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Vacuum packaging of minimally processed un-ripe Jackfruit (*Artocarpus heterophyllus*. L) bulbs

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ABSTRACT

Jackfruit (Artocarpus heterophyllus. L) is an important underutilized fruit cultivated widely in Karnataka, Kerala, Andhra Pradesh, Tamil Nadu, West Bengal, Maharashtra, Assam, Andaman, and Nicobar Islands. In India, the un-ripe jackfruit is extensively used for preparation of chips and other value added products. The minimally processed un-ripe jackfruit bulbs could not be made available to people across the country due to its very short shelf-life. To address this issue, a study was conducted for shelf-life extension of minimally processed un-ripe jackfruit bulbs for duration of 3-4 weeks. Three vacuum percentages (60, 70 and 80%) were selected for packaging of minimally processed un-ripe jackfruit bulbs. Minimally processed jackfruit bulbs were given a dip pre-treatment with citric acid prior to packaging. The samples were packed in polyethylene packages (300 gauge) and stored at two environments i) low temperature (3-5 °C) for 3 weeks, and ii) deep-freeze temperature (-12°C) for 6 weeks. The results indicated that the dip pre-

treatment with citric acid, packaging at 3 vacuum percentages and storage under deep freeze temperature were found to be effective in restricting reducing sugar, TSS, titratable acidity & microbial load compared to control. Vacuum packaging was found to be very effective in controlling microbial contamination when stored in low temperature environments.

Key words: Un-ripe jackfruit, minimal processing, vacuum packaging, polyethylene package, shelf-life

1. INTRODUCTION

Jackfruit (*Artocarpus heterophylus*. L) is an important underutilized fruit cultivated widely in Karnataka, Kerala, Andhra Pradesh, Tamil Nadu, West Bengal, Maharashtra, Assam, Andaman, and Nicobar Islands. It is the national fruit of Bangladesh and Indonesia. In India, the total area under jackfruit is approximately 1.02 lakh ha (Bose *et al*., 2003) and in Karnataka, it is cultivated in an area of about 6.78 ha, mostly in the southern plains and Western Ghats, producing about 231.57 million tones of fruits per year (Anon, 2011). Minimally processed fruit or a vegetable is defined as those products that may be cleaned, peeled, cut, sliced, packaged or processed by any means short of killing the tissue. Packing and storage conditions of such processed products must be very specific to maximize the shelf-life. Under minimally processed conditions, fruits and vegetables are vulnerable to microbial attack even by pathogenic microorganisms (Romphophak et *al.,*1995). Kabasa Mary Sally *et al,* (2011) studied on packaging and storage of minimally processed jackfruits bulbs and reported that the vacuum packaging of 80 per cent using PE/PP (300 gauge) enhanced the shelf-life of fully matured ripe of minimally processed jackfruit bulbs.

2. MATERIAL AND METHODS

Sample preparation: Fresh, healthy and well matured unripe bulbs of good quality jackfruits were procured from a known jackfruit grower in Bangalore Rural district of Karnataka. The fruits were cut into convenient halves using sharp stainless steel knives smeared with cooking oil. The bulbs were separated from the rind and the core parts of the fruit. The seeds were then separated from the bulbs and deseeded bulbs were trimmed and used for the experiment. The details of the experimental treatments are follows:

1.*Vacuum Percentage Levels :* i) 60 per cent ii) 70 per cent iii) 80 per cent
2.*Pre-treatment to Bulbs :* T_1 = Citric acid (0.25%), T_2 = Control (without pre-treatment)
3.*Storage temperature:* i) Refrigeration storage (3-5°C) ii) Deep freeze storage (-12°C)

Pre-treatment and different vacuum percentage packaging

Four equal portions were weighed from the deseeded bulbs by means of a digital balance. Three of the parts were pre-treated by dipping in citric acid 0.25 % and vacuum packaged at 60, 70 and 80 % each, respectively. The fourth part was not given any pre-treatment and was used as the control. These samples were packaged in PE and stored in i) low temperature (3-5°C) for 3 weeks, and ii) in deep-freeze temperature (-12°C) for 6 weeks.

The samples were analyzed, at periodic intervals, for TSS, titratable acidity, microbial contamination and reducing sugar. The TSS (°Brix) was assessed with a hand refractometer. The titratable acidity of jackfruit bulbs was determined by the visual titration method (Ranganna, 1986).

$$\text{Titratable acidity \%} = \frac{\text{Titre value} \times \text{N of NaOH} \times \text{Volume made up} \times \text{Equivalent weight}}{\text{Aliquot taken for titration} \times \text{weight of sample} \times 1000} \times 100$$

The microbiological analysis was carried out by employing Dilution Plate Count Method (Somasegaran and Hoben, 1985). The estimation of reducing sugars was done by the Nelson-Somogyi method (Sadasivam and Manickam, 1992).

$$\textbf{Reducing sugars, \% =} \frac{0.05 \times \text{Volume made up} \times 100}{\text{Titre value} \times \text{Weight of sample (g)}}$$

3. RESULTS AND DISCUSSION

The results of TSS (^{0}Brix) of minimally of processed un-ripe jackfruit bulbs during storage are presented in Table 1. The data showed that there was an increase in TSS in all the samples during storage. The increase was greater in control samples compared to different vacuum samples. The results agreed with the study by Saxena *et al.*, (2008).

Table 1 Influence of vacuum packaging on TSS (^{o}Brix) of minimally processed un-ripe jackfruit bulbs in different storage environments

Vacuum (%)	TSS (^{o}Brix)									
	Storage period (week)									
	Refrigeration storage (3-5 °C)				Deep-freeze storage (-12 °C)					
	0	1	2	3	0	1	2	3	4	6
Control	5.4	5.82	7.00	9.8	5.4	5.63	6.57	8.29	10.60	13.22
60 %	5.4	5.32	5.52	5.68	5.4	5.43	5.69	5.74	6.41	6.65
70 %	5.4	5.34	5.56	5.72	5.4	5.44	5.71	5.85	6.44	6.87
80 %	5.4	5.37	5.72	5.80	5.4	5.45	5.72	5.88	6.50	6.98
F test	NS	*	*	NS	NS	**	*	*	*	NS
SEm ±	-	0.006	0.002	-	-	0.015	0.031	0.026	0.002	-
CD at 5 %	-	0.019	0.018	-	-	0.05	0.102	0.085	0.042	-

The titratable acidity (%) values of the minimally processed un-ripe jackfruit bulb samples decreased during storage (Table 2). This reduction could be attributed to the conversion of organic acids into sugars due to the processes associated with ripening. It was observed that the different vacuum percentages of 80, 70 and 60 levels had lesser titratable acidity values compared to control sample which is in agreement with the research findings of Saxena *et al.*, (2008).

Table 2 Influence of vacuum packaging on titratable acidity (%) of minimally processed un-ripe jackfruit bulbs in different storage environments

Vacuum (%)	Titratable acidity (%)									
	Storage period (week)									
	Refrigeration storage (3-5°C)				Deep-freeze storage (-12 °C)					
	0	1	2	3	0	1	2	3	4	6
Control (No-vacuum)	0.007	0.007	0.006	0.005	0.007	0.006	0.005	0.004	0.003	0.002
Vacuum 60 %	0.007	0.004	0.003	0.002	0.007	0.004	0.004	0.003	0.002	0.001
Vacuum 70 %	0.007	0.005	0.004	0.002	0.007	0.006	0.005	0.004	0.003	0.001
Vacuum 80 %	0.007	0.006	0.005	0.002	0.007	0.006	0.005	0.004	0.003	0.001
F test	NS	*	*	*	NS	*	*	*	*	*
SEm ±	-	0.214	0.371	0.522	-	0.322	0.455	0.265	0.457	0.587
CD at 5 %	-	0.523	0.452	0.624	-	0.441	0.628	0.451	0.521	0.632

*Significant- *, Non significant- NS, PE- Polyethylene*

The results of reducing sugar content of the minimally processed un-ripe jackfruit bulbs during storage are presented in Figure 1. The reducing sugars of the minimally processed samples were increased during storage. The increase of reducing sugar profile was found to be much slower in deep-freeze storage compared to low temperature storage environment. It is well known fact that the rate of hydrolysis is a function of the concentration of sucrose, temperature, and acid - catalyst concentration (Babsky *et al.*, 1986).

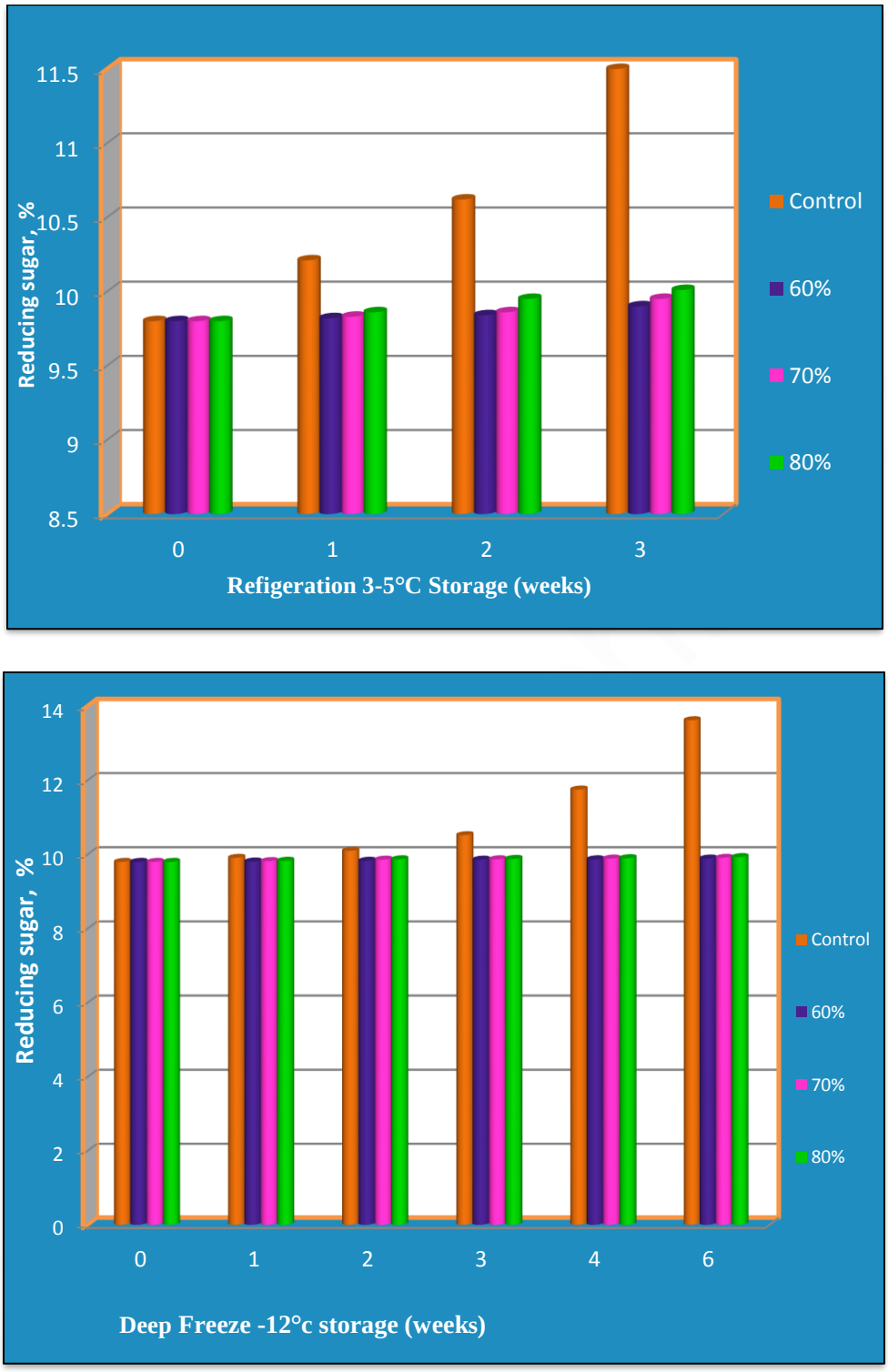

Figure 1 Influence of vacuum packaging on reducing sugar content of minimally processed un-ripe jackfruit bulbs in different storage environments

The microbial profile in terms of total plate counts is presented in Figure 2. Vacuum packaging was found to be very effective in controlling the microbial contamination in packages. The total counts observed in vacuum packaging at different vacuum percentage of 80, 70, and 60 % were found to be much less compared to the total counts in the control sample.

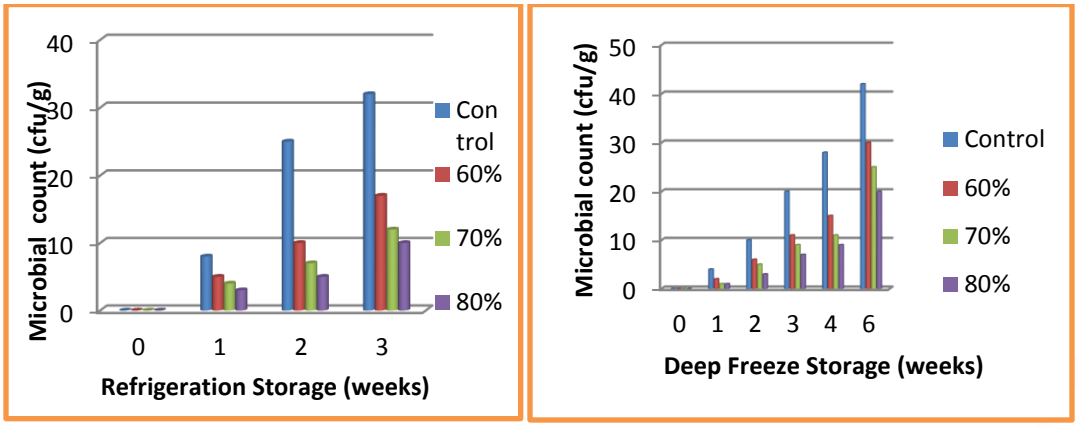

Figure 2 Influence of vacuum packaging on microbial counts (cfu/g) of minimally Processed un-ripe jackfruit bulbs in different storage environments

4. SUMMARY

The pH value increased during storage. The samples under different vacuum had the least increase in TSS compared to the control sample. The samples in different vacuum percentages had lesser titratable acidity compared to control samples. The samples in deep-freeze storage were found to be better compared to low temperature storage. The sample at 80 % vacuum had higher titratable value compared to 60 and 70 % vacuum. Reducing sugars were found to increase in all the samples of the minimally processed jackfruit bulbs under different vacuum percentages. Total sugar increased during storage. The 80 % vacuum sample had higher retention compared to 60 and 70 % of vacuum. Lower microbial counts were observed in different vacuum samples compared to control. Deep-freeze storage contained less number of microbial counts in the minimally processed jackfruit bulbs compared to refrigeration storage. No coli forms were observed in any of the minimally processed jackfruit bulbs during storage.

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