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Research Article

STUDY THE SUITABILITY OF PACKAGING MATERIAL FOR STORAGE OF JACKFRUIT CHIPS

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Abstract- Jackfruit (*Artocarpus heterophyllus* L.) is a species of tree in the mulberry and fig family and it is native to parts of south and Southeast Asia. The jackfruit belongs to an important underutilized tropical fruit and bulbs are rich in energy, dietary fiber, minerals and vitamins, which can be processed into several types of value added products. Chips, also known as crisps, are one of the popular and relished savory items that are prepared by deep fat frying technique. The quality of the chips mainly crispiness depends on frying temperature and time. A study was conducted in the Postharvest Engineering and Technology Scheme under University of Agricultural Sciences, Gandhi Krishi Vigyan Kendra Bangalore, to find out a suitable packaging material of jackfruit chips and their storage period. Among three packages - polyethylene, polypropylene and aluminium laminate pouches tested for storing jackfruit chips at ambient conditions for two months, aluminium laminate was found to be best since the chips in this package had least moisture content, free fatty acids, peroxide value and thiobarbituric acids value. Hence, this chips indicating that the product was acceptable as snack food.

Keywords- Deep fat frying, frying temperature, Frying time, Jackfruit Chips.

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Introduction

Jackfruit (*Artocarpus heterophylus* L.) is a species of tree from the family *Moraceae*. It is grown in an area of 97,536 ha with annual production of 348 million fruits and productivity of 3,568 fruits per ha [4]. It is one of the most popular and widely grown, evergreen fruit trees in the country that produces heavier yield than any other tree species and bears largest known edible fruit weighing around 35-50 kg each. This is one of the unexploited nutritious fruits indigenous to the rainforests of Western Ghats of India [7]. Every 100 grams edible portion(pulp) contains 84 per cent water, 18 g carbohydrates, 1.9 g proteins, 0.1 g fat, 1.1 g fiber, 30 mg calcium, 287 mg potassium, 0.5 mg iron, vitamin 'A' 50U.I., and thiamine 30U.I.[1]. The fruits of some jackfruit trees suitable for dessert purpose may not be appropriate for making chips due to variation in their biochemical composition [6]. Under such circumstances, proper postharvest technology is necessary to make use of on seasonal production of jackfruit and to avoid postharvest losses. Fried jackfruit chips may be one of the important potential jackfruit products. Chips are packed in packages of various dimensions and materials, including polyethylene, polypropylene and aluminium laminate pouches are used to packages of chips [2]. Keeping this in view, the research program was undertaken to study the packaging and storage stability of chips from jackfruit.

Materials and Methods

Out of 3 genotypes, only 2 genotypes namely, Tane Varikka and Muttom Varikka were found to be better suited for chips production and hence the jack chips produced at optimal frying conditions of these genotypes were selected for storage studies.

The selected jackfruit chips were packed in 3 different types of packages namely, Poly ethylene, PE (P_1), Poly propylene, PP (P_2) and laminated aluminium laminate pouches and stored at ambient condition of Bangalore for two months to study the shelf-life. The packages were thermally sealed to make them air tight. The quality parameters such as moisture content, free fatty acid, peroxide value, thiobarbituric acid value and colour of stored chips were analyzed at regular intervals of 15 days to study the effect of different packaging materials on stored jackfruit chips.

Moisture content

Jackfruit bulbs were subjected to moisture and dry matter analysis as per Association of Analytical Communities [AOAC] protocols. The moisture content was determined for triplicate samples by measuring weight loss of measured sample in a moisture box by desiccation in an oven maintained at 105˚C until constant weight. The dry matter content was estimated as the difference of sample weight and moisture content.

$$\text{Moisture content}\,(\%) = \frac{\text{Initial weight - Final weitht}}{\text{Initial weight}} \times 100$$

Free fatty acids (FFA)

The free fatty acids (FFA) content (acid value) of stored jackfruit chips was estimated by using the method described by Sadasivam and Manickam, 1992 [8]. One percent phenolphthalein solution in 95% aqueous ethanol, 0.1N NaOH solution and neutral solvent were prepared for FFA analysis. About 1 to 10 g of ground chips sample was dissolved in 50 ml of the neutral solvent in a 250 ml conical flask. Few drops of phenolphthalein was added and titrated against 0.1N sodium hydroxides (NaOH). The FFA value was calculated using the following formula:

$$\text{Acid value (mg of NaOH/g)} = \frac{\text{Titre value} \times \text{Normality of NaOH} \times 40}{\text{Weight of sample (g)}} \times 100$$

Peroxide value

Weigh one gram of oil or fat into clean dry boiling tube and add 1 gram of powdered potassium iodide and 20 ml of solvent mixture. Place the tube in boiling water so that the liquid boils within 30 seconds and allow vigorous boiling for not more than 30 seconds. Transfer the content quickly to a conical flask containing 20 ml of 5% potassium iodide solution. Wash the tube twice with 25 ml water each time and collect into the conical flask. Titrate against N/500 sodium thiosulphate solution until yellow colour is almost disappeared. Add 0.5 ml of starch solution, shake vigorously and titrate carefully till the blue colour just disappeared. A blank should also be set at the same time and the peroxide value was calculated using following equation:

$$\text{Peroxide Value (meq/kg of fat)} = \frac{S \times N \times 1000}{\text{Weight of sample (g)}} \times 100$$

Estimation of thiobarbituric acid value (Malondialdehyde content)

According to the method of **Heath and Parker (1968)**[5], the lipid peroxidation rate was estimated by measuring spectrophotometrically the Malondialdehyde (MDA) content as an index. In a test tube, powdered 2 g of crushed sample was taken to which 10 ml of TBA reagent was added. The sample was kept in a boiling water bath for 15 min then filtered. The optical density at 630 nm of filtered solution was measured. To 10 ml of biological sample, with 2.0 ml of TCA-TBA-HCL was added and thoroughly mixed. The solution was heated for 15 min in a boiling water bath. After cooling, the mixed flocculent precipitate was removed by centrifugation at 2500 rpm for 15 min. The absorbance of the sample was determined at 630 nm against a blank that contains all the reagents minus the lipid. The malondialdehyde concentration of the sample can be calculated using extinction co-efficient of $1.56 \times 10^2\ m^{-1}\ cm^{-1}$.

Colour

The tri-stimulus colour (L^*, a^*, b^*) values of jackfruit chips were determined using Minolta Chromameter. The product was ground using domestic mixer and the colour of ground chips powder was measured.

Results and Discussion

During storage, as the storage period increased, the moisture content of chips increased from the initial value 4.23% to 13.14% in PE; 4.26 to 13.25% in PP and 4.26 to 7.73% in Al laminate for 15, 30, 45 and 60 days of storage, respectively for Tane Varikka genotype. For Muttom Varikka genotype also, similar increase in moisture content was observed increased It was clear that, in all packages, the moisture content of chips increased with storage period perhaps due to migration of moisture into the chips from surrounding gases. At a given storage period, the jackfruit chips stored in 300 gauges of PE and PP bags recorded significantly higher moisture content during 2 months observation. However, the moisture content of chips of both Tane Varikka and Muttom Varikka varieties was less in aluminium laminate pouches when compared to other two packages. This is due to more or less impervious nature of Al laminate pouches and the slight increase in moisture of chips in this package was due to headspace moist air.

During storage, the free fatty acids of jackfruit chips in different packages as the storage period increased, the free fatty acids (mg/100 g) of chips decreased from the initial value of 0.246 to 0.011% in PE; 0.110 to 0.012% in PP; 0.116 to 0.002% in Al laminate for 15, 30, 45 and 60 days of storage, respectively for Tane Varikka genotype. Similarly, for Muttom Varikka genotype also the free fatty acids of stored chips increased. The increase in free fatty acids of chips of both Tane Varikka and Muttom Varikka varieties was less in aluminium laminate pouches compared to other two packages. When moisture availability was less as in the case of chips in Al laminate pouches, the increase in free fatty acids was also less. This may be due to hydrolyzation of fat present in the chips to produce free fatty acids.

The peroxide value of stored jackfruit chips of two genotypes namely, Tane Varikka and Muttom Varikka, packed in three types of packages- polyethylene, polypropylene and aluminium laminate. As the storage period increased, the peroxide value increased in all packaging materials both for Tane Varikka and Muttom Varikka chips. The maximum peroxide value was observed in aluminium laminate pouches.

The TBA value of jackfruit chips of two genotypes stored in different packages at ambient condition for a period of 60 days. As the storage period increased, the TBA value of jackfruit chips decreased. In case of Tane Varikka genotype, it decreased from initial TBA value of 70.01 (mg MDA/100 g) to 28.46 in PE; 74.61 to 17.69 in PP and 79.99 to 22.30 Al laminate for 15, 30, 45 and 60 days of storage period, respectively. For Muttom Varikka genotype also, the TBA value decreased during 60 days of storage. The decrease in TBA value of chips during storage may be due to rancidity developed in chips.

The tristimulus colour of stored jackfruit chips in terms of L*a*b* values are presented in Tables 5. From the table, it was observed that as the storage period increased the L* values of chips decreased in all packaging materials. The luminosity L* value of jackfruit chips decreased from the initial value of 63.25 to 61.96 in PE; 62.86 in PP and 62.06 in Al laminate for Tane Varikka genotype. Similarly for Muttom Varikka genotype, the L* value of chips decreased from the initial value of 61.43 to 60.40 in PE; 61.43 to 60.95 in PP and 61.43 to 60.13 in Al laminate for 60 days of storage, The decrease in L* value of chips with storage indicated dulling of product that may be due to chemical reactions. a* value of Tane Varikka chips decreased from the initial value of 6.33 to 5.80 and b* value decreased from 43.39 to 33.23 during 60 days of storage. In the case of Muttom Varikka chips, a* value decreased from the initial value of 6.20 to 4.16 and b* value from 48.36 to 23.50 during 60 days of storage. The variations in both a* and b* values of jack chips with storage indicated change in original colour which is mainly due to complex changes in biochemical properties.

Fig-1 Jackfruit chips from Tane Varikka and Muttom Varikka genotypes

Table-1 *Effect of different packaging materials on moisture content of jackfruit chips during storage*

Packaging Material	Moisture content of chips (% w.b)											
	Tane Varikka						Muttom Varikka					
	Storage period (days)						Storage period (days)					
	0	15	30	45	60	Means	0	15	30	45	60	Means
Polyethylene	4.23	4.32	5.80	8.75	13.14	7.22	4.21	6.27	7.93	9.14	14.09	8.29
Polypropylene	4.23	4.26	4.94	9.97	13.25	7.63	4.21	4.37	6.78	8.28	14.32	7.95
Al Laminate	4.23	4.26	4.30	5.07	7.73	5.16	4.21	4.28	5.32	7.17	8.69	5.43
Means	4.23	3.99	5.00	7.93	11.38	6.48	4.21	4.21	5.33	8.20	12.37	7.22

ANOVA

Genotypes (G)	Tane Varikka (G1)		Muttom Varikka (G2)		
Mean	6.48		7.22		
Packaging material (P)	Polyethylene (P1)		Polypropylene (P2)		Aluminium laminate pouch (P3)
Mean	7.75		7.63		5.16
Storage periods (D)	0 Days (D1)	15 Days (D2)	30 Days (D3)	45 Days (D4)	60 Days (D5)
Mean	5.05	4.10	5.16	8.06	11.87

	F-Value	SEM	CD (@5%)
G	*	0.175	0.495
D	*	0.277	0.782
P	*	0.214	0.606
G x D	NS	0.391	1.106
G x P	NS	0.303	0.857
P x D	*	0.479	1.355
G x D x P	*	1.17	1.920

NOTE: *= Significant, NS = Non significant

Table-2 *Effect of different packaging materials on free fatty acids of jackfruit chips during storage*

Packaging Material	Free fatty acids (%)											
	Tane Varikka						Muttom Varikka					
	Storage period (days)					Means	Storage period (days)					Means
	0	15	30	45	60		0	15	30	45	60	
Polyethylene	0.246	0.170	0.012	0.012	0.011	0.08	0.167	0.123	0.046	0.011	0.009	0.071
Polypropylene	0.246	0.110	0.010	0.010	0.012	0.07	0.167	0.123	0.013	0.011	0.006	0.064
Al Laminate	0.246	0.116	0.011	0.010	0.002	0.07	0.167	0.120	0.010	0.010	0.003	0.062
Means	0.246	0.132	0.011	0.011	0.008	0.08	0.167	0.122	0.023	0.011	0.006	0.060

ANOVA

Genotypes (G)	Tane Varikka (G1)		Muttom Varikka (G2)		
Mean	0.08		0.06		
Packaging material (P)	Polyethylene (P1)		Polypropylene (P2)		Aluminium laminate pouch (P3)
Mean	0.08		0.07		0.07
Storage periods (D)	0 Days (D1)	15 Days (D2)	30 Days (D3)	45 Days (D4)	60 Days (D5)
Mean	0.246	0.132	0.011	0.011	0.008

	F-Value	SEM	CD (@5%)
G	*	0.002	0.005
D	*	0.003	0.008
P	*	0.002	0.006
G x D	*	0.004	0.012
G x P	NS	0.003	0.009
P x D	*	0.005	0.014
G x D x P	*	0.010	0.020

NOTE:*= Significant, NS = Non significant

Table-3 *Effect of different packaging materials on peroxide value of jackfruit chips during storage*

Packaging Material	Peroxide value (meq/ kg of sample)											
	Tane Varikka						Muttom Varikka					
	Storage period (days)					Means	Storage period (days)					Means
	0	15	30	45	60		0	15	30	45	60	
PE	17.0	17.8	23.50	27.47	27.73	22.70	17.07	17.33	18.87	19.67	20.27	18.64
PP	17.0	18.3	23.13	24.30	24.47	21.44	17.07	21.47	21.57	21.63	21.83	20.71
Al Laminate	17.0	18.8	21.20	22.40	24.50	20.78	17.07	18.13	19.33	20.47	21.13	19.23
Mean	17.0	18.13	22.61	24.72	25.57	21.64	17.07	18.98	19.92	20.59	21.08	15.75

ANOVA Table

Genotypes (G)	Tane Varikka (G1)		Muttom Varikka (G2)		
Mean	21.64		15.75		
Packaging material (P)	Polyethylene (P1)		Polypropylene (P2)		Aluminium laminate pouch (P3)
Mean	22.70		21.44		20.78
Storage periods (D)	0 Days (D1)	15 Days (D2)	30 Days (D3)	45 Days (D4)	60 Days (D5)
Mean	17.00	18.13	22.61	24.72	25.57

	F-Value	SEM	CD (@5%)
G	*	0.096	0.273
D	*	0.153	0.431
P	*	0.118	0.334
G x D	*	0.216	0.610
G x P	*	0.157	0.472
P x D	*	0.264	0.747
G x D x P	*	0.65	1.06

NOTE:*= Significant, NS = Non significant

Table-4 *Effect of different packaging materials on TBA value of jackfruit chips during storage*

Packaging material	TBA (mg of MDA/100 g)											
	TaneVarikka						MuttomVarikka					
	Storage period (days)					Means	Storage period (days)					Means
	0	15	30	45	60		0	15	30	45	60	
Polyethylene	70.01	69.22	33.84	29.99	28.46	46.30	71.05	69.99	41.85	30.77	30.00	48.73
Polypropylene	70.01	74.61	33.07	30.07	17.69	45.22	71.05	67.79	33.20	32.30	24.61	45.79
Al Laminate	70.01	79.99	51.53	26.15	22.30	50.00	71.05	66.80	43.77	13.84	11.53	41.82
Mean	70.01	71.40	36.98	27.68	24.96	47.17	71.05	68.19	39.61	25.64	22.75	45.44

ANOVA Table

Genotypes (G)	TaneVarikka (G1)				MuttomVarikka (G2)
Mean	47.17				45.44
Packaging material (P)	Polyethylene (P1)		Polypropylene (P2)		Aluminium laminate pouch (P3)
Mean	46.30		45.23		50.00
Storage periods (D)	0 Days (D1)	15 Days (D2)	30 Days (D3)	45 Days (D4)	60 Days (D5)
Mean	70.01	71.40	36.98	27.68	24.96

	F-Value	SEM	CD (@5%)
G	*	0.466	1.317
D	*	0.736	2.082
P	*	0.570	1.613
G x D	*	1.041	2.944
G x P	*	0.806	2.280
P x D	*	1.275	3.606
G x D x P	*	3.12	5.10

NOTE: *= Significant, NS = Non significant

Table-5 *Effect of different packaging material on tristimulus colour value of chips during storage*

Packaging material	Colour parameters	TaneVarikka					MuttomVarikka				
		Storage period (days)					Storage period (days)				
		0	15	30	45	60	0	15	30	45	60
Polyethylene	L*	63.25	63.20	62.17	62.11	61.96	61.43	61.35	61.10	60.59	60.40
	a*	6.33	6.33	6.00	5.36	5.80	6.20	5.40	5.40	5.20	4.16
	b*	43.93	43.93	40.03	34.83	33.23	48.36	33.43	27.73	26.26	23.5
Polypropylene	L*	63.25	63.20	63.13	63.09	62.86	61.43	61.36	61.13	61.05	60.95
	a*	6.33	5.43	5.06	4.60	4.10	6.20	6.00	5.40	5.40	5.13
	b*	43.93	43.70	43.32	42.90	42.60	48.36	33.63	25.13	26.03	24.6
Al Laminate	L*	63.25	63.16	62.83	62.51	62.06	61.43	61.29	61.15	60.59	60.13
	a*	6.33	6.20	6.17	6.10	5.90	6.20	6.06	5.86	5.30	5.23
	b*	43.93	43.73	43.53	42.14	41.36	48.36	36.30	36.25	36.11	33.70

Conclusion

At ambient conditions, among three packages-polyethylene, polypropylene and aluminium laminate pouches; the last packaging material was found to be best for storing jackfruit chips up to 60 days.

Conflict of Interest: None declared

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