Research Article

Experimental studies on re-hydration of vacuum freeze-dried Asparagus (*Asparagus officinalis* L.) with a hydrophilic substance

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Citation

Fahim Ullah. Experimental studies on re-hydration of vacuum freeze-dried Asparagus (*Asparagus officinalis* L.) with a hydrophilic substance. Pure and Applied Biology. Vol. 10, Issue 2, pp445-457.

<http://dx.doi.org/10.19045/bspab.2021.100048>

Received: 20/07/2020

Revised: 26/09/2020

Accepted: 11/10/2020

Online First: 24/10/2020

Abstract

Vacuum freeze-drying is one of the best water removal methods, with final products of the highest quality. The solid-state of water during freeze-drying protects the primary structure and the product's shape with minimal volume reduction. As the leading quality problem of dehydrated green Asparagus, this experiment was to study the technique of improving the rehydration of dehydrated green Asparagus by adding a hydrophilic substance (Maltodextrin, sucrose, salt) and controlling two ways in the process of vacuum freeze-drying. The mixed solution was soaked at the rate of three different concentration ratios, i.e., 1 (10%), 2 (15%), and 3 (20%) for maltodextrin, sucrose, and salts, respectively, using the L9 orthogonal and two-factor comparison experiment. It was concluded that increasing the mass of the Asparagus samples decreased the convective heat transfer coefficient. The evolution of drying months in the range of 1.78 - 4.74 W/m²°C was recorded for the mass of Asparagus samples. The results noted that to dry the Asparagus by vacuum freeze-dryer from 09:00 to 18:00 hour decreases the product's drying rate up to 0.011 g.(H₂O).g⁻¹(d. m).cm⁻².hr⁻¹ and moisture level up to 8%. The study results noted that the pre-freezing condition was 23°C with the frozen time of 4 hours, which could remarkably improve the vacuum freeze-dried green asparagus rehydration. Finally, from the results, it was recommended that, from the actual production, to save energy, reduce costs; 23°C was better for the precooling temperature with the pre-freezing time was 4 hours for drying green Asparagus.

Keywords: Green Asparagus; Hydrophilic Substance; Rehydration; Vacuum Freeze-Drying

Introduction

Green Asparagus is also an extremely perishable vegetable. Freshly harvested Asparagus deteriorates quickly, which results in a short shelf life under normal postharvest handling at room temperature. Drying is one of the most methods used for preservation.

The drying of agricultural products has always been of great importance for preserving food by human beings. It is a primary preservation method and applies to a wide range of industrial and agricultural products. Adedeji et al. [1] reported that Asparagus (*Asparagus officinalis* L.) is

commonly grown in temperate climates worldwide perennial plant with 100–150 cm tall, stout stems and soft vegetation. Asparagus's essential ingredients are energy, proteins, vitamins, fats, carbohydrates, etc. necessary in food with high nutritional value in the kitchen [2]. It is not only used to add food palatability, but it is also widely used in medicines, bakery products, wine and meat products, a soap product, etc. [3].

Asparagus is the most important cash crop globally, cultivated in China, Pakistan, Indian, Afghanistan, Uzbekistan, Japan, and Indonesia [4, 5]. An *et al.* [6] stated that the People Republic of China producer 17 million tons a year of Asparagus and 45% of the total world's Asparagus contributing. Nearly half of the total production of Asparagus consumed as white and red Asparagus. In contrast, the remaining 30% converted into dry Asparagus for medicinal purposes, and 20% used as seed material [7]. Agricultural product drying has a vital role in preserving and shelf-life improvement after harvesting [8]. In developing countries, sun-drying is a popular, effective, and economical method for drying food and herbal products. Sun-drying is a common food preservation technique used to control agricultural products' moisture content [9]. Traditionally, herbs, like Asparagus dried in the open sun, depend on sunshine availability and require ample drying space and long drying time [10].

Green Asparagus is very resistant to the storage; after harvesting of 1-2 days, it will lose water, rot, and lose nutritional values [11]. The traditional processing method is to process green Asparagus into canned or frozen products. The research on the drying of green Asparagus is less; the main reason is that the drying of green Asparagus is reduced, which is also the key to dehydrated green quality asparagus [12]. The moisture content of the solar-dried unpeeled Asparagus found to be 7.0 %, unlike that of

sun-drying, which could attain only 17.0 % moisture content [13]. Other researchers [14, 15] have reported the drying behavior of Asparagus at four different drying air temperatures, *i.e.*, 25°C, 35°C, and 45°C, with the fixed air velocity of 1.3 m/s. The study results concluded that moisture content reduced from 87% to 6%, with a temperature of 45°C on a wet basis.

Blanching is the pre-treatment method used to arrest a few physiological processes. It helps in the inactivation of the enzymes, acceleration of drying rate, and reduced quality loss. It expels intercellular air from the tissues and softens it (16). Generally, the blanching of fruits and vegetables is done by heating in steam or hot water. Drying, a routine food preservation technique, is a crucial aspect of food processing [16, 17]. The dried product's shelf life has been demonstrated to extend by reducing the water concentration at which microbiological and physicochemical deterioration is limited [18]. The drying method and processing conditions significantly affect the color, texture, density, porosity, and sorption characteristics of plant materials [19]. Therefore, the same plant raw material may yield a completely different product, depending on the type of drying and extraction methods employed [20].

In the past, it was mainly through controlling the soaking temperature, soaking time, and water consumption to improve the rehydration of dehydrated vegetables. In recent years, researchers have started to develop the ratio of rehydration in the view of pre-treatment. The pore of dehydrated vegetable infiltrated into maltodextrin, sucrose, and salt molecule, improving the rehydration ratio of dehydrated through the immersion of hydrophilic material green asparagus, which was much better than using the physical method alone.

Material and Methods

Description of the experimental procedure

We took fresh green asparagus samples from the local market accessible in Nanjing, China, and washed them with distilled water for experimental work. The samples were cut cylindrical tube with a length of 3.6 mm and a 1.4 mm in diameter and placed on the weighing balance. Ullah *et al.* [21] reported that they are usually tiny and intense, growing 10–20 mm long and 3–7 mm in diameter. Asparagus samples were cut into cylindrical shapes with a length of 4mm, and a diameter of 6mm was also reported [22]. The data was recorded from 9:00 to 18:00 in June, July, and August 2016. The asparagus specimens were put in trays and placed on the digital electronic balance in each drying hour to determine water content discharge. After each hour of drying, the experimental observation data were recorded, as well as the evaporation was scrapped with the attained constant weight of the samples. The literature observed that the Asparagus dried from its average initial moisture content of 89% to the final moisture content of 8% [23].

The data obtained from the measurements of Asparagus weight used for drying kinetics and analysis of Asparagus in terms of moisture removal rate, and the drying was discontinued. The samples' constant weight was achieved. The difference in weight directly gave the quantity of water content evaporated during any time interval. Wet and dried Asparagus samples are shown in (Fig. 1). The moisture removal rate was expressed on a dry basis. Equation 1 was used for the determination of the moisture removal rate of the product. The moisture ratio of Asparagus during the drying can be obtained from equation 2. While the dry matter is the dry weight of the Asparagus can be calculated using equation 3, evaluated [24]. For determining the area of fruits, inch tape was used for recording the diameter before and after each hour of drying with the use of

equation 4, reported [25]. Therefore drying rate is the evaporation of water content from the products in unit area unit time. It can be calculated from the dry matter of the product how much moisture was lost during the drying. Equation 5 was used to calculate the product's drying rate each hour studied by [26]. Similarly, the symbols used in the equations, "Dm" is Dry matter (g), "Wt" wet weight (g), " $M_{initial}$ " is Initial moisture removing rate (%), "W_w" is the weight of wet Asparagus (g), "W_d" represents the weight of dry Asparagus (g), "MR" is the moisture ration (%), "Mo" is the initial moisture content (%), "Me" is the equilibrium moisture content (%), "A_p" is the cross-sectional area of the product (cm²), " π " constant term 3.144, "r" radius of the product (cm), "D_r" is the drying rate of the product [(g (H₂O).g⁻¹(d.m).cm⁻².h⁻¹)] and "D_t" denoted the drying time (hr).

$$M_{initial} = \frac{W_w - W_d}{W_d} \times 100 \text{ Eq. (1) [27]}$$

$$MR = \frac{M - M_e}{M_o - M_e} \text{ Eq. (2) [28]}$$

$$D_m = W_t - (W_t \times M_{initial}) \text{ Eq. (3)}$$

$$A_p = \pi r^2 \text{ Eq. (4)}$$

$$D_r = \frac{W_w - W_d}{D_m \times A_p \times D_t} \text{ Eq. (5)}$$

In (Table 1) it shows the moisture removal rate data, indoor and outdoor vacuum freeze-dryer temperature, product temperature, the surrounding temperature of the product, and ambient temperature during the experiment.

Experimental methods

The mixed solution was soaked at the rate of three different concentration ratios, i.e., 1 (10%), 2 (15%), and 3 (20%) for maltodextrin, sucrose, and salts, respectively, using the L9 orthogonal and two-factor comparison experiment. Determination of re-hydration of green Asparagus with vacuum freeze-drying process, the fresh green Asparagus was selected for blanching treatment with maltodextrin's robust solution; sucrose, and salt concentrations (sodium Chloride, NaCl) (29) and soaked for

30min. In this experimental work, we used the treatment solution separately for determining the rehydration ratio. Kingsly et al., [29] studied the rapid HPLC method for the separation of isomaltulose (also known as Palatinose) from other common edible carbohydrates such as sucrose, glucose, and maltodextrins, commonly present in food and dietary supplements. After the treatment of blanching, we infiltrate the maltodextrin, sucrose, and salt molecules with the help of the osmotic process to improve the drying of green asparagus water are the best and suitable methods to increase the shelf life of products [30]. In this experiment, the concentration of maltodextrin, the sucrose level, and salt's strength was to select orthogonal analysis quality. Determination of water ratio in drying Asparagus repeated the quality times, using the SAS software reported by Vesali *et al.* [31] the variance of quality "L9" orthogonal experiment and "LSD," according to the results of multiple comparisons [32].

The experiment chooses the pre-freezing temperature and the precooling time as a factor. The drying ratio product to the measuring index influences its state of dehydrated products and then influences its rehydration factors. Lin & Brewer [33] According to the resistance method, the temperature of the eutectic point of green

Asparagus was measured. The temperature of the 5-10°C was lower than that of the eutectic point, so the highest temperature of green Asparagus was determined to be 23°C. The pre-freezing time's relevant research data is less, and it needs to choose the wide horizontal range, and according to the result of the preliminary experiment. They used SAS software to analyze the variance of the experimental results and 1/2 multiple comparisons, a better pre-freezing process parameter chosen according to various comparisons.

The rehydration capacity was used as a quality characteristic of the dried product [34] expressed in the rehydration rate – RR. Approximately 2g (± 0.01 g) of the dried sample was placed in a 250ml laboratory glass (two analyses for each sample), 150ml distilled water was added, and the glass was covered and heated to boil within 3 minutes. The laboratory glass content was then gently boiled for ten (10) min more and then cooled. The cooled content was filtered for 5min under vacuum and weighed. The drying ratio was calculated from equation 6. At the same time, " W_r " is the drained weight (g) of the rehydrated sample, and " W_d " represents the weight of the dry sample used for rehydration [35].

$$RR = \frac{W_r}{W_d} \text{ Eq. (6)}$$

Figure 1. Show asparagus samples before drying (A) and after drying (B)

Table 1. Shows the experimental data during re-hydration of vacuum freeze-dried asparagus samples

Time (hr)	$T_{i,v}$ ($^{\circ}\text{C}$)	$T_{o,v}$ ($^{\circ}\text{C}$)	T_c ($^{\circ}\text{C}$)	T_e ($^{\circ}\text{C}$)	M_{evp} (g)	$M_{removing\ rat}$ (%db)
9.00	25.8	43.7	26.5	26.5	-	-
10.00	31.2	57.4	35	34.3	8.6	1.6
11.00	32.8	64.3	38.5	38	17	3.4
12.00	34	68.8	40.9	40.4	26.1	5.7
1.00	36	69.8	42.3	41.8	27.4	6.4
14.00	36.1	68.2	42	41.9	25	6.2
15.00	35.6	62.7	41	40.8	23	6.0
16.00	33.2	54.6	38.3	38.1	22.2	6.3
17.00	32.4	43.3	33.8	33.4	16	4.5
18.00	30.7	41.6	31.9	32.2	14.7	4.2

Note: $T_{(i,v)}$ is the temperature at vacuum freeze-dryer inlet ($^{\circ}\text{C}$), $T_{(o,v)}$ is the temperature at vacuum freeze-dryer ($^{\circ}\text{C}$), T_c is the product temperature ($^{\circ}\text{C}$), T_e is the product surrounding temperature ($^{\circ}\text{C}$), M_{evp} is the moisture evaporation (g), and $M_{removing\ rat}$ is the moisture removing rat in the products with the unit of (%db).

Results and Discussion

Under natural convection mode, the hand-peeled cylindrical shaped (diameter 1.4 mm, length 3.6 mm) mass of Asparagus samples is dry. Rect angular trays were used to conduct drying assessments of Asparagus specimens. (Fig. 2) represents the comparison

between the means of solar radiation (MSR) and the mass of the products of asparagus samples for the three months. Jamil et al. [36] studied bean moisture diffusivity and drying kinetics. They reported that the conditions of pre-freezing temperature and time would affect the size and quantity of products.

Figure 2. Comparison between the MSR and mass of the products of asparagus samples for the three months

Solar irradiation and product mass data collected for June, July, and August 2016 at a drying time of 60-minute duration under natural heat transfer solar energy drying, as shown in (Fig. 2). It has been observed that green asparagus re-hydration increases from morning to noon and decreases from noon to evening due to swelling and diminishing trend of solar irradiation in one day. The present results are in substantial agreement with the study's previous results reported by Deshmukh et al. [37]. They said that different products' rehydration process, *i.e.*, apples, banana, green chili, red chili, green Asparagus, etc., started increasing from morning to noon. The study results agreed with Ismail [38]. They studied that the rehydration process increased with increasing solar irradiance.

The data given in (Table 2) show the moisture removing rate, indoor and outdoor collector temperature, product and product surrounding temperature, and ambient temperature during the experiment. Table 2 shows the moisture removal rate is dependent on the total moisture present in the product mass. Hence, it has been observed that the moisture removal rate increases with an increase in green Asparagus samples mass and decreases significantly with the progression of drying days [39]. However, the moisture removal rate is also dependent

on the ease of heat transfer [40]. (Fig. 3) shows the moisture lost and drying rate in Asparagus during dry. The products (Green Asparagus) were dried in the vacuum freeze-dryer with the process of rehydration, moisture loss, and drying rate was determined. Moisture lost in each hour of drying by a vacuum freeze-dryer is correlated with drying time. The drying rate is correlated with the change in percent moisture content to find the vacuum freeze dryer's promising performance as a drier for Asparagus's rehydration. The results show that moisture was lost with the higher temperature of the dryer. Before drying, 89% moisture was noted, and dried the product up to 8% moisture level with a dryer. Ullah and Kang [24] reported that the moisture content of the product was decreased with the highest temperature of the dryer.

Similarly, the drying rate of the apples was starting to decrease from $0.032 \text{ g(H}_2\text{O).g}^{-1}(\text{d.m}).\text{cm}^{-2}.\text{h}^{-1}$ to $0.011 \text{ g(H}_2\text{O).g}^{-1}(\text{d.m}).\text{cm}^{-2}.\text{h}^{-1}$ with the increasing temperature of the dryer after 10hr of the drying process. Kohli et al., [15] stated that the drying rate of the product was reduced with the highest temperature of the dryer. The results are similar to [41], who found that the drying is directly related to the product's moisture content.

Figure 3. Shows the moisture lost and drying rate in each hour of vacuum freeze-dryer by Asparagus samples

Table 2. Multiple comparisons of maltodextrin, sucrose, and salt concentration

Maltodextrin concentration			
A factors	A1	A2	A3
$\bar{x}_i$	6.052	6.672	7.041
Significant (5%)	b	ab	a
Sucrose concentration			
B factors	B1	B2	B3
$\bar{x}_i$	6.627	6.111	7.026
Significant (5%)	ab	b	a
Salt concentration			
C factors	C1	C2	C3
$\bar{x}_i$	6.656	7.138	5.970
Significant (5%)	ab	a	b

Determination of hydrophilic matter concentration

Variance analyses of orthogonal experiment results are shown in (Table 3). The multiple maltodextrin concentration comparisons

from (Table 2) show that maltodextrin's concentration was 20% (3). The ratio of water in green Asparagus is more significant at this time; removing Asparagus has better rehydration.

Table 3. L9 Orthogonal experimental results

S. No	(A) Maltodextrin concentration (%)	(B) Sucrose concentration (%)	(C) Salt concentration (%)	Water recovery ratio %		
1	1	1	1	5.88		
2	1	2	2	6.21		
3	1	3	3	6.07		
4	2	1	2	7.46		
5	2	2	3	5.29		
6	2	3	1	7.26		
7	3	1	3	6.55		
8	3	2	1	6.83		
9	3	3	2	7.75		
ANOVA table variance analysis						
Sources of Variation		Sum of squared	DOF	Mean square	F Test	Pr>F
A		4.49514	2	2.24757	4.18	0.0304
B		3.79289	2	1.89644	3.53	0.0487
C		6.21105	2	3.10554	5.78	0.0105
Error		10.75345	20			
Total of Variance		25.25254	26			

From the table results, it concluded that 20% is the preferred concentration of maltodextrin. The results reported in the

literature reported by Resende et al., [42] nearly matched with the present study results. Similarly, when the 15% (2) concentration of

maltodextrin was applied, the water recovery was not significant. The second level of concentration of 15% (2) could be used as a balanced choice for other factors. The results agree with the findings [43]. They reported that decreasing the maltodextrin's concentration ratio in the products' rehydration process, the effect on the water recovery rate was not significant. The results showed that the difference between the first 10% (1) and the third 20% (3) levels of concentration is substantial, and the effect on the rehydration is not apparent.

Table 2 shows the multiple comparisons of maltodextrin, sucrose, and salt concentration. When the sucrose concentration was at 20% (3), which improved the asparagus' rehydration, so optimum absorption of sucrose was 20%. The results are similar to the results [44]. The static results show in (Table 3) that when the sucrose concentration is the 10% (1) level, the difference between the water and the 10% (1) level is not significant, theoretically chosen as the object. Still, the influence of the other two factors should be considered. Serratos et al., [45] conducted experimental results that are nearly matched with the present study results. At the 20% (3) level, the ratio of rehydration was significantly different, and the effect on the water recovery was not noticeable. The multiple salt concentration comparisons from (Table 2) show that salt's frequency is 15% (2). The ratio of green Asparagus is higher than the average value, so, to improve the rehydration of dehydrated products, a better salt concentration should be selected as 15%. These results are in agreement with the findings [46]. They reported that the concentration ratio of salt for the rehydration process of different products was 17%. Therefore, when the salt concentration was 10% (1) level, the proportion of water to the (2) level was not significant and could be used in balance with the other two factors. Singh et al., [47] reported that study results

contradict the present study results. When the salt concentration was at the (3) level 20%, the rehydration effect was not significant, as shown in (Table 3).

Determination of the concentration of hydrophilic substances found in preliminary experiments, when the frequency of maltodextrin was low, mostly under 10% concentration, there was little effect on the drying green Asparagus [48]. The main reason was that the low concentration maltodextrin's osmotic pressure was not enough to spread the maltodextrin to the inside of the material, only on the paste's surface. As a result, when the green Asparagus is dried and reused, the dextrin's surface first absorbs water to expand, instead of preventing it from spreading to the inside [49]. When the concentration of maltodextrin is more significant, especially when it is greater than 45%, the material is easily absorbed and melted during the dry process, resulting in shrinkage and deformation. Also, the dry products in the maltodextrin are very easy to moisture absorption, so that the storage becomes difficult, and there is too sticky feeling [50]. So in the appropriate concentration range, you can choose a higher concentration of maltodextrin, according to the results of multiple comparisons, the final determination of maltodextrin concentration of 20% [51]. Sucrose and salt are added to the maltodextrin to increase the solution's osmotic pressure [17]. However, the addition of sucrose and salt will affect the taste of dehydrated green Asparagus, after the experiment found that the sweet and salty ratio of 4:3 is more appropriate, so sucrose concentration of 20%, the salt concentration of 15% [52]. It is more suitable to be considered the final process parameter, whether from improving the rehydration or from a sweet-salty angle.

Determination of pre-freezing process conditions

The independence of the Eutectic Point of the pre-freezing cooling curve of green Asparagus is shown in (Fig. 4). As the temperature drops, the figure shows that the resistance changes very little; when the temperature drops to -11°C to -13°C, the resistance value suddenly increased. Due to the early freeze, green Asparagus inside there is a lot of water present, more charged ions can be moved freely, and with the temperature [53]. Most of the green asparagus water is converted to ice crystals, and when the temperature drops to -11°C to -13°C, the green Asparagus is frozen, and the resistance value suddenly increases [54]. Therefore, from the experimental result, the eutectic point temperature range for the green Asparagus is noted up to -11°C to -13°C.

The results and analysis of the two factors of the water recovery ratio shown in (Table 4). They are using SAS software to analyze the variance of water recovery effects, shown in (Table 4). From the analysis of variance results in (Table 4), it can be seen that the P-value of the precooling temperature is less than 0.05, the P-value of the pre-freezing time is less than 0.01, and these two factors have a significant or significant effect on the

rehydration ratio of the dehydrated green Asparagus [23]. Among them, pre-time is an essential factor, and the precooling temperature is the secondary factor. They are using the method of LSD to compare the pre-freezing temperature and the pre-freezing time, taking the rehydration ratio of the dehydrated green Asparagus as the object of study, the proper conditions of precooling determined according to the results [14].

The multiple comparisons of the pre-freezing temperature (Table 5) show that when the pre-freezing temperature -20 (°C) and -30 (°C), the green asparagus ratio is higher than the average is no significant difference between the two. So the precooling temperature is 23°C and -30°C, which is beneficial to improving the drying ratio of the green Asparagus [44]. When the pre-freezing temperature is the second level, the water recovery ratio's mean value is lower. There is a significant difference with the other two levels, which has no significant effect on improving the rehydration of the dehydrated green Asparagus.

The multiple comparisons of pre-freezing time are shown in (Table 5). When the pre-freezing time is 6 hours and 4 hours, the green asparagus ratio is higher, and the difference between them is not significant.

Figure 4. Eutectic point of the pre-freezing cooling curve of green Asparagus

Table 4. Experimental comparison results of two factors of water recovery ratio

Pre-freezing time (hr)	Pre-freezing temperature (°C)					
	-20 (°C)	-25 (°C)	-30 (°C)			
4	9.78	9.34	8.78			
6	9.39	9.97	9.25			
8	8.26	8.34	7.99			
10	8.60	4.10	9.51			
12	8.82	7.68	8.54			
ANOVA variance analysis						
Sources of Variation		Sum of squared	DOF	Mean square	F Test	Pr>F
A Pre-freezing temperature (°C)		10.28023	2	5.14011	3.40	0.0438
B Pre-freezing time (h)		27.09503	4	6.77375	4.48	0.0046
Error		57.44839	38			
Total error		94.82365	44			

Table 5. Multi-comparison of pre-freezing temperature and pre-freezing time

Pre-freezing temperature					
A factors	A1		A2		A3
$\bar{x}_i$	8.967		7.886		8.815
Significant (5%)	a		b		a
Pre-freezing time					
B factors	B1	B2	B3	B4	B5
$\bar{x}_i$	9.301	9.531	8.197	7.401	8.350
Significant (5%)	ab	a	bc	c	bc

So the pre-freezing treatment of 6 hours and 4 hours can improve the dehydrated Asparagus [36]. 6 hour is the first choice of parameters, the remaining three levels and above two levels of water ratio difference is significant, to improve the drying of green Asparagus. For analyzing the above factors, 6 hours and 4 hours is the pre-freeze time [20].

Conclusion

The research reported in this paper includes the evaluation of re-hydration of vacuum freeze-dried Asparagus (*Asparagus officinalis* L) with hydrophilic substance (Maltodextrin, sucrose, salt) and moisture removing rate for the mass of asparagus samples. The experiment finally determined that, in the pre-treatment process, the green Asparagus soaked with 20% maltodextrin,

20% sucrose, and 15% salts in a mixed solution with the Pre-freezing temperature of 23°C and 4 hours was the pre-freezing time can improve the absorption of dehydrated green Asparagus. The following observations and conclusions noted from the results:

From the experiment results, the parameters of the pre-freezing process improving the ratio of water recovery.

The experimental results noted that the convective heat transfer coefficient varies from 1.78 to 4.74 W/m²°C for green asparagus samples.

The precondition of selecting the pre-freezing process of precooling temperature was noted 23°C and -30°C with the pre-freezing time 6 hours and 4 hours.

The experiment results recommended that, from the actual production, to save energy,

reduce costs; 23°C was better for the precooling temperature. The pre-freezing time was 4 hours for the drying of green Asparagus.

Authors' contributions

Conceived and designed the experiments: F Ullah, Performed the experiments: F Ullah, Analyzed the data: F Ullah, Contributed materials/ analysis/ tools: F Ullah, Wrote the paper: F Ullah.

Acknowledgments

We extend our thanks to all the research contributors to support and provide research facilities for this study.

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