RESEARCH PAPER

FOOD SCIENCE RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 6 | Issue 2 | October, 2015 | 326-332
DOI : 10.15740/HAS/FSRJ/6.2/326-332

Development of raw jackfruit based noodles

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Underexploited jackfruit can be better utilised, if consumer acceptable products like noodles can be prepared from this fruit. Jackfruit bulbs and seeds were subjected to different treatments for preparation of flour. Bulbs and seeds were standardised for optimum width, blanching, immersion in different media, drying and milling. Composite flour was prepared by mixing refined flour, bulb flour and seed flour in different combination (40:30:30, 50:25:25, 50:30:20, 50:40:10, 50:10:40, 50:20:30). Noodles were extruded from these combinations. Noodles were evaluated for sensory parameters. Sensory scores indicated that combinations T_5 (50:10:40) and T_6 (50:20:30) were highly acceptable. Therefore noodles prepared with substituted jackfruit flour were found to be feasible. This nutrient rich noodles will be good source of instant food for all age group people.

Key Words : Jackfruit, Bulb, Seed, Composite flour, Noodle

How to cite this article : Kumari, Veena, Divakar, Suma, Ukkruu, Mary and Nandini, P.V. (2015). Development of raw jackfruit based noodles. *Food Sci. Res. J.,* **6**(2): 326-332.

INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam.) belongs to the family 'Moraceae' and is a native of India. It bears the largest fruits among edible fruits. Even though it enjoyed the status of a heavenly fruit in Kerala ancient periods, it has lost its status and is one of the most under exploited fruits in the state today. Jackfruit has been referred to as the poor man's crop. Amongst the enlightened population of Kerala, it is valued for its nutritional content and medicinal properties. The fresh fruits contain nutritional and health promoting constituents, including vitamins, minerals, antioxidant, and phytochemicals and dietary fibres along with being relatively low in calories (Mukprasirt and Sajjaanantakul, 2004). Its consumption has decreased due to its cumbersome handling procedures. Besides, it is a common practice that after utilizing the bulbs of ripe fruit, the seeds rich in carbohydrates and proteins are usually discarded as waste. The market potential of jackfruit can be promoted if the fruits are made available to the consumer in a ready to eat or ready to cook form throughout the year. Moreover it has become necessary to open new avenues for its better utilization, as traditional uses have already become stabilized. There lies a great opportunity for non-traditional uses of jackfruit in the form of convenience foods like noodles. In this scenario of health and changing life styles, the demand for ready to cook foods like extruded foods has raised considerably. This is mainly due to change in perceptions, economic considerations, westernization, urbanization, busy times schedules, increased women employment and increased per capita income (Anand, 2011). Among ready to cook foods, 'noodles' form an

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important part of urban dietary. These products are rich in starch, fat and energy but are lacking in fibre. Fibre content of commercial noodles was found to be of negligible quantity. Various epidemiological studies have shown that the diet lacking in fibre may be the cause of various gastrointestinal and cardiovascular diseases (Kumari and Grewal, 2007). Kulkarni *et al*. (2012) standardised 30 per cent unmalted and malted ragi flour noodles and reported that their concentration was high due to ragi which is good source of fibre. Hence, this study envisages incorporating raw jackfruit seed flour and bulb flour in the development of an extruded product- namely, noodles. Besides convenience, such products are necessary in the context of food security, as Kerala situation demands, the systematic exploitation of hitherto under exploited and unexploited food sources like jackfruit.

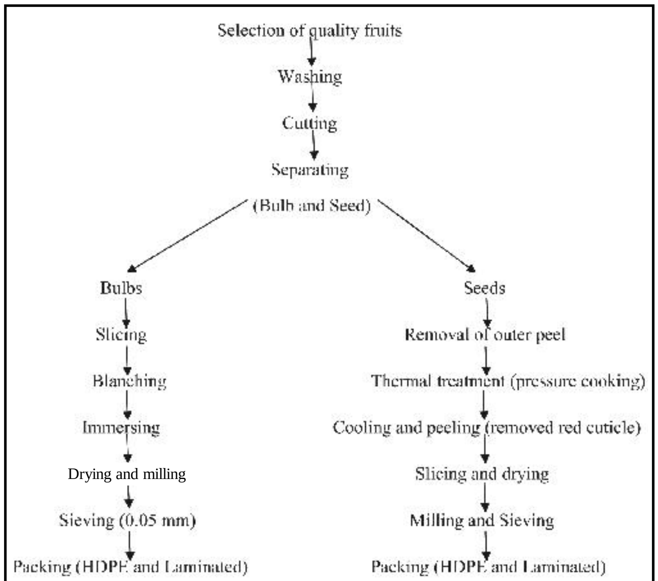

Fig. A : Flow diagram for preparation of raw jackfruit flour (RJF) flour

METHODOLOGY

Selection and collection of jackfruit :

Jackfruit cultivar *koozha* was selected for the study owing to its abundant availability and lower utilisation. Raw mature (90-110 days) fruits were procured from Instructional Farm, College of Agriculture, Vellayani. The other ingredients namely refined flour; and iodised salt were purchased from super market.

Processing of flour from raw jackfruit bulbs and seeds:

One of the most pressing problems associated with jackfruit is its seasonal availability, handling and storage. The problem associated with the availability, bulkiness and perishability can best be solved if more of the harvested fruits are processed into chips, and flour. Dried jackfruit chips, seeds and flour have a longer shelf life than the fresh fruits (Fig. A).

Cleaning and recording weight :

Freshly harvested jackfruits were washed under clean running water and then cleaned from sterilised water and cut into large slices. The bulbs and seeds were separated from fruits. The fresh weight of whole jackfruit, bulbs and seeds were recorded in order to determine the final yield of the processed product after dehydration.

Standardization of width of raw material (bulb and seed) :

Optimum width of the jackfruit bulbs and seeds were selected by the Over-all visual quality (OVQ) scores. OVQ scores were given using 9 point scale where, 9 refers to excellent appearance, 7 to good, 5 to fair (limit of marketability), 3 to fair useable but not saleable and 1 to unusable (Yuan *et al*., 2010), by a panel comprising of 10 members. Different variations in width of jackfruit bulbs (lengthwise) and seeds (crosswise) were studied.

Standardization of blanching time of raw jackfruit bulb :

The best identified widths of jackfruit bulb were subjected to blanching in steam and then immediately immersed in cold water. The optimum blanching time was thus identified by analysing the scores of overall visual quality (OVQ) as rated by the sensory panel after blanching for different durations of time.

Standardization of boiling time of seeds :

The jackfruit seeds were cleaned manually and white arils (seed coat) were manually peeled off. The spermoderm layer was removed by rubbing the seeds between the hand and washing thoroughly under running water. It was then subjected to pressure cooked in various durations of time, and cooled. The red cuticle was peeled off and the seed was cut crosswise into thin and small pieces of different width and the optimum width was selected from the scores given by the sensory panel.

Standardization of immersion media for the bulbs :

The various treatments applied to the blanched slices of jackfruit bulb. Five hundred grams of blanched slices were immersed in one litre water with the respective additives. The best of these variations were again identified by analysing the scores of OVQ after the treated material were drawn out and then rated by the sensory panel.

Standardization of immersion time :

The blanched bulbs were immersed in the selected media for different durations of time. Most suitable immersion time in the selected media for retaining maximum sensory qualities was identified on the basis of scores obtained by OVQ score.

Dehydration and milling :

The pre-treated bulbs and seeds were drained and dried in a cabinet drier at 60^0C till crisp and breaking stage. They were milled into fine flours separately and sieved through a 0.05 mm sieve and packed in HDPE and laminated covers for further analysis.

Formulation of noodles :

Maida, bulb flour and seed flour were combined in different proportions to prepare composite flour for the noodles. In all the combinations, bulb and seed flour were varied while refined flour remained same except one. The current trend is to develop composite flours based food products with enhanced nutritional as well as other quality traits that add variety to the food basket (Baljeet *et al*., 2014). Maida gives volume to the composite flour and lacks a strong flavour or taste. Such qualities are essential as an ingredient in extruded products.

Extrusion of noodles :

Water was added in 3 phases to the composite flour and kept, for refrigeration so as to maintain the moisture level at 33 per cent. This moist flour was placed in Brabender single screw food extruder (Japan) and the temperature was set in 3 different zones were 35^0C, 45^0C, and 60^0C. The other parameters set for the extrusion were- Screw speed - 40 min-1, dosing screw speed - 15 min-1, speed of feeder - 16 rpm, size of the die - 2 mm x 4 strands. The extruded sheets were cut into strips. The noodles strips were dried in the cabinet dryer at 60^0 C and sealed in HDPE and laminated covers for further analyses (Fig. B).

Fig. B : Flow chart for extrusion of noodles

Sensory evaluation of jackfruit noodle :

All the six treatments were reconstituted and evaluated by a panel of 10 trained judges from Department of Home science and compared with commercial noodles. Sensory characteristics like appearance, colour, texture, taste and overall acceptability of the noodles were assessed by using a five point scale.

Statistical analysis :

The data obtained was analysed statistically to determine statistical significance of treatment. The significant difference was assessed with ANOVA using ICAR Goawasp 2 software at a significance of 0.05 per cent level

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized in Tables 1 to 5 :

Cleaning and recording weight :

As jackfruit was obtained directly from farm, it was cleaned to remove external impurities which had adhered during carrying or transportation. The Food and Drug Administration state that all fruits and vegetables, including those that are organically grown, could benefit from a thorough washing to reduce soil, surface microbes and some pesticides. It can be seen that on an average the yield of wet bulb and seed ranged from 45.98 to 58.15 per cent from raw jackfruit; whereas dry yield of bulb and seed ranged from 15.03 to 21.03 per cent.

Standardization of width of slices :

Selection of appropriate width of slices of the vegetables or fruits to be dried is very important, as thicker slices will dry at a slower rate or may not dry fully and it may subsequently deteriorate after packing than thinner pieces. And in the case of very thin pieces there is a tendency to stick to the drying trays and they will also be difficult to remove.

Width of slices was varied keeping in mind that water loss increases with increase in the surface area of fruit pieces. It was assured that all of the pieces are about same size, so that they would dry at the same rate (James and Kuipers, 2003). OVQ scores for the different treatments revealed that T_3 i.e. bulb slices of 2.5 x 1 cm was found to be the most accepted dimension with a score 8.20. In case of width of seeds, the highest OVQ score 8.65 was recorded for T_3 (1.5 x 1 cm) sized slices. When chips are thick the outer layer easily compresses, thereby preventing the free air movement through the mass (FIIR, 2005). Abano and Samamoah (2011) reported that the rate of drying time depends on temperature of the drying air and thickness of the slices. Oghenechavwuko *et al.* (2013) reported that cassava tubers were cut into chips of 2.0 cm thickness for faster dehydration. Rengsutthi and Charoenrein (2011) reported that jackfruit seeds were sliced (2 mm) and tray dried at 45^0 C until the moisture content was less than 13 per cent for obtaining seed starch.

Standardization of blanching time :

Blanching vegetables to inactivate endogenous enzymes is a critical step prior to processing. However, the severity of the process should be limited in order to maintain colour, texture, flavour, and nutritional quality. These blanching conditions permit a decrease in the activity of catalase and peroxidase to a level below 5 per cent of the initial value. The total absence of peroxidase activity indicates over blanching and there is a substantial body of evidence suggesting that the quality of products frozen after blanching is superior if a certain level of peroxidase activity remains at the end of the blanching process (Kmiecik *et al*., 2008). Kendall *et al*. (2005) reported that heat treatment expands the tissue of vegetables, so that the slices will dry faster. Blanching time of 1 min score highest OVQ score (8.67) as it was obtained by T_1.

Standardization of boiling time of seed :

Boiling helps to remove the brown layer and helps in easy cutting of seeds. This also prohibits the activity of trypsin inhibitors. The optimum boiling time of 20 min scored the highest in OVQ. Powerful trypsin inhibitory activity was reported in jackfruit seeds and it was seen that the activity could be destroyed by boiling the aqueous solution of seed at 100^0C for 40 minutes (Bhat and Pattabiraman, 1989). Ejiofor and Owuno (2013) too had boiled jackfruit seeds for various durations of time to get the flour and to know the effect of processing methods on the functional and compositional properties of flour. The highest score (7.86) was obtained by T_5 being 20 min.

Standardization of pre- treatment media :

Pre-treating light-coloured fruits before drying is important for the quality and safety of the final product (Robinson, 2012). On analysing the OVQ scores for the

Table 1 : Yield of jackfruit bulb and seed

Sr. No	Whole weight of jackfruit (kg)	Wet weight (bulb + seed) (kg)	Dry weight (bulb + seed) (kg)
1.	10. 275	5.310 (51.67)	1.580 (15.37)
2.	13. 550	7.880 (58.15)	2.050 (15.12)
3.	15.465	7.635 (49.36)	2.325 (15.03)
4.	19.220	9.451 (49.17)	4.043 (21.03)
5.	20.00	9.197 (45.98)	3.085 (15.42)

Figures in parenthesis denotes percentage

6 different treatments, the treatment T_2 with KMS (0.2%) was observed to have the highest score. According to Rahman *et al*. (1999) jackfruit bulbs treated with 0.1 per cent KMS before osmotic dehydration gave the most acceptable product. Ioannou and Ghoul (2013) reported that appropriate chemical pre-treatments can be adopted to preserve colour and inactivate enzymatic action.

Standardization of immersion time :

Immersion of vegetables in alkaline or acid solution prior to drying of vegetables prevents discolouration (Sunkja and Raghavan, 2004). T_3 for 10 minute gave the highest score (8.22) for OVQ among all the treatments. In the preparation of jackfruit candy, jackfruit bulbs were cut into 1 x 0.5 cm sized pieces, blanched in hot water for 4 min and immersed in 2 per cent calcium lactate and 0.1 per cent KMS solution for 2 min. It was inferred that higher immersion time increased the strength of the product (Zuniga *et al*., 2004).

Sensory qualities of noodles :

Sensory evaluation plays an important role in acceptability of a new product. Numerical scoring is generally used to evaluate particular characteristics of one or more samples indicating the rating as excellent, very good, good, fair and poor (Manay and Swamy, 2000).

Appearance :

The first impression of food is usually visual and a major part of willingness to accept a food depends on its appearance. It can be noticed from the data that T_5 scored the highest (4.59) among all six treatment for appearance, though T_7 (commercial noodles) scored higher (5.00) than T_5. Treatment T_5 was immediately followed by T_6 with the score of 4.42. T_2 T_1 and T_3 scored 3.87, 3.79 and 3.71, respectively. The lowest score was obtained by T_4 (2.98).

Colour :

Colour is one of the important visual attributes that has been used to judge the overall quality of foods for a very long time. If the colour is unattractive, a potential consumer may not be impressed by any other attribute. The data revealed that there was a significant difference in the score obtained for colour. The highest score was obtained by control (5.00) in comparison with the other six treatments. The second highest score obtained by T_5 and it was followed by T_6 with the score of 4.77 and 4.74, respectively. The other three treatments T_1, T_2 and T_3 scored less compared to above three treatments (3.89, 3.72 and 3.55, respectively). The lowest score was obtained by T_4 (3.37).

Texture :

Texture constitutes a physical property of food stuffs apprehended by the eye, skin and muscle senses located in the mouth. Score for texture of developed noodles was high in T_5 and T_6 with the score of 4.89 and 4.75 and they were at par. The next highest score was observed in T_3 (4.54) and T_4 (4.21). Highest score was obtained for

Table 2 : OVQ scores of dimension of bulbs and seeds

Sr. No	Treatments	Bulb (cm)	OVQ score bulb	Seed (cm)	OVQ score seed
1.	T_1	1.5 x 1	6.90	0.5 x 0.5	6.30
2.	T_2	2 x 1	7.25	1 x 1	7.40
3.	T_3	2.5 x 1	8.20	1.5 x 1	8.65
4.	T_4	3 x 1	7.65	2 x 2	7.65
C.D. (P=0.05)		1.394		1.207	

Results are expressed as mean values of ten replicates

Table 3 : OVQ scores of blanching and boiling time of bulb and seed

Sr. No.	Treatments	Blanching time of bulb (min. sec)	OVQ score of bulb	Boiling time of seed (min. sec)	OVQ score of seed
1.	T_1	1.00	8.67	5.00	3.20
2.	T_2	1.30	7.81	7.00	4.17
3.	T_3	2.00	7.72	10.00	4.92
4.	T_4	2.30	5.49	15.00	6.82
5.	T_5	3.00	2.95	20.00	7.86
6.	T_6	3.30	1.52	25.00	5.85
C.D. (P=0.05)		1.463		1.756	

Results are expressed as mean values of ten replicates control (4.91) with respect to texture assessment. Least score for texture was shown in T_1 (3.65) followed by T_2 (3.73).

Taste :

Taste is the major attribute which determines the acceptability of a food. Results revealed that taste of the developed noodles was appreciably high in all the treatments as shown in Table 6. All the treatments had scored higher values, though the highest scores was observed in T_6 (4.93) and T_5 (4.87) among developed treatments. Commercial noodles had higher values among all the treatments (4.96).

Overall acceptability :

Overall acceptability comprises appearance, colour, texture and taste of developed products. The data in revealed that overall acceptability was higher for T_5 (4.78). The next higher score was obtained by T_6 and T_3 with the score of 4.71 and 4.14, respectively. All the treatments had lower values than control (4.96).

Conclusion :

Based on organoleptic evaluation T_5 and T_6 was selected as the best combinations which are based on refined flour, JF bulb flour and JF seed flour and in the ratio of 50:10:40 and 50:20:30, respectively. Though sensory scores were lower than that of control, they were not found to be significantly different. It can be affirmed that the nutritional quality will be higher, owing to the substitution of refined flour with jackfruit flour. Additives like colour and adhesive could improve the quality of

Table 4 : OVQ scores of immersion media of jackfruit bulb

Sr. No.	Treatments	Particulars of immersion media (%)	OVQ score
1.	T_1	Salt (0.5)	6.15
2.	T_2	KMS (0.2)	7.70
3.	T_3	Citric acid (0.2)	6.42
4.	T_4	Salt (0.5) + KMS (0.2)	7.49
5.	T_5	Salt (0.5) + Citric acid (0.2)	7.22
6.	T_6	KMS (0.2) + Citric acid (0.2)	7.45
		C.D. (P=0.05)	NS

(Results are expressed as mean values of ten replicates) (NS- not significant)

Table 5 : OVQ scores of immersion time of jackfruit bulb

Sr. No.	Treatments	Time (min)	OVQ score
1.	T_1	5.00	5.42
2.	T_2	7.00	5.89
3.	T_3	10.00	8.22
4.	T_4	12.00	5.65
5.	T_5	15.00	4.65
	CD (P=0.05)		0.736

(Results are expressed as mean values of ten replicates)

Table 6 : Scores of sensory evaluation

Sr. No.	Treatments	Appearance	Colour	Texture	Taste	Overall acceptability
1.	T_1	3.79	3.89	3.65	4.45	3.92
2.	T_2	3.87	3.72	3.73	4.29	3.90
3.	T_3	3.71	3.55	4.54	4.78	4.14
4.	T_4	2.98	3.37	4.21	4.71	3.81
5.	T_5	4.59	4.77	4.89	4.87	4.78
6.	T_6	4.42	4.74	4.75	4.93	4.71
7.	T_7 (control)	5.00	5.00	4.91	4.96	4.96
	C.D. (P=0.05)	0.516	0.474	0.408	0.035	0.533

(Results are expressed as mean values of ten replicates) the product.

Acknowledgement :

Support rendered by Central Tuber Crop Research Institute (CTCRI), Sreekaryam extruder (Brabender single screw food extruder) facility.

The financial assistance of Kerala Agricultural University is deeply acknowledged.

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Received : *25.08.2015;* **Revised:** *05.09.2015;* **Accepted :** *14.09.2015*