IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 16, Issue 2 Ser. I (February 2022), PP 47-55
www.iosrjournals.org

Physicochemical Properties and Shelf Life of Osmotically Dehydrated Jackfruit Slices

Md. Golam Ferdous Chowdhury*, Md. Hafizul Haque Khan, Md. Mainuddin Molla, Ahfak Ahmed Sabuz, Md. Miaruddin, Md. Shahjahan[1], Shahnaj Pervin, Mojibar Rahman, Md. Habibur Rahman[2]

Postharvest Technology Division, Bangladesh Agricultural Research Institute, Gazipur 1701, Bangladesh
[1]Professor, German University Bangladesh, Gazipur-1701
[2]Senior Instructor, Department of Youth Development, Govt. of Bangladesh
**Corresponding Author: Email: ferdous613@gmail.com*

Abstract: *The present study was carried out to preserve the jackfruit slices through osmotic dehydration techniques. Fully ripe jackfruit of Khaja cultivar was collected from the farmer's orchard of Gazipur and then peeled and cut longitudinally to separate the bulb. For this study five different concentration of sugar solution (30, 40, 50, 60 and 70^{o}Brix) were used to squeeze out water from the jackfruit slices followed by drying in mechanical dryer. Results revealed that moisture content of osmotically dehydrated jackfruit slices increased slightly from the initial 5.87-7.42% to final 8.06-9.44% after 6th month of storage. The ash content was recorded by dehydrated jackfruit slices prepared using 30^{o}Brix (1.28%) sugar solution. Results also showed that the acidity was increased throughout the storage period in all samples. The total sugar content was decreased throughout the storage period while reducing sugar was increased in all the samples. All the dehydrated jackfruit slices contained significant amount of energy value (450.98 to 538.10 KCal/100g) after 6th month of storage; however, jackfruit slices prepared using 70^{o}Brix sugar showed the maximum calorific value. All the samples retained considerable amounts of different bioactive compounds such as ascorbic acid, total carotenoids, total phenols and showed significant antioxidant properties after 6th month of storage. The sensory evaluation revealed acceptable overall sensory qualities of dehydrated jackfruit, however, 60^{o}Brix sugar concentration showed higher acceptability than the other samples. Conclusively, the dehydrated jackfruit slice can be prepared commercially and preserved more than 6th month in high density polypropylene (HDPE packet) at ambient condition (26±2^{o}C, 75±5%RH) without appreciable nutrient loss.*

Keywords: *Jackfruit, Osmotic dehydration, Bioactive compounds, Shelf life, Storage.*

Date of Submission: 10-02-2022 Date of Acceptance: 25-02-2022

I. Introduction

Among the tropical fruits, jackfruit is an important underutilized fruit and often called the poor man's fruit because of its affordability and availability in large quantities during the harvesting season. Jackfruit trees are mostly gown in the homestead garden without any management practices. It is the national fruit of Bangladesh which is grown almost in all districts. The annual production of jackfruit is about 10.02 lakh metric ton covering an area of 40.90 thousand acres during 2019-2020 (BBS, 2020). Jackfruit is nutritionally very rich and contains high amount of vitamins and minerals. The fruit is rich in carotene and carbohydrates and moderately rich in ascorbic acid. It also contains some minerals like calcium and potassium and vitamin B like thiamin, riboflavin, and niacin (Saxena *et al.,* 2009 and Swami *et al.,* 2012). Thus, jackfruit provides huge opportunity for livelihood as well as nutritional and food security of the rural communities of Bangladesh. Jackfruits can be processed into a variety of products such as canned fruit, dried fruit and pulp, jackfruit jam, dehydrated jackfruit, chips etc. (Swami *et al.* 2012; Swami and Kalse, 2019) Therefore, jackfruit has great potential for value addition for minimizing postharvest loses and enhancing the non-seasonal availability. Dehydration is one of the ancient methods of food preservation used in agro-processing industry (Kamal *et al.,* 2019). It is the method of protecting food from deterioration by reducing the moisture to a safe level that is unavailable to the microorganism for their growth and metabolism (Kamal *et al.,* 2020). The shelf life of dehydrated products is almost unlimited and the cost of transportation, handling and storage are considerably lower than that of other methods of preservation (Shishir *et al.,* 2019). In the recent year, several dehydration techniques such as mechanical drying and use of osmotic agents are frequently applied to foodstuffs. Among the various techniques, osmotic dehydration is one of the low cost and sustainable methods of food preservation used in the food industry. In this process, different osmotic agents, e.g. salt and sugar are used to squeeze out the moisture from foodstuffs (Bakhara *et al.*, 2018). Osmotic dehydration is the phenomenon of removal of water from lower concentration of solute to higher concentration through semi permeable membrane results in the equilibrium condition in both sides of membrane (Tiwari 2005). Osmotic dehydration found wide application in the preservation of food-materials since it lowers the water activity of fruits and vegetables. This method is preferred over other methods due to their color, aroma, nutritional constituents and flavor compound retention value (Yadav and Singh, 2014). Application of osmotic treatment has been suggested for partial dehydration of foods usually as an upstream processing step prior to drying or freezing to reduce product water load with simultaneous improvement in final product quality of less heat damage, good blanching effect, less enzymatic browning, better retention of flavor (Yadav and Singh, 2014; Kaushal and Sharma, 2016 and Bakhara *et al.*, 2018). Though osmotic dehydration followed by convective drying is a well-advanced progressive technology, however, osmotically dehydrated jackfruit is scanty in the country. Therefore, the present work has been undertaken to investigate the osmo-dehydration of jackfruit slices followed by hot air convective drying to obtain better quality dehydrated product which can be available throughout the year.

II. Materials And Methods

2.1 Collection and preparation of raw materials

Fresh and fully ripe jackfruit of Khaja cultivar was collected from the farmer's orchard of Gazipur, Bangladesh. Jackfruit was washed with running tap water and then cut longitudinally to separate the bulb. The bulbs were slices (approximately 2 cm × 2 cm) by cutting into halves and were dipped into 0.6% potassium metabisulphite (KMS) solution for 10 minutes and then dipped into 0.5% potassium sorbate solutions for 10 minutes to avoid excessive browning and fungal contamination. Analytical grade chemicals (Merck, Germany) and reagents were purchased from the local traders.

2.2 Preparation of osmotically dehydrated jackfruit slices

The jackfruit slices were first blanched in boiling water for 5 minutes and cooled immediately in ice water. The blanched slices were dipped into different osmotic solutions (30, 40, 50, 60 and 70^{o}Brix) and keep in rest overnight. On the following day, the slices in solution were heated for 20 minutes and the solution was removed from the slice. Then, the slices were dried at 60^{o}C until the moisture content reached to <12% (wet basis). After drying, the jackfruit slices were packed in HDPE (60 micron) packet and stored at room temperature (26±2^{o}C, 75±5%RH). The shelf life of osmotically dehydrated jackfruit slices was evaluated over six (6) month at 45 days' interval. The developed processing protocols are as follows (Figure 1):

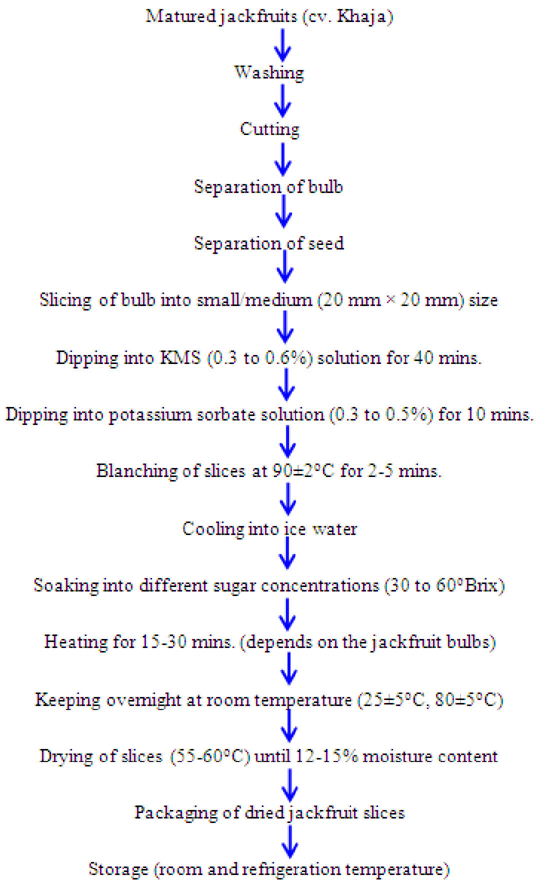

Figure 1. Process Flow Diagram for Osmotically Dehydrated Jackfruit Slices

2.3 Determination of physicochemical properties

The moisture and ash content was determined based on the AOAC official methods (AOAC, 2005). The total acidity was determined following the methods of Ranganna (2007). Firmness was measured using the texture analyzer (TX. PLUS, Stable Microsystem, Germany) and expressed as the newton (N). Total sugar content was determined following the procedure of Ranganna (2007). The calorific value was determined using the bomb calorimetric method. Color attributes were measured based on the CIELa*b* color coordinates using a Chroma meter (CR-104, Konica Minolta, Japan), where L denotes the lightness, a* represents green/red, and b* implies blue/yellow.

2.4 Determination of bioactive compounds and antioxidant activity of dehydrated jackfruit slices

Ascorbic acid content was determined by 2, 6-dichlorophenolindophenol titrating methods following the description of Kamal *et al.* (2019a) and the result was expressed as mg/100g. Total carotenoids were determined by the methods of Baria *et al.* (2019) with some modification. Total phenolic content was determined by spectrophotometer using Folin-Ciocalteu method following the procedure of Kamal *et al.* (2020) with slight modification using Gallic acid as the standard, and the result was expressed as mg GAE/100g of sample. The antioxidant activity was evaluated in terms of DPPH free radical scavenging activity, which was expressed as percent inhibition (Kamal *et al.*, 2019b).

2.5 Sensory evaluation

The sensory properties such as, color, taste, flavor, texture, and overall acceptability of osmotically dehydrated jackfruit were evaluated twice over the storage period (initial and final storage day) by 10-expert panelists using 9-point hedonic scale.

2.6 Statistical analysis

Statistical analysis was carried out using the software package SPSS (version 22.0, SPSS Inc., Chicago, IL) by using one-way analysis of variance (ANOVA). Duncan Multiple Range Test (DMRT) at the significance level 5% ($P<0.05$) was used to determine significant differences among the samples and storage periods.

III. Results And Discussion

3.1 Physicochemical properties of dehydrated jackfruit slice

The moisture content of dehydrated jackfruit is presented in **Table 1**. It was found that moisture content ranged from 5.87 to 7.42% on the initial processing day while it was fluctuated between 8.06 to 9.44 % on the final storage periods (180 days). **Table 1** also showed that the values for moisture content significantly differed among the samples and increased with the storage periods. The maximum and minimum moisture was found in sample T_2 (40^{o}B) and T_4 (60^{o}B) at the beginning and it was the highest in T_1 (30^{o}B) and the lowest in T_5 (70^{o}B) at the end of storage period. The variation in moisture content of dehydrated jackfruit slices depends on the extend of drying period and the perforation of packages along with the storage environment. Ash content represent the total content of different mineral substances. The values for ash content of osmotically dehydrated jackfruit slices were showed in **Table 1**. It can be seen that ash content was significantly differed among the samples. Its content was ranged from 0.52 to 0.64% and 0.74 to 1.28 % on the beginning and end of the storage period, respectively. The maximum and minimum ash was found in sample T_1 (30^{o}B) and T_3 (50^{o}B) at the beginning and it was the highest in T_1 (30^{o}B) and the lowest in T_5 (70^{o}B) at the end of storage period. The total acidity of the dehydrated jackfruit slices was summarized in **Table 1** which showed that the prepared samples were very low in acid content and ranged between 0.10 to 0.15% on the processing day and 0.40 to 0.51% after final storage period. It was found that the values of total acidity significantly differed among the sample irrespective of storage periods (**Table 1**). The maximum and minimum acidity was found in sample T_1 (30^{o}B) and T_2 (40^{o}B), T_4 (60^{o}B) and T_5(70^{o}B) at the beginning and it was the highest in T_1 (30^{o}B) and the lowest in T_3 (50^{o}B) at the end of storage period. It was found that the acidity of the prepared sample was increased in all samples with the storage period. The calorific value (energy content) of the dehydrated jackfruit slices was presented in Table 1. It is seen that all sample showed an excellent source of energy, which ranged from 395-425 KCal/100g at the beginning and 457 to 538 KCal/100g at the end of storage period (**Table 1**). These values were found to differ significantly among the dehydrated jackfruit slices prepared using different sugar concentration and were increased slightly with the extension of storage period. The sugar content in dehydrated jackfruit slice obtained in this study is shown in **Table 1**. It is observed from Table 1 that the reducing sugar content was ranged between 7.70 to 8.16% on the processing day while it was recorded in the range of 8.96 to 13.17% after 180 days of storage. It is clearly demonstrated in **Table 1** that the reducing sugar showed a slightly increasing trend throughout the storage period and varied significantly among the samples (**Table 1**). On the other hand, the total sugar content followed decreasing trends during the storage period. It observed from **Table 1** that the total sugar content of dehydrated jackfruit slice varied between 30.59-31.17% and 17.14-19.78% after 0 day and 180 days of storage, respectively. Since the contained sugars in jackfruit mostly are starch, it might be the degradation of starch and carbohydrate in to different molecules due to the action of heat and reactions with other component present in the sample (Rahman *et al.*, 2012).

Table 1. Changes in physicochemical properties of osmotically dehydrated jackfruit slices during 180 days of storage

Sample (^{o}Brix)	Moisture (%)				
	0 Day	45 Days	90 Days	135 Days	180 Day
T_1	7.13±0.01b	8.16±0.35a	8.53±0.32ab	9.15±0.02a	9.44±0.02a
T_2	7.42±0.03a	7.35±0.16b	9.13±0.30a	8.85±0.04a	9.21±0.08b
T_3	7.38±0.03a	7.25±0.11b	7.63±0.26bc	8.03±0.04bc	9.17±0.06b
T_4	5.87±0.13c	7.73±0.24ab	6.81±0.62c	8.13±0.03b	8.61±0.07c
T_5	7.36±0.02a	7.49±0.22ab	7.60±0.31bc	7.63±0.29c	8.06±0.02d
Sample (^{o}Brix)	**Ash (%)**				
	0 Day	45 Days	90 Days	135 Days	180 Day
T_1	0.64±0.01a	0.61±0.01a	0.66±0.02a	0.66±0.02b	1.28±0.03a
T_2	0.56±0.03b	0.55±0.03ab	0.57±0.01b	0.64±0.01b	0.93±0.11b
T_3	0.52±0.02b	0.50±0.02b	0.59±0.01ab	0.74±0.01a	0.99±0.02b
T_4	0.56±0.01b	0.55±0.01ab	0.54±0.02b	0.72±0.01a	0.94±0.03b
T_5	0.59±0.01ab	0.57±0.01ab	0.56±0.03b	0.52±0.01c	0.74±0.01c
Sample (^{o}Brix)	**Acidity (%)**				
	0 Day	45 Days	90 Days	135 Days	180 Day
T_1	0.15±0.02a	0.24±0.01ab	0.31±0.01b	0.37±0.01a	0.51±0.02a
T_2	0.10±0.01b	0.27±0.01a	0.31±0.01b	0.37±0.01a	0.45±0.03ab
T_3	0.11±0.01ab	0.24±0.01ab	0.33±0.01ab	0.36±0.01bc	0.40±0.02b
T_4	0.10±0.01b	0.24±0.01ab	0.34±0.01a	0.33±0.01d	0.45±0.01ab
T_5	0.10±0.01b	0.23±0.01b	0.32±0.01ab	0.35±0.01c	0.47±0.01ab

Sample (°Brix)	Energy (KCal/100g)				
	0 Day	45 Days	90 Days	135 Days	180 Day
T_1	413.65±7.95a	412.147±7.95a	422.27±4.02ab	450.09±2.17b	450.98±5.30c
T_2	395.64±5.70b	394.16±8.70b	407.29±6.12b	475.38±2.55a	481.67±1.70b
T_3	425.44±7.22a	424.06±5.22a	434.19±9.30a	472.59±5.41a	463.47±9.22c
T_4	424.28±6.53a	422.97±5.54a	433.10±8.02a	464.82±1.49ab	457.66±4.45c
T_5	415.74±6.68a	414.39±6.76a	424.52±7.68a	476.43±9.36a	538.10±2.47a
Sample (°Brix)	**Reducing sugar (%)**				
	0 Day	**45 Days**	**90 Days**	**135 Days**	**180 Day**
T_1	7.70±0.07b	7.94±0.17a	7.86±0.31a	12.20±0.17b	12.12±0.04b
T_2	8.16±0.04a	7.99±0.11a	8.12±0.28a	12.88±0.16a	12.83±0.18a
T_3	7.85±0.03b	8.04±0.05a	8.62±0.27a	9.53±0.05c	13.17±0.19a
T_4	8.16±0.04a	8.12±0.09a	8.39±0.39a	9.35±0.05c	8.96±0.07c
T_5	7.85±0.05b	8.14±0.02a	8.03±0.08a	12.20±0.17b	12.35±0.08b
Sample (°Brix)	**Total sugar (%)**				
	0 Day	**45 Days**	**90 Days**	**135 Days**	**180 Day**
T_1	31.17±0.47a	30.67±0.30a	30.10±0.91a	25.50±0.12b	17.61±0.14c
T_2	30.72±0.28a	30.42±0.42a	28.08±0.71a	26.06±0.14a	19.78±0.06b
T_3	30.90±0.16a	30.34±0.57a	30.14±0.17a	25.13±0.18bc	17.14±0.11c
T_4	31.17±0.28a	30.90±0.35a	29.69±1.02a	24.83±0.11c	17.45±0.22c
T_5	30.59±0.55a	31.53±0.27a	29.03±1.13a	25.35±0.26bc	20.25±0.11a

Note: Values are mean ± standard error of mean (n=3); Means followed by different lowercase letters in each column are significantly different at P<0.05. T_1-30°Brix; T_2-40°Brix; T_3-50°Brix; T_4-60°Brix; T_5-70°Brix.

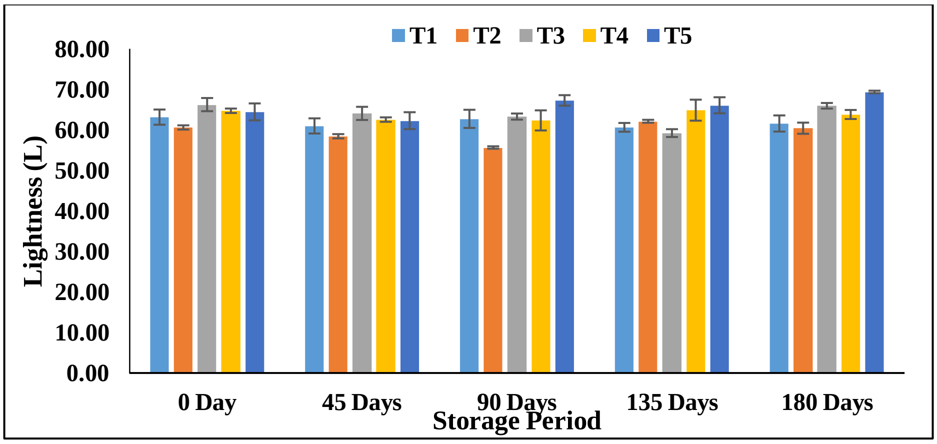

Figure 2. Lightness (L) values of osmotically dehydrated jackfruit slices (T_1-30°Brix; T_2-40°Brix; T_3-50°Brix; T_4-60°Brix; T_5-70°Brix)

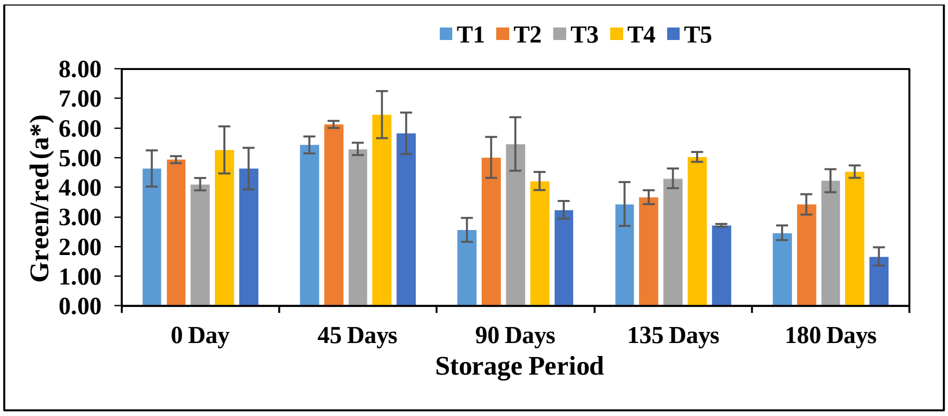

Figure 3. Red/greenness (a*) values of osmotically dehydrated jackfruit slices (T_1-30°Brix; T_2-40°Brix; T_3-50°Brix; T_4-60°Brix; T_5-70°Brix)

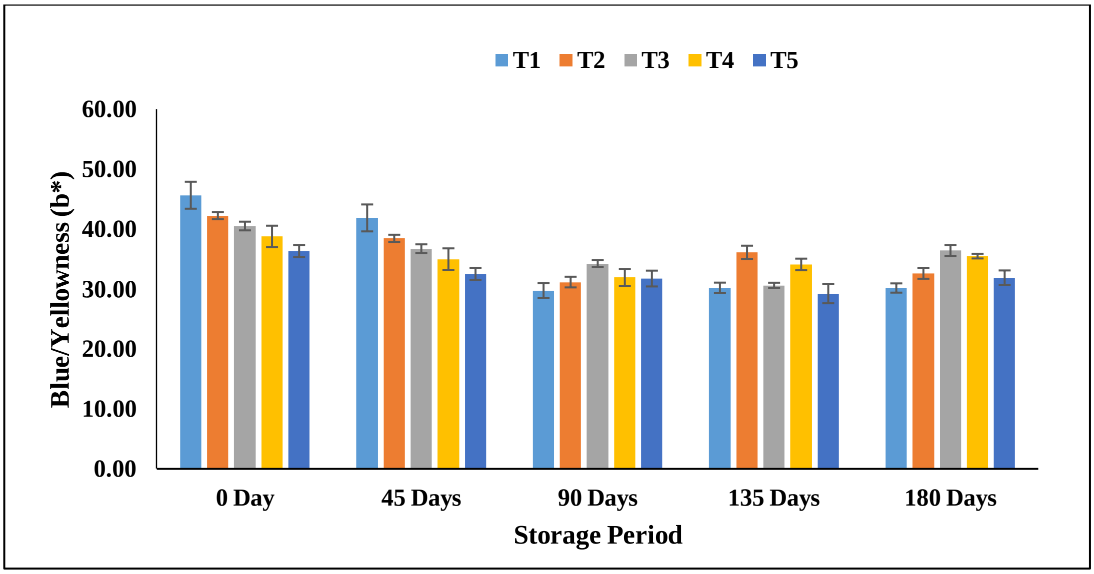

Figure 4. Blue/yellowness (b*) values of osmotically dehydrated jackfruit slices (T_1-30°Brix; T_2-40°Brix; T_3-50°Brix; T_4-60°Brix; T_5-70°Brix)

3.2 Color attributes

Color is an important quality parameter that determined the consumer's preference to a product. The changes in the color properties of dehydrated jackfruit slice in terms of lightness (L), green/redness (a*), and blue/yellowness (b*) are presented in **Figure 2**, **Figure 3** and **Figure 4**, respectively. **Figure 2** revealed that the brightness of studied dehydrated jackfruit slice was ranged from 60.54 to 66.18 on the initial storage day and it was in the range of 60.35 to 69.30 after 180 days of storage. It was found that the L values of dehydrated jackfruit slices were decreased slightly up to 90 days then were increased again still final storage (180 days). It is observed from the Figure 3 that the lightness increased with the increased sugar concentration used for the preparation of the dehydrated jackfruit slices. The lightness of prepared sample was also found to vary significantly among the sample irrespective of storage period. From **Figure 3**, it is observed that the values of a* (green/redness) was decreased among the dehydrated samples prepared using different sugar concentration. It was recorded that the a* values were differed significantly ($p<0.05$) among the samples throughout the storage period and ranged from 4.10 to 5.26 on the processing day while it was found to range from 1.66 to 4.52 after 180 days of storage, which showed slight redness of the prepared samples. On the other hand, the b* (blue/yellowness) values were found to range between 36.30 to 45.63 and 36.39 to 30.14 after 0 day and 180 days of storage (**Figure 4**). These values are indicative of bright yellowness of the osmotically dehydrated jackfruit slices. It is observed from the Figure 5 that the yellowness of the dehydrated sample was reduced with the storage period which might be due to the degradation of pigmented substances due to reaction with sugar molecules and also during the drying process. Furthermore, color changes in dehydrated products also pronounced due to different factors like heat, light, chemical reaction of the constituents and so on (Kamal *et al.*, 2020).

3.3 Bioactive compounds of dehydrated jackfruit slices

3.3.1 Ascorbic acid content

Natural antioxidants are widely reported to restrict oxidation-induced degenerative changes in cell physiology and ageing. Ascorbic acid has an important role as a phytochemical, due to its functionality as an antioxidant. The ascorbic acid content was recorded in **Table 2**. It was found in **Table 2** that the ascorbic acid ranged from 8.26 to 11.79 mg/100g at processing day, which was found to varied significantly among the samples and ranged between 2.17 to 2.78 after 180 days of storage. In the present study, the ascorbic acid content followed a decreasing trend throughout the storage period for all dehydrated jackfruit sample (**Table 2**) and differed significantly ($p<0.05$). It is evidenced from the previous researches that ascorbic acid is highly unstable, readily decreased during the processing operations and highly susceptible to heat, light, air and directly affected by the reaction with metallic particles present in the food items (Kamal *et al.*, 2019).

Table 2. Changes in bioactive compounds and antioxidant activity of osmotically dehydrated jackfruit slices during 180 days of storage

Sample (°Brix)	Ascorbic acid (mg/100g)				
	0 Day	**45 Days**	**90 Days**	**135 Days**	**180 Day**
T_1	7.40±0.33e	5.84±0.01a	4.31±0.19ab	3.50±0.19a	2.78±0.05a
T_2	9.41±0.18c	5.69±0.01ab	4.50±0.20a	3.29±0.06a	2.35±0.12bc
T_3	8.26±0.02d	4.20±0.12c	3.66±0.14b	3.41±0.10a	2.17±0.01c
T_4	11.79±0.02a	5.62±0.04ab	3.90±0.20ab	3.21±0.21a	2.72±0.08ab
T_5	10.61±0.02b	5.41±0.16b	3.77±0.26b	3.39±0.02a	2.66±0.21ab
Sample (°Brix)	**Total carotenoids (mg/100g)**				
	0 Day	**45 Days**	**90 Days**	**135 Days**	**180 Day**
T_1	9.15±0.05b	8.30±0.66a	4.06±0.24c	3.33±0.20a	2.27±0.04c
T_2	8.89±0.03c	6.67±0.27a	4.80±0.07ab	3.38±0.18a	2.78±0.07ab
T_3	10.05±0.02a	7.45±0.95a	5.23±0.18a	2.04±0.27b	2.48±0.24bc
T_4	10.05±0.02a	6.39±0.43ab	4.72±0.10b	2.58±0.12b	3.14±0.10a
T_5	8.40±0.02d	4.74±0.23b	4.47±0.04bc	3.68±0.09a	2.80±0.08ab
Sample (°Brix)	**Total phenol (mg GAE/100g)**				
	0 Day	**45 Days**	**90 Days**	**135 Days**	**180 Day**
T_1	1200.22±34.29b	1166.70±55.36b	1078.92±56.39a	675.23±10.31bc	576.90±1.61a
T_2	1337.93±45.41a	1317.87±51.85a	982.53±54.15b	596.57±36.27d	386.15±8.61c
T_3	1306.85±65.36a	1238.70±40.80ab	1031.62±26.09a	712.87±3.64b	385.48±4.08c
T_4	1132.38±16.69b	1119.77±9.58b	1059.83±22.93a	616.78±9.11cd	390.30±5.44c
T_5	1179.73±11.51b	1143.50±20.42b	967.65±22.53b	852.72±42.02a	459.85±3.23b
Sample (°Brix)	**% DPPH inhibition**				
	0 Day	**45 Days**	**90 Days**	**135 Days**	**180 Day**
T_1	54.96±1.11a	49.93±1.11a	43.14±1.11a	35.77±1.03a	31.87±1.11a
T_2	41.49±0.14b	36.46±0.15b	29.67±0.14b	22.30±0.69b	18.40±0.14b
T_3	40.19±0.07b	35.16±0.07b	28.37±0.07b	21.00±0.29b	17.10±0.07b
T_4	41.49±0.52b	36.46±0.43b	29.67±0.53b	22.30±1.06b	18.40±0.52b
T_5	55.47±1.99a	50.44±1.09a	43.65±0.59a	36.28±0.79a	32.38±0.99a

Note: Values are mean ± standard error of mean (n=3); Means followed by different lowercase letters in each column are significantly different at P<0.05. T_1-30°Brix; T_2-40°Brix; T_3-50°Brix; T_4-60°Brix; T_5-70°Brix

3.3.2 Total carotenoids content

Carotenoids are the pigments present in food staffs have some beneficial health effects. The total carotenoid content in dehydrated jackfruit slices obtained in this study is shown in **Table 2**. It is observed from **Table 2** that the total carotenoids among the samples ranged between 8.40 to 10.05 mg/100g on the processing day while it was fluctuated within 2.27 to 3.14 mg/100g after the final storage period (180 days). As like ascorbic acid, total carotenoids content also showed decreasing trends throughout the storage periods. After 180 days of storage study, the maximum carotenoids were recorded in T_4 (60°Brix) while the minimum in in T_1 (30°Brix). It is clearly demonstrated in Table 2 that the total carotenoids showed a significantly variation among the samples throughout the storage period. However, a significant amount of total carotenoids has been retained in the samples. It is evidenced from the literature and previous studies that the carotenoid pigments are heat and light sensitive elements, which degraded during the processing operations (Mezzomo and Ferreira, 2016; Kamal *et al.*, 2019 and Molla *et al.*, 2021).

3.3.3 Total phenolic content

Phenolic compounds are considered as the most important group of phytochemicals that provide antioxidant properties against oxidative stress. The phenolic content of dehydrated jackfruit slices is presented in **Table 2**. It is observed from **Table 2** that total phenolic content was ranged from 1132-1200 mg GAE/100g of sample at the beginning of the storage and it was found to varied between 385 to 577 mg GAE/100g of sample after 180 days of storage. It is also clear from **Table 2** that the total phenolic content varied significantly ($p<0.05$) with the increase in concentration of sugar used as osmotic agent. Besides, phenolic content was also decreased with the increase in storage period (**Table 2**). However, the entire sample possessed significant amount of total phenols after the storage period. The changes in phenolic content influenced by the conjugation of polyphenols with other components of food matrices including proteins, sugar, organic acids, and so on (Xu *et al.*, 2007 and Kamal *et al.*, 2020).

3.3.4 Antioxidant activity

Foodstuffs rich in antioxidative compounds can play a critical role in fight against the reactive oxygen species (ROS) induced diseases (Kamal *et al.*, 2019). In the present study, the antioxidant property of dehydrated jackfruit slices was evaluated in terms of DPPH radical scavenging activity and is given in **Table 2**. The DPPH value for dehydrated jackfruit slice prepared in this study varied between 40.19 to 54.96% on initial storage day (**Table 2**) which were found to range between 17.10 to 32.38% after 180 days of storage. It is clearly demonstrated in **Table 2** that the values of DPPH differed significantly among the samples and were also found to decrease with the extension of storage period. The changes in antioxidant capacity of osmotically dehydrated jackfruit might be reflected by its content of different phenolic compounds present in the samples. However, the decrease in antioxidant activity may occur due to the reaction of different enzymes such as polyphenol oxidase along with the degradation of different bioactive compounds, which boosted the antioxidant capacity of products (Kamal *et al.*, 2019; Kulkarni & Aradhya, 2005).

3.4 Sensory attributes of osmotically dehydrated jackfruit slices

The sensory evaluation of the osmotically dehydrated jackfruit slices was conducted twice (at the initial day and final day) throughout the storage period. The results obtained for sensory attributes of dehydrated jackfruit slices were demonstrated graphically in **Figure 5**. Sensory evaluation is one of the determinants of consumer's choice of a product. Color is one of the most important quality parameters of dehydrated jackfruit products. It is closely related to the perception and reception of the product. It was observed that the color score for dehydrated jackfruit slices were ranged from 7.60 to 7.90 points at the initial day, which was ranged from 7.40 to 7.80 points after 180 days (**Figure 5**). The flavor attribute was ranged from 7.60 to 7.80 at the beginning and 7.50 to 7.70 points at the end of storage period. The texture was ranged from 7.10 to 7.80 at the beginning and 6.10 to 7.10 at the end of storage. The taste property ranged from 7.10 to 7.80 at the initial day and 6.50 to 7.60 points after 180 days of storage. While the overall accessibility of dehydrated jackfruit slices was ranged between 7.35 to 7.75 points at the beginning and 6.88 to 7.55 after 180 days of storage. It was observed that the sensory attributes were slightly decreased from the initial to final storage period. It is noticeable that all the sensory items were acceptable while the texture value was slightly lower, which might be due to over drying or cell degradation during drying that created a hard texture of the dehydrated jackfruit slices. It can be concluded from Figure 6 that the sample prepared using sugar concentration ranging from 40-60^{o}Brix provided the best sensory scores for all attributes and may be applied for industrial production of dehydrated jackfruit slices.

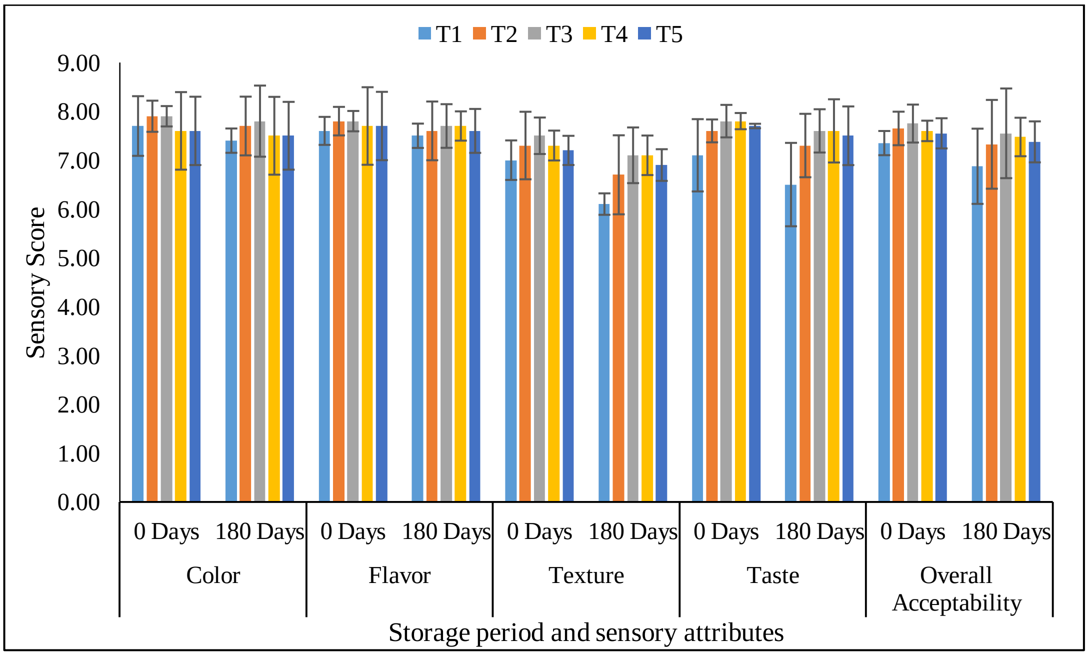

Figure 5. Sensory score of dehydrated jackfruit slices during storage (T_1-30^{o} Brix; T_2-40^{o} Brix; T_3-50^{o} Brix; T_4-60^{o} Brix; T_5-70^{o} Brix)

IV. Conclusion

Results of this study revealed a good content of nutritional and bioactive compounds along with excellent sensory performance of the dehydrated jackfruit slices, which could be stored up to 180 days (six month). Based on the overall quality assessment for dehydrated jackfruit slices, it can be concluded that 50°Brix sugar concentration was the best option for preparing the dehydrated jackfruit slices. This technology will add value in agro-processing industry to produce osmotically dehydrated jackfruit slices for domestic consumption and export purpose and will assist to reduce postharvest loss of jackfruit of our country.

Acknowledgements

The authors would like to thank and grateful to the Krishi Gobeshona Foundation (KGF) for funding support of the project entitled Postharvest Management, Processing and Marketing of Jackfruits under BKGET grant (ID#TF 65-C/19). The author would like to express gratitude and special thanks to the Postharvest Technology Divisional scientists and scientific staffs of Bangladesh Agricultural Research Institute, Gazipur, Bangladesh for use of Lab equipment and facility during the experimentation.

References

[1]. AOAC. 2005. Official Methods of Analysis of AOAC International. 19th ed. Gaithersburg, MD, USA.

[2]. Bakhara, C.K., Pal, U.S. and Bal, L.M. 2018. Drying characteristic and physico-chemical evaluation of tender jackfruit slices during osmo-convective drying. Food Measure, 12: 564–572.

[3]. Baria, B., Upadhyay, N., Singh, A.K. and Malhotra, R.K. 2019. Optimization of 'green' extraction of carotenoids from mango pulp using split plot design and its characterization. LWT-Food Science and Technology, 104: 186–194.

[4]. BBS. 2020. Year Book of Agricultural Statistics of Bangladesh 2020. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh. www.bbs.gov.bd.

[5]. Kamal, M.M., Ali, M.R., Rahman, M.M., Shishir, M.R.I., Yasmin, S. and Sarker, M.S.H. 2019. Effects of processing techniques on drying characteristics, physicochemical properties and functional compounds of green and red chilli (Capsicum annum L.) powder. Journal of Food Science and Technology, 56(7): 3185-3194.

[6]. Kamal, M.M., Ali, M.R., Shishir, M.R.I. and Mondal, S.C. 2020. Thin-layer drying kinetics of yam slices, physicochemical, and functional properties of yam flour. Journal of Food Process Engineering, 43(8): e13448.

[7]. Kamal, M.M., Rashid, M.H., Mondal, S.C., El Taj, H.F. and Jung, C. 2019. Physicochemical and microbiological characteristics of honey obtained through sugar feeding of bees. Journal of Food Science and Technology, 56(4): 2267-2277.

[8]. Kaushal, P. and Sharma, H.K. 2016. Osmo-convective dehydration kinetics of jackfruit (Artocarpus heterophyllus). Journal of the Saudi Society of Agricultural Sciences, 15: 118–126.

[9]. Kulkarni, A. P. and Aradhya, S.M. 2005. Chemical changes and antioxidant activity in pomegranate arils during fruit development. Food Chemistry, 93(2): 319-324.

[10]. Mezzomo, N. and Ferreira, S.R.S. 2016. Carotenoids functionality, sources, and processing by supercritical technology: a review. Journal of Chemistry, 7: 1-16.

[11]. Molla, M.M., Kamal, M.M., Sabuz, A.A., Chowdhury, M.G.F., Khan, M.H.H., Khatun, A., Miaruddin, M., Uddin, M.Z. and Islam, M.M. 2021. Chemical composition, bioactive compounds, antioxidants potential and mycotoxin of minor exotic Archidendron pauciflorum fruit with the focus to Bangladesh. Biocatalysis and Agricultural Biotechnology, 34: 102039.

[12]. Rahman, M.M., Miaruddin, M., Chowdhury, M.G.F., Khan, M.H.H., and Muzahid-E-Rahman, M. 2012. Preservation of jackfruit (Artocarpus heterophyllus) by osmotic dehydration. Bangladesh Journal of Agricultural Research, 37(1): 67-75.

[13]. Ranganna, S. 2007. Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd). McGraw Hill publishing Co. Ltd, New Delhi.

[14]. Saxena, A., Bawa, A.S. and P.S. Raju. 2009. Phytochemical changes in fresh-cut jackfruit (Artocarpus heterophyllus L.) bulbs during modified atmosphere storage. Food Chemistry, 115 1443–1449.

[15]. Shishir, M.R.I., Karim, N., Bao, T., Gowd, V., Ding, T., Sun, C. and Chen, W. (2019). Cold plasma pretreatment—A novel approach to improve the hot air drying characteristics, kinetic parameters, and nutritional attributes of shiitake mushroom. Drying Technology, 1–17.

[16]. Swami, S.B. and Kalse, S.B. 2019. Jackfruit (Artocarpus heterophyllus): Biodiversity, Nutritional Contents, and Health. J.-M. Mérillon, K.G. Ramawat (eds.), Bioactive Molecules in Food, Reference Series in Phytochemistry, https://doi.org/10.1007/978-3-319-78030-6_87.

[17]. Swami, S.B., Thakor, N.J., Haldankar, P.M. and Kalse, S.B. 2012. Jackfruit and its many functional components as related to human health: a review. Comprehensive Reviews in Food Science and Food Safety, 11(6): 565-576.

[18]. Tiwari, R.B. 2005. Application of osmo-air dehydration for processing of tropical fruits in rural areas. Indian Food Ind. 24(6):62–69.

[19]. Xu, G., Ye, X., Chen, J. and Liu, D. 2007. Effect of heat treatment on the phenolic compounds and antioxidant capacity of citrus peel extract. Journal of Agricultural and Food Chemistry, 55(2): 330–335.

[20]. Yadav, A.K. and Singh, S.V. 2014. Osmotic dehydration of fruits and vegetables: a review. Journal of Food Science and Technology, 51(9):1654–1673.