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Biochemical Changes in Jackfruit Pulp as Affected by Cold Temperature

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Abstract
Biochemical changes of three types of jackfruit pulp stored at low temperature were analyzed to make prediction whether the pulp could be made available year round by means of cold temperature treatment. Extracted fruit juice was stored at about -20^0C and the analysis was carried out at 0 day, 30 day, 60 day, 90 day, 180 day and 270 day of storage period. The results show that there are significant changes in the chemical properties of jackfruit pulp during storage. Carotene and vitamin C content decreased gradually for all the varieties up to 270 days of storage period. TSS content increased slightly during storage. Total, reducing and non-reducing sugar contents were almost stable throughout the storage period. TA for all the varieties decreased and pH values increased.

Key words: Carotene, Fruit juice, Pulp, Storage

Introduction

Jackfruit (*Artocarpus heterophyllus* Lam) has been originated in the Indian subcontinent and now is widely cultivated in Bangladesh, Burma, India, Indonesia, Malaysia, the Philippines, Srilanka, Thailand, and to some extent in Brazil and Queensland (Australia) (Oches *et al*., 1981). Jackfruit is the most popular, delicious and indigenous fruits in Bangladesh and has gained the position of national fruit due to its popularity and various other features. Bangladesh produces 719920 tons of Jackfruit annually from an area of 9145 hectares of land at the rate of 78.72 tons per hectare (BBS, 2006). It ranks second in production among the fruits grown in Bangladesh. There are no well defined varieties of jackfruit in Bangladesh (Kamaluddin, 1966). However, existing variability in bulb characters among the fruits suggest their three different types namely, '*Khaja'*, '*Gila'* and '*Dorasa'* (Haque, 1977). Khaja is characterized by hard and crispy bulb, while Gila by soft, juicy and mostly melting bulb, and Dorasha an intermediate between Khaja and Gila (Haque, 1993).

Jackfruit has high nutritive value and may significantly contribute to the nutrition of the people of Bangladesh.(Hassan *et al*., 1994) reported that the Khaja type (ripe fruit) contains 4.49 mg percent Vitamin C, 10.48 percent total sugar, 14.24 percent total soluble solids (TSS) while Gila and Dorasha types contain 10.67 and 5.41 mg percent Vitamin C, 11.55 and 8.39 percent total sugar, 14.87 and 11.32 percent TSS, respectively. Every year a huge amount of jackfruit is produced from June to August i.e. during the rainy season. Characteristically, this fruit is highly perishable and seasonal. Because of monsoon rainfall and poor transport facilities, marketing of fruit in the season becomes difficult and the farmers do not get a desirable price of the commodity. If the excess fruits in the season are preserved by any means ensuring the quality, consumers would have the taste of this seasonal fruit year round. Therefore, finding out the way of storing this fruit is inevitable. Keeping this mind, the present study was aimed with the following objectives: 1. To see the changes in the physico-chemical characteristics of pulp during storage; 2. To make prediction whether the pulp can be made available year round by means of cryopreservation.

Materials and Methods

The research work was conducted in the Food Biochemistry Laboratory of the Department of Biochemistry and Molecular Biology, Bangladesh Agricultural University, Mymensingh during the period from July, 2010 to May, 2011. The research work was conducted to evaluate organoleptic characteristics and Chemical composition of jackfruit pulp at storage.

Fully ripe jackfruits were collected in July, 2010 from Bhaluka upazilla under Mymensingh district and transported immediately to the laboratory of the Department of Biochemistry and Molecular Biology, Bangladesh Agricultural University, Mymensingh. The fruits were then cleaned and samples were taken from middle section of the fruit. First of all, fruit juice was extracted by blending the pulps. Next, the extract was divided into four plastic bottles. One bottle of juice was treated and utilized as freshly prepared sample; and the rest of the three bottles were stored at about -20^0 C and analysis of organoleptic characteristics and biochemical composition was carried out at every 90 days interval i.e. on 90th day, 180th day and 270th day of storage period. All experiments were conducted at room temperature and carried out in three replications.

pH of pulp was determined by Fischer pH meter. Titrable acidity of pulp was estimated according to the procedure as described by Ranganna (1979). Total soluble solid of pulp was determined by using refractometer as described by Ranganna (1979). Carotene content of pulp was determined by column chromatographic method described in

AOAC (2000). Vitamin C content of pulp was determined according to the 2, 6 – dichlorophenol indophenol visual titration method described in AOAC (2000). Total sugar content of pulp was determined colorimetrically by the anthrone method (Jayaraman, (1981) described in AOAC (2000). Reducing sugar content of pulp was determined by dinitrosalicylic acid method (Miller, 1972) described in AOAC (2000). Non-reducing sugar of pulp was determined in accordance to the method given in AOAC (2000). Moisture, dry matter and ash contents of pulp of jackfruit were determined by the methods described in the Manual of Analysis of Fruit and Vegetable Products by Ranganna (1979).

Results and Discussion

The results of the study on biochemical changes of jackfruit pulp as affected by cryopreservation are presented and discussed in this chapter. All the experiments were carried out in triplicate and the data have been represented in table(s) and figures.

Biochemical composition of three varieties of Jackfruit Pulp

pH and titrable acidity (TA)

The pH of freshly collected sample of jackfruit pulp not varied widely for the three varieties. However, the pH of pulps showed a little variation at various storage periods (Fig. 1). At 90 and 180 days of storage, all the varieties showed an increase in pH followed by a little decrease at 270 day of storage. The results pertaining to the variation in pH of pulps during storage are in complete agreement with other researchers (Fulya *et al.*, 1999; Doreyyapa *et al.*, 2001). The initial increase in pH may be due to breakup of acids with respiration during storage (Pesis *et al.*, 1999) and final decrease due to the presence of sodium benzoate in the fruit pulp samples (Bajwa *et al*., 2002; Hussain *et al*., 2008).

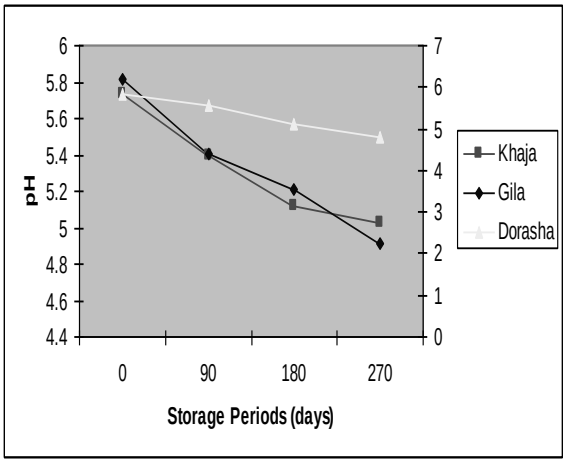

Fig. 1. Effect of storage on pH

The TA of freshly prepared sample of jackfruit pulp not varied widely for the three varieties. However, the TA of varieties showed a wide variation at various storage periods (Fig. 2). At 90 and 180 day of storage, all the varieties showed a remarkable decrease in TA. At this storage condition, khaja showed the lowest TA. A little increase in TA occurred for all the three varieties at 270 day of storage. At this storage condition, gila showed the highest TA. (Reddy *et al.*, 2004) had reported a similar variation in acidity which is in the range of 0.18 to 0.68%. The initial decrease in acidity during storage is due to a rapid utilization of acids by respiration (Edmundo *et al.*, 1998). The final increase in acidity may be ascribed to rise in the concentration of weakly ionized acid and their salts during storage.

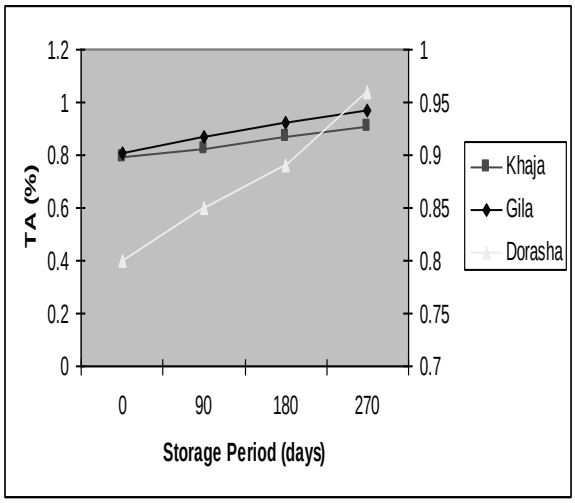

Fig. 2. Effect of storage on Titrable acidity

This increase in acidity is also due to formation of acid by degradation of polysaccharides and oxidation of reducing sugars or by breakdown of pectic substances and uronic acid (Hummel and Okay, 1950; Iqbal *et al.*, 2001; Hussain *et al.*, 2008). Although not calculated, apparently pH was negatively correlated with the TA which confirms the actual changes during storage period.

Carotene and vitamin C

Carotene content varied widely among the freshly prepared sample of jackfruit pulps (Fig. 3). Dorasha exhibited the highest amount of carotene among the varieties. The carotene content of Khaja and Gila was more or less same which is much lower than that of Dorasha. The carotene content of the varieties decreased gradually at various storage periods. The decrease in carotene content followed the same trend at 90, 180 and 270 day of storage. But a remarkable decrease was observed at 180 and 270 days storage time. The amount of carotene in dorasha was always higher compared to that of khaja and gila. However, the loss of carotene content is due to the non-oxidative changes (cis - trans isomerization, epoxide formation or heat degradation of tissues) (Aruna *et al.*, 1999).

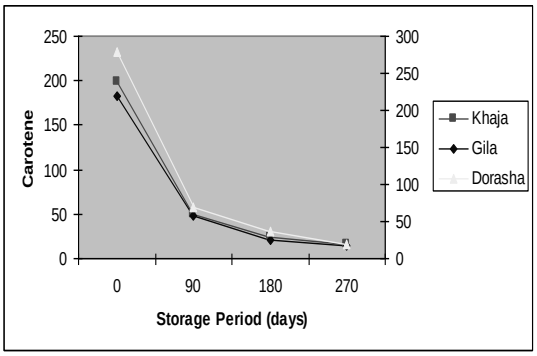

Fig. 3. Effect of storage on Carotene

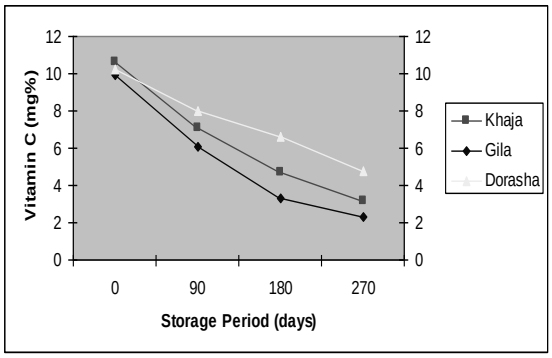

Fig. 4. Effect of Storage on vitamin C

The vitamin C content of freshly prepared sample did not vary widely for the three varieties of jackfruit pulps. The vitamin C content of the varieties decreased gradually at various storage periods (Fig. 4). A greater decrease in vitamin C content was observed for all the varieties at 270 day of storage. However, the rate of decrease in vitamin C content was always lowest in dorasha compared to khaja and gila. The results pertaining to the decrease in vitamin C content of pulps during storage are in complete agreement with the previous finding (Sritananan *et al*., 2005). This reduction in vitamin C contents of the pulps may be attributed to the susceptibility of ascorbic acid to oxidative destruction by some enzyme which has not been ascertained in this study.

Moisture, dry matter and ash

The moisture content of freshly prepared sample of jackfruit pulps did not vary widely among the varieties. All the varieties showed little variations at different storage periods (Table 1). All the varieties showed little decrease in moisture content at 90 and 180day of storage. Surprisingly, a little increase in moisture content was observed at 270 day of storage for all the three varieties. This result is in complete agreement with that of Hossain, (1976).

The dry matter content of freshly prepared sample of jackfruit pulps did not vary widely for the three varieties (Table 1). All the varieties showed a little increase in dry matter content at 90 and 180 day of storage. However little decrease in dry matter content was observed at 270 day of storage for all the three varieties. This result is in complete agreement with those reported by Hossain and Haque, (1979).

Table 1. Moisture (%), dry matter (%) and ash content (%) of jackfruit pulp at various storage periods

Variety	Moisture (%)				Dry matter (%)				*Ash (%)			
	0 day	90 days	180 days	270 days	0 day	90 days	180 days	270 days	0 day	90 days	180 days	270 days
Khaja	79.25	76.51	74.61	73.07	20.75	23.49	25.39	26.93	0.89	0.83	0.87	0.91
Gila	81.12	79.02	77.02	75.36	18.88	20.98	22.98	24.64	0.83	0.85	0.82	0.94
Dorasha	80.05	76.30	73.25	72.03	19.95	23.70	26.75	21.97	0.85	0.87	0.83	0.92

The ash content of freshly prepared sample of jackfruit pulps did not vary widely for the three varieties. All the varieties showed little variations at different storage periods (Table 1). At 90 day of storage, a little decrease in ash content was observed for all the varieties. This decreasing trend continued upto 180 day of storage. However, a little increase in the ash content was observed at 270 day of storage for all the varieties. This result is in complete agreement with that of Hossain (1976).

TSS and total sugar

The TSS content of freshly prepared sample did not vary widely for the three varieties of jackfruit pulps. However, the TSS content increased gradually at various storage periods (Table 2). This increase in TSS content is attributed to the conversion of starch to sugars (Sharaf and El-Saadany, 1987).

Table 2. TSS (%) content of jackfruit pulp at various storage periods

Variety	**0 day**	**90 days**	**180 days**	**270 days**
Khaja	20.03	20.32	20.67	21.07
Gila	19.10	19.50	19.73	21.00
Dorasha	18.70	18.98	19.44	19.74

The total sugar of freshly collected sample of jackfruit pulp did not vary widely for the three varieties of jackfruit pulps (Table 2). At 90day of storage, a little decrease in total sugar content was observed for all the varieties. This decreasing trend continued up to 180day of storage. However, a little

increase in the total sugar content was observed at 270 day of storage for all the varieties. The values are in agreement with those reported by Hoque (1993).

Reducing and non-reducing sugar

The reducing sugar content of freshly prepared sample of jackfruit pulps did not vary widely for the three varieties (Fig. 5). At 90 day of storage, a little decrease in reducing sugar content was observed for all the varieties. This decreasing trend continued up to 180 day of storage. However, a little increase in the reducing sugar content was observed at 270 day of storage for all the varieties. The values are slightly higher than those reported by Hossain (1976).

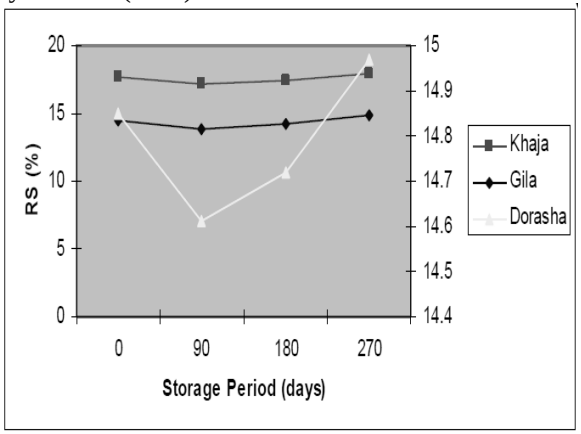

Fig. 5. Effect of Storage on Reducing sugars

The non-reducing sugar content of freshly prepared sample of jackfruit pulps did not vary widely for the three varieties (Fig. 6). At 90 day of storage, a little increase in non-reducing sugar content was observed for all the varieties. This increasing trend continued up to 180 day of storage. However, a little decrease in the reducing sugar content was observed at 270 day of storage for all the varieties. The values are in agreement with those reported by Hoque (1993).

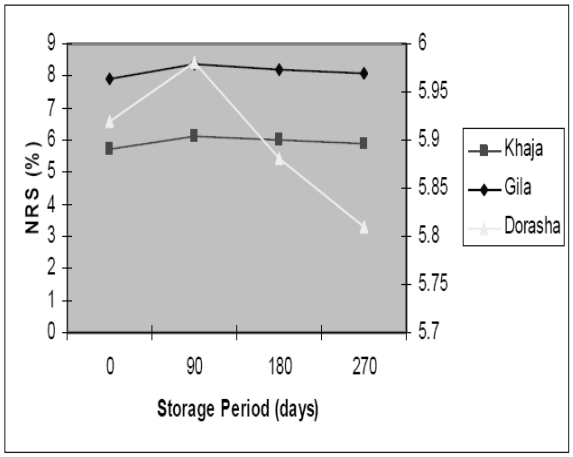

Fig. 6. Effect of Storage on Non-reducing sugars

Conclusions

The results show that there are significant changes in the chemical properties and organoleptic attributes of jackfruit pulp at storage. The result of the study provides important information to the processing industry to produce products with a better nutritional quality and investigate whether the jackfruit pulp has a potential market for commercial cultivation. The two nutritionally important compounds, vitamin C and carotene need some attention so that they can be preserved during storage.

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