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PREPARATION AND PACKAGING OF JACKFRUIT CHIPS

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ABSTRACT

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A study was conducted in the laboratory of Postharvest Technology Section under Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during June to September 2007 to find out a suitable preparation technique of quality jackfruit chips and their good packaging. Fruit's slices treated with preservative and firming agents, pricked, blanched and then processed. A taste-testing panel for different sensory attributes using a 9- point hedonic scale tasted the fresh and stored chips. There were three packaging materials viz., metalex foil pouch, high density polyethylene and polypropylene pouch. During two months storage, the results showed that chips packed in metalex foil pouch secured the highest sensory score (crispiness: 9.0, colour: 9.30, flavour: 9.20 and overall acceptability: 9.10) followed by high density polyethylene pouch and polypropylene pouch obtained the lowest score (crispiness: 6.4, colour: 5.0, flavour: 5.6 and overall acceptability: 5.9).

Keywords: Fruit chip processing, oil content, moisture content, frying time and temperature, packaging and storage

INTRODUCTION

Jackfruit (*Artocarpus heterophyllus)* is the largest edible fruit in the world and is the national fruit of Bangladesh. It is a very popular fruit in Bangladesh. The poor people of Jackfruit growing area, used to eat this fruit instead of rice, for one of their daily meals. Hence, Jackfruit is called "poor mans food". People consumed it mostly as a fruit when ripe but also as vegetable in the unripe stage. The jackfruit significantly contributes to the nutrition of the people of this country as a source of vitamins, minerals and calories. Both tender and ripe fruits as well as the seeds are rich in minerals and vitamins. At present (BBS, 2006) Bangladesh produces 719920 tons of Jackfruit annually from an area of 9145 hectares of land at the rate of 78.72 tons per hectare. It ranks second in production among the fruits grown in Bangladesh. It is grown and sold in the market almost everywhere in the country. However, the fruit is perishable and cannot be stored for long time because of its inherent compositional and textural characteristics. In every year, a considerable amount of jackfruit, specially obtained in the glut season (June-July) in every year goes waste due to lack of proper postharvest knowledge during harvesting, transporting and storing both in quality and quantity. Proper postharvest technology for prolonging shelf life is, therefore, necessary. Besides, alternate ways of using jackfruits in on-season plays significant roles in reducing postharvest losses. Among them, processing is important ones. It adds diversified and attractive food items in dietary menu as well as contributes to generation of income and employment.

Preservation of fruits by processing has been the research pursuits of many developed and developing countries and has yielded quite a number of technologies. Home and cottage level processing of some fruits, specially 'Ber, Tamarind, Indian olive,' etc. exists in Bangladesh. However, processing techniques of jackfruit is very scanty in Bangladesh. There has been a little research worth mentioning to find possibility of processing of jackfruit into durable and nutritious food products. Chips are the most popular snack item in many fast food outlets. Fried jackfruit chips may be one of the important potential jackfruit products in Bangladesh. Jackfruit chips may be also easily salable snack food in the markets. For longer shelf life, crispiness and chips quality moisture content is the most important factor as far as storage stability is concerned. Bacteria and other microorganism cannot grow easily in lower percentage of moisture content in chips. Visual colour is the major quality criterion for determining the commercial quality with respect to consumers' preferences and cost of the chips (*Anand et al., 1982*). Packaging and storage condition are the most important quality control factors of chips preservation. Storage stability depends on packaging. Good packaging and storage condition extend the storage duration of chips. Chips are packed in packages of various dimensions and materials, including cellophane and waxed glassine. Fibreboard cartons are used to casing the packages of chips (Ahmed, 1977).

In Bangladesh, few research works have been considered in this regard. Keeping this in view, the research program was undertaken to study the processing, packaging and quality aspect of chips from jackfruit and thus suggest ways and means for production of good quality jackfruit chips.

MATERIALS AND METHODS

A study was conducted in the laboratory of Postharvest Technology Section under Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during June to September 2007 to find out a suitable preparation technique of quality Jackfruit chips and also to select appropriate packaging materials for preservation of the same. The maximum and minimum relative humidity of the room was 84% and 74% respectively under the room temperature of 28-32^{o}C. Fully mature jackfruit was collected from the Fruit Research Farm of Pomology Division, Horticulture Research centre (HRC), BARI, Gazipur. Fully mature jackfruit, salt, tasting salt, KMS, palm oil, knife, saucepan and cloves powder were used in the experiment.

***Processing*:** Fully mature jackfruit was taken and washed with clean *water. Then peeling was done carefully. After peeling, bulbs were collected and seeds were removed from the bulbs. Then the bulbs were cut into 4cm X 2 cm slices. The cut slices were blanched in water for 10 minutes. Then the slices were weighed out and immersed in 0.1% KMS for 15 minutes using 2 kg of solution per kg of bulbs. After sieving water, the slices were dried using a mechanical dryer in view to absorbing less oil in subsequent frying. Then the slices were fried in palm oil and stirred with narrow wooden stick maintaining temperature 70^{o}C for 1 hour and 60^{o}Cfor rest 6 hours. When the slices were obtained in light yellow colour, the chips were put out from saucepan. The prepared chips were mixed with tasting salt and spices in a bowl. After this, the processed products were packed in different packaging materials, namely i) Polypropylene pouch ii) High density polyethylene pouch (HDPE Pouch) and iii) Metalex foil pouch and stored in ambient temperature (28-32^{o}C).*

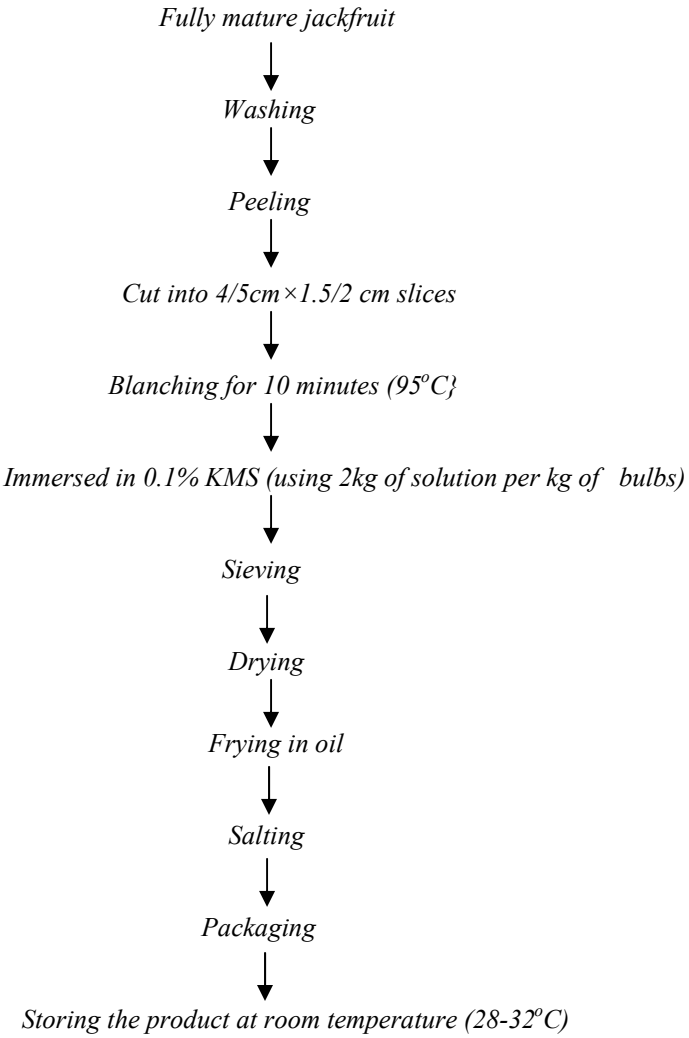

Figure 1. Flow diagram for the preparation of fried jackfruit chips

***Determination of frying time*:** The moisture content of freshly prepared fried chips should be 4.0%. So, the frying time is determined as the time required to obtain 4% moisture content in fried chips from initial moisture content of dried slices (75%).

Determination of oil content: The percentage of oil content was calculated as follows:

$$\% \text{ Oil content} = \frac{\text{Weight of oil}}{\text{Weight of sample slice}} \text{ x100}$$

Determination of weight gain (%): The percentage of weight gain was calculated as follows

$$\% \text{ Weight gain} = \frac{\text{Final weight - Initial weight}}{\text{Initial weight}} \text{ X 100}$$

Determination of moisture content: Moisture content was determined according to Ranganna (1991). It was determined several times as in fresh jackfruit bulbs, freshly prepared slices, dried chips and stored chips.

Determination of frying temperature: Development of colour depends on frying temperature. Prepared slices were fried at 150^{o}C, 160^{o}C and 170^{o}C and tasted by a taste-testing panel consisting of 10 judges for selecting the desired frying temperature, which gave the best colour of chips. A 1-9 point hedonic scale was used for a taste testing panel.

Sensory evaluation: Sensory evaluation of all the prepared chips was done by taste testing panel. The taste testing panels were consisting of 10 members. They were asked to evaluate the crispiness, taste, flavor, color and overall acceptability by a scoring rate on a 9- point hedonic scale. 9=Like extremely, 8=Like very much, 7=Like moderately, 6=Like slightly, 5=Neither like nor dislike, 4=Dislike slightly, 3=Dislike moderately, 2=Dislike very much and 1=Dislike extremely. The different preferences as indicated by scores were evaluated by statistical methods. The analysis of variance with CRD was used for this evaluation. The difference was quantified by Duncan's Multiple Range Test. The procedures of MSTAT were followed for statistical analysis.

Packaging materials used to preserve the jackfruit chips
P_1 = Polypropylene pouch (0.8 mm)
P_2 = High density polyethylene pouch (0.9 mm)
P_3 = Metalex foil pouch. (0.10 mm)

Storage studies: The prepared jackfruit chips were stored at room temperature (28-32^{0}C) for storage studies. The changes in moisture content (%), weight gain (%), crispiness, taste, flavour, colour and gas formation during 2 months storage of chips were observed under room temperature (28-32^{0}C) at O day, 30 days and 60 days of storage.

RESULTS AND DISCUSSION

Results regarding preparation, packaging and storage periods of jackfruit chips were described below:

Preparation of jackfruit chips

Determination of oil content of chips: From the economic point of view and quality aspect, oil content of chips should be as low as possible. So, determination of oil content of chips was essential. The oil content of freshly prepared chips was found 45% at 170^{o} C. Similar observation was found in papaya chips processing (Rahman and Shams-Ud-Din, 2003)

Determination of the ratio of jackfruit slice to oil: Trial and error method was used for determining jackfruit slice to oil ratio by. When jackfruit slices were placed in the hot oil then the initial temperature dropped. Here, jackfruit slices were fried at oil temperature of 170^{o}C. To maintain this desired temperatures, jackfruit slices to oil ratio was chosen to give an initial temperature drop of 10^{o}C. The ratio of jackfruit slice to oil was 4:10.

Time and temperature required for frying to get 4% moisture content in chips: The rate of water removal depends on frying time and temperature. Getting 4% moisture content in jackfruit chips required frying time was 10 minutes at 170^{0} C.

Influence of frying temperature on colour of jackfruit chips: Jackfruit slices were fried at 150^{o}c, 160^{o}c and 170^{o}c for different periods to get desired colour of chips maintaining with final moisture content of 4%. For

obtaining desired colour, the minimum time required for different temperature was recorded. The results are shown in Table 1.

Table1. Effect of frying temperature on colour of jackfruit chips

Oil temperature (0^{o}c)	Time required (min.)	Colour
150^{o}c	13	Light yellow and adhesion of oil
160^{o}c	12	Light yellow
170^{o}c	10	Yellowish

From Table 1, it revealed that chips fried at temperature 150^{o}C and 160^{o}C was unacceptable for its color as per specifications given by Misra and Premchanda (1988). However, the yellowish color given by frying at 170^{o}C for a minimum time of 10 minutes was acceptable.

Packaging and storage studies of Jackfruit chips in relation to moisture content (%) and weight gain (%)

The moisture content of jackfruit chips during storage is dependent on relative humidity of the storage structure. Storage at low relative humidity is helpful to preserve crispiness of the prepared chips. Moisture content of fresh jackfruits was 86%. On the day of preparation (0 day), the moisture content of jackfruit chips was maintained 4%. During two months of storage studies moisture content was increased in all the packaging materials (Table 2, 3 & 4). This might be due to absorption of moisture through sealing error. Irrespective of storage periods significant variations were found in moisture content (%) and weight gain (%) in fried chips in different packaging materials (Table 2). Among the packaging system tested, the lowest moisture percent (4.23%) was observed in samples packed in metalex foil. This might be due to its double layer of polyethylene. On the other hand, chips packed in polypropylene pouch obtained the highest percentage of moisture (4.52%). The results are an agreement with *Rahman and Shams-Ud-Din (2003).*

After two months of storage periods, chips packed in all the packaging materials gained weight (Table 2, 3& 4)). This might be due to absorbed moisture and experimental error. The results are an agreement with *Molla, et.al. (2006)*.

The study indicated that chips packed in metalex foil pouch performed the best and packed in polypropylene pouch could not be kept for longer period. Similar observation was found by (Rahman and Shams-Ud-Din, 2003) in papaya chips processing. These results are also an agreement (Islam and Shams-Ud-Din, 2003) in cassava chips processing.

Polypropylene pouch High density polyethylene pouch Metalex foil pouch

Figure 2. Jackfruit chips packed in different packaging materials

Table 2: Moisture content (%) and weight gain (%) of stored jackfruit chips in different packaging materials

Packaging materials	Moisture content (%)	Weight gain (%)
Polypropylene pouch (P_1)	4.52a	54.59a
High density polyethylene pouch (P_2)	4.46b	52.75b
Metalex foil pouch (P_3)	4.23c	51.53c
Level of significance	**	**
CV (%)	0.17	0.31

Table 3. Moisture content (%) and weight gain (%) of jackfruit chips during storage

Storage Periods	Moisture content (%)	Weight gain (%)
0 day	4.00c	49.92c
30 days	4.49b	53.51b
60 days	4.72a	55.44a
Level of significance	**	**
CV (%)	0.17	0.31

Table 4. Combined effect of storage periods and packaging materials of jackfruit chips

Storage periods x Packaging materials	Moisture content (%)	Weight gain (%)
OXP_1	4.00d	50.00f
OXP_2	4.00d	50.00f
OXP_3	4.00d	50.00f
$30XP_1$	4.64abc	55.68b
$30XP_2$	4.54bc	53.16d
$30XP_3$	4.30cd	51.70e
$60XP_1$	4.92a	58.10a
$60XP_2$	4.85ab	55.10c
$60XP_3$	4.40c	53.12d
Level of significance	**	**
CV (%)	0.17	0.31

P_1 = Polypropylene pouch (0.8 mm), P_2 = High density polyethylene pouch (0.9 mm) and P_3 = Metalex foil pouch. (0.10 mm)

Sensory evaluation of jackfruit chips

Significant variations were found in sensory attributes of chips in different packaging materials for 60 days storage (Table 5 &6) at ambient condition. During the storage studies of two months, the crispiness, color, flavor, and texture of jackfruit chips were good in metalex foil pouch (P_3). There was no feeling of gas formation in metalex foil pouch (P_3), whereas fully and slightly gas formation had felt in the slices packed in polypropylene pouch and high-density polyethylene pouch. The color of the chips didn't change up to two months of storage. Among the different packaging materials, chips packed in polypropylene did not retain the initial flavor and texture. In high-density polyethylene pouch, these quality traits were fully changed.

The processed chips were not subjected to microbial spoilage because of their low moisture content. Up to two months storage of the products, the maximum level of moisture content was 4.49% and this was not suitable condition for microbial growth. For this reason, microbial analysis was not carried out.

Table 5. Storage studies of jackfruit chips for crispiness, color, flavor, texture and gas formation at different storage periods.

Storage periods	Sensory attributes	Packaging materials		
		P_1	P_2	P_3
0 day	Crispiness	Good	Good	Good
	Colour	No change	No change	No change
	Flavor	Good	Good	Good
	Texture	Good	Good	Good
	Gas formation	Nil	Nil	Nil
30 days	Crispiness	Slightly changed	Good	Good
	Colour	No change	No change	No change
	Flavor	Off flavour	Good	Good
	Texture	Slightly changed	Good	Good
	Gas formation	Slightly formed	Nil	Nil
60 days	Crispiness	Fully changed	Slightly changed	Good
	Colour	No change	No change	No change
	Flavor	off flavour	Off flavour	Good
	Texture	Fully changed	Slightly changed	Good
	Gas formation	Fully formed	Slightly formed	Nil

P_1 = Polypropylene pouch (0.8 mm), P_2 = High density polyethylene pouch (0.9 mm) and P_3 = Metalex foil pouch.(0.10 mm)

Based on taste testing panel, the mean scores for crispiness, colour, flavour and overall acceptability of stored jackfruit chips were analyzed statistically. A two-way analysis of variance (ANOVA) was conducted for this. The result revealed that the best performance have been obtained in metalex foil pouch regarding crispiness, taste, flavour, colour and overall acceptability of stored chips (Table 6) during two months storage period.

Table 6. The mean score for crispiness, colour, flavour and overall acceptability of stored jackfruit chips

Packaging materials	Crispiness	Colour	Flavour	Overall acceptability
Polypropylene	6.40c	5.00c	5.60c	5.90c
High-density polyethylene	7.50b	6.50b	7.70b	7.20b
Metalex foil	9.00a	9.30a	9.20a	9.10a

CONCLUSION

The preparation of jackfruit chips is very simple and can easily be processed. Considering moisture content (%), weight gain (%), quality aspects and sensory attributes like crispiness, colour, flavour and overall acceptability, metalex foil pouch was found most suitable for packaging of jackfruit chips. The prepared chips can be stored at ambient condition keeping in metalex foil for two months without loss of organoleptic quality.

Recommendation: In rural areas where modern facilities of processing do not exist, this technology can be easily achieved. Many food industries also can adopt the procedure for medium and large scale processing. Establishment of small-scale processing unit at grower's level could utilize the jackfruit for processing of chips, which will be helpful to get this product during off season, ultimately minimizes postharvest losses of jackfruit and generates income to the growers.

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