Nusratova NR, Samandarov DI Research of freeze drying of strawberry fruits: Monograph./ Tashkent: "Science and Development", 2025.

3. Ratti, C. (2001). Hot air and freeze-drying of high-value foods: a review. Journal of Food Engineering, 49(4), 311–319.

4. Mujumdar, AS (2007). Handbook of Industrial Drying. CRC Press.

5. AOAC (2016). Official Methods of Analysis. 20th ed .

6. Krokida , MK, & Maroulis, ZB (2001). Quality changes during drying of food materials. Drying Technology, 19(9), 203–210.

7. Wang, Z., Sun, J., Chen, F., Liao, X., & Hu, X. (2007). Effect of drying methods on physicochemical properties and antioxidant capacity of garlic. Food Science and Technology International, 13(6), 437–443.

8. Barbosa -Cánovas , GV, Vega-Mercado, H. (1996). Dehydration of Foods. Springer Science & Business Media.

9. Vega-Gálvez, A., Di Scala, K., Rodríguez, K., Lemus-Mondaca, R., Miranda, M., López, J., & Perez-Won, M. (2009). Effect of air-drying temperature on physicochemical properties, antioxidant capacity, color and total phenolic content of red pepper (Capsicum annuum, L. var. Hungarian). Food Chemistry, 117(4), 647–653.

10. Ciurzyńska , A., & Lenart, A. (2011). Freeze-drying–application in food processing and biotechnology–a review. Polish Journal of Food and Nutrition Sciences, 61(3), 165–171.

11. Zhang, M., Tang, J., Mujumdar, AS, & Wang, S. (2006). Trends in microwave-related drying of fruits and vegetables. Trends in Food Science & Technology, 17(10), 524–534.