DEVELOPMENT AND QUALITY ASSESSMENT OF COMPOSITE STRING HOPPERS DEVELOPED BY USING THE JACK SEED FLOUR (Artocarpus heterophyllus L.) AND THE RICE FLOUR (Oryza sativa)

M.R.F. Rukshana and M.B. Fathima Jemziya

Department of Biosystems Technology, Faculty of Technology,
South Eastern University of Sri Lanka,
Sri Lanka

jemziya@seu.ac.lk

ABSTRACT: *The study was done to produce the string hoppers using composite flour of jackfruit seed (Artocarpus heterophyllus) and rice flour (Oryza sativa) and to determine the quality properties of the final sample. The different ratios of mixtures of rice flour (Samba) and jackfruit seed flour (Varikka) were mixed in the proportions of 100:0, 95:05, 90:10, 85:15, and 80:20 (w/w). The mixtures (100g) were combined with dissolved salt (2 g) water (0.5 l) and the types of dough were prepared. The string hoppers were developed and steamed. Then, they were subjected to quality determination using AOAC 2000 and the data were statistically interpreted at 0.05 significant level. The proximate analysis of jackfruit seed flour revealed that it contained 5.78% protein, 2.49% crude fibre, 1.77% fat, 15.88% moisture, 2.62% total mineral content and 71.46% of carbohydrates. The sensory determination showed that the string hoppers complemented with 5% of jackfruit seed flour were well accepted for their colour, texture, flavour, mouth feel and overall acceptability related to the other mixtures and they were closely resembled the rice flour string hoppers. The mixture of 5% jackfruit seed flour and 95% of rice flour was fruitful for the preparation of string hoppers with best physico-chemical and sensory qualities.*

Keywords: Composite flour, development, Jackfruit seed flour, Rice flour, String hoppers, Quality characters

1. INTRODUCTION

Jack tree (Artocarpus heterophyllus) has its place to the family Moraceae. It is an evergreen largest tree, which can grow to height up to 50 ft, has a strong sturdy trunk, and long branches sprout. Jackfruit is the climacteric fruit, which is sweet and delicious. It consists of pulp (29%), seeds (12%) and rind 54% (Aziz, 2006). The unripe fruit can be consumed as a vegetable by cooking and ripen fruit can be eaten as fresh. The dimension of jackfruit seeds can be described as round or oval shape with 2-3 cm length and 1-1.5 cm in diameter (Prakash et al.). The light brown seeds have fleshy white cotyledon covered over by thin brown spermorderm, and white aril.

The seeds are in the proportion of 10-15% of the total fruit weight and also can be processed by the way of utilizing excellent source of important nutrients such as carbohydrate and protein, displayed in Table 1. Further, they are good source of starch (22%) and dietary fiber (3.19%) (Hettiarchi et al., 2010). The seed contains phytonutrients including lignans, isoflavones and saponins. Moreover, it has wide range health benefits including anticancer, antiaging, antioxidant antihypertensive, antiulcer and more (James and Friday, 2010).

Table 1. Nutritional composition of jack seed fruit

Composition of jackfruit seed (100g edible portion)	
Composition	Value
Water (g)	51.0 - 64.5
Proteins (g)	6.6 - 7.04
Fat (g)	0.40 - 0.43
Carbohydrates (g)	25.8 - 38.4
Fiber (g)	1.0 - 1.5
Calcium (mg)	50.0
Magnesium (mg)	54.0
Phosphorus (mg)	38.0 - 97.0
Potassium (mg)	24.6
Sodium (mg)	63.2
Iron (mg)	1.5
Vitamin A (iu)	10 - 17
Thiamine (mg)	0.25
Ribo flavin (mg)	0.11 - 0.30
Vitamin C (mg)	11.0

(Source; Narasimham *et al*., 1990; Azad *et al.,* 2000; Arkroyd *et al*., 1996; Gunasena *et al*., 1996)

Jack seeds have wide of usage in value addition techniques, which can be processed into flour. The flour is used for preparing many value added products such as bread, biscuit, cake, cookie and string hopper. String hopper is the one of the mostly consumed foods in Sri Lanka, which can be prepared by using either rice flour or wheat flour. Composite string hoppers of jack seed flour would be an innovative food product and highly nourishing food. Furthermore, jackfruit seed are the by-product and are considered as food waste materials. Therefore, they can be obtained easily and cheaply. By incorporating jack seed flour for preparing string hopper is most beneficial for consumers because of its high nutritional composition. The aim of this study was to prepare a novel food product by using under-utilized waste materials of jackfruit.

2. MATERIALS AND METHODOLOGY

2.1. Procurement of raw materials and ingredients

The jackfruit seeds were collected from the home garden (Varikka). The white rice (Samba) and salt were obtained from the local market. The method of preparation of the jack seed flour and rice flour were described in Figure 1 and Figure 2 respectively.

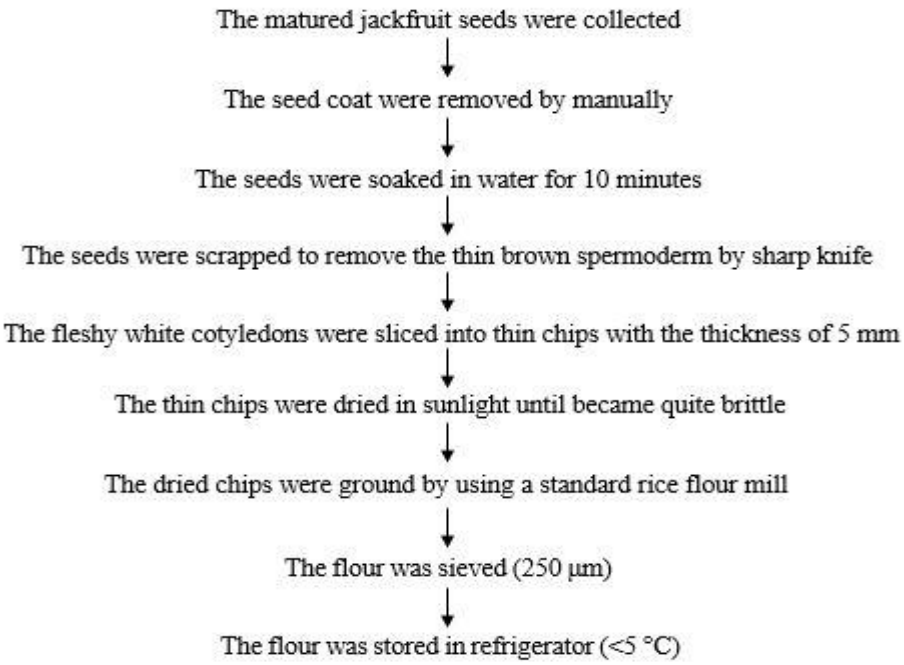

Figure 1. The flow chart of the preparation of the jack seed flour

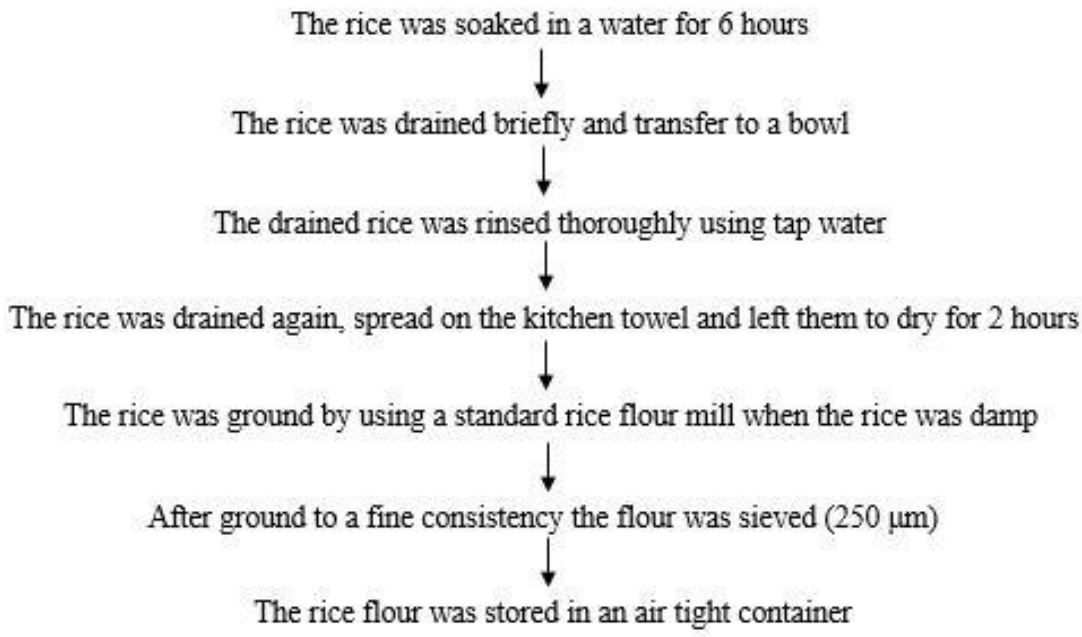

Figure 2. The flow chart of the preparation of the rice flour

2.2. Experimental Design

The experiment was done with six treatments for 100 g mix. The development technique of the composite string hoppers was illustrated in Figure 3.

T1 (control): The rice flour (100 g)
T2: The rice flour (95 g) + the jackfruit seed flour (05 g)
T3: The rice flour (90 g) + the jackfruit seed flour (10 g)
T4: The rice flour (85 g) + the jackfruit seed flour (15 g)

T5: The rice flour (80 g) + the jackfruit seed flour (20 g)

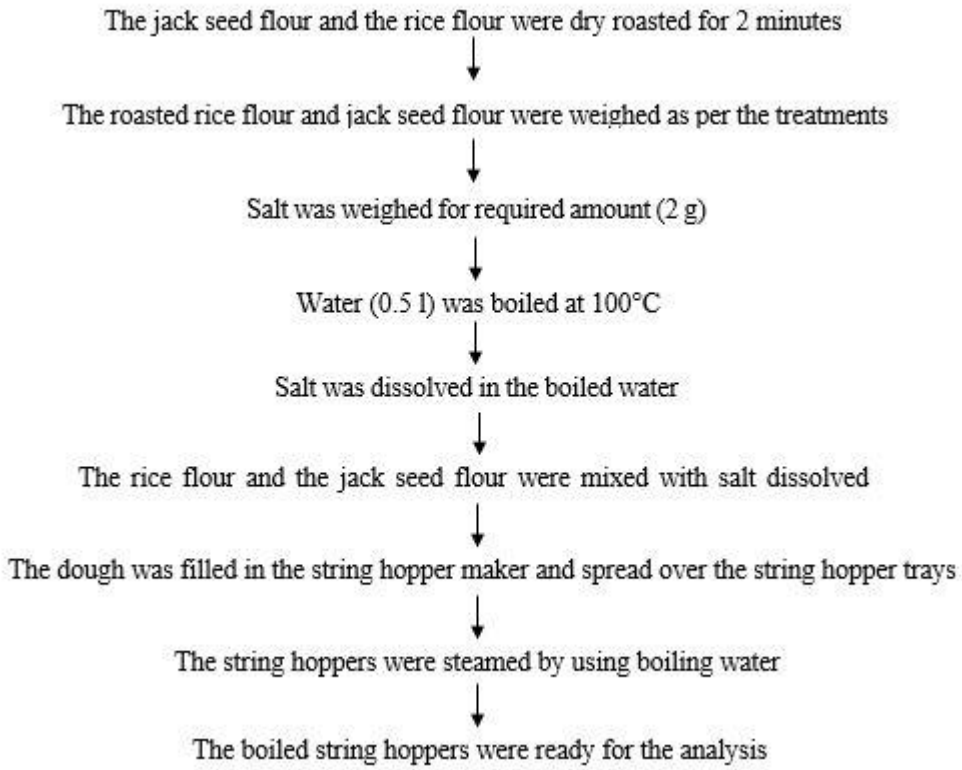

Figure 3. The flow chart of the development of the composite string hoppers.

2.3. Nutritional and Sensory Analysis of the Jack Seed Flour and the Rice Flour Composite String Hoppers

Nutritional quality of the composite string hoppers made by jack seed flour and wheat flour were analysed (AOAC, 2016). The mean differences were compared by Duncan's Multiple Range Test (DMRT). The sensory properties including texture, colour, flavour, mouth feel and overall acceptability were assessed by a skilled panel with 20 members. The nine-point hedonic scale was implemented to determine the observable variances in strength of an characteristic among treatments. Further, the mean differences were compared by Friedman test using SPSS 22.0 at 0.05 significant level.

3. RESULTS AND DISCUSSION

3.1. Physicochemical Composition of the Jack Seed Flour

The physicochemical composition of the jack seed and the rice flour are illustrated in Table 2. The nutritional value of the jack seed flour closely resembled the results obtained by Shariful et al. (2015), Satheeshan et al. (2019) and Ocloo et al. (2010). Similarly, the nutritional value of rice flour is relatively as the values obtained by Olugbenga and Magoh (2019).

Table 2. Nutritional composition of the jack seed and the rice flour.

Composition	Values (% Dry Matter)	
	Jack Seed Flour (Varikka)	Rice Flour (Samba)
Moisture	7.88 ± 1.26	6.51 ± 0.26

Protein	11.78 ± 0.04	10.25 ± 0.31
Fat	1.66 ± 0.03	4.22 ± 0.05
Crude fiber	1.49 ± 0.04	3.15 ± 0.02
Ash	2.23 ± 0.16	1.40 ± 0.01
Total carbohydrates	74.45 ± 0.21	77.62 ± 1.24

The values are means of triplicates ± standard error mean (SEM)

The moisture content determines the storability of food products. The lesser the moisture content extend the shelf constancy and value of products. The moisture content of the jack seed flour also had lower value (7.88%), and which can be storable at optimum conditions for long days like other types of common flour. The protein content of products may vary with varietal differences, maturation of the seeds, method of cultivation and environmental factors. The ash content reflects the existence of minerals. The jack seed flour mainly composite by such minerals including calcium (Ca), magnesium (Mg), iron (Fe) and sodium (Na) (Ocloo et al. in 2010). The protein and mineral content of the jack seed flour comparatively higher than the value of the rice flour. The fat, fiber and total carbohydrate content slightly higher in rice flour compared to the jack seed flour. However, the jack seed flour had a better profile to compete other types of common flour.

The sensory assessment of the string hoppers exposed that there were significant differences ($p < 0.05$) observed between the samples in terms of texture, colour, flavour, mouth feel and overall acceptance (Table 3), when jack seed flour was increased from 0 (T1) to 20% (T5). The different rates of predilection, satisfactory values of panellists and the quality of finished products those were prepared may be the reasons to have the different patterns of scores.

Table 3. Sensory scores of the jack seed flour and rice flour string hoppers

Treatment (T)	Texture	Colour	Flavour	Mouthfeel	Overall acceptability
T1 (control)	8.1 ± 0.233^{c}	8.6 ± 0.221^{c}	8.6 ± 0.221^{c}	8.1 ± 0.233^{d}	8.7 ± 0.153^{d}
T2	7.0 ± 0.210^{bc}	6.5 ± 0.373^{b}	7.6 ± 0.340^{c}	7.5 ± 0.269^{cd}	7.3 ± 0.300^{cd}
T3	5.6 ± 0.542^{b}	5.0 ± 0.516^{ab}	6.1 ± 0.407^{b}	4.8 ± 0.416^{b}	2.5 ± 0.307^{ab}
T4	7.0 ± 0.211^{bc}	5.0 ± 0.422^{ab}	5.6 ± 0.371^{b}	6.5 ± 0.373^{c}	2.8 ± 0.359^{b}
T5	3.3 ± 0.473^{a}	4.3 ± 0.423^{a}	2.8 ± 0.291^{a}	3.6 ± 0.427^{ab}	2.4 ± 0.267^{ab}

The values are means of 20 replicates ± standard error.
Within a column, means followed by the same letter are not significantly different by the Friedman's test at p=0.05.

Texture and mouth feel are the important sensory factors interrelationship with physical and functional characteristics of the products. The jack seed flour had range of functional properties including with optimum ranges of water absorption capacity, fat absorption capacity, dispersibility, swelling power and solubility (Shariful et al., 2015). The T1 had high mean score for the texture and mouth feel followed by T2 and T4. However, there were no significant differences ($p > 0.05$) between the texture and mouth feel of the rice flour string hoppers and 5% jack seed flour incorporated string hoppers. The colour of the string hoppers changed from off white to dark brown, and mean scores were with a decreasing trend. The Maillard reaction; reaction of reducing sugars and protein may develop the dark colours on the product during the processing. The colour of the composite string hoppers were significantly deviated from the string hopper made by the sole rice flour.

Flavour is the determining factor of the acceptability of any product in terms of taste and aroma, which has the main effect on the market retaining of the products. The string hoppers containing 5% of the jack seed flour had highest mean value of flavour

compared to other combinations. However, there was no significant differences between the control and T2. The string hoppers from the T2 that consisted of 5% of the jack seed flour had the peak mean value than the other string hoppers mix for the overall acceptance. Eventually, 5% composite string hoppers simply resembled the string hoppers with 100% rice flour. Certain studies were also dealt to determine the best formulation of jack seed flour composite products, of which 30% for biscuits (Shariful et al., 2015), 10% for halwa (Satheeshan et al., 2019), and 25% for bread (Mohammad et al., 2014).

4. CONCLUSION

The jack fruit seeds are the food waste material and the underutilized seed with the higher nutritional properties. The composite string hoppers of the jack seed flour (5%) is the one of the best small business ideas which will be preferred by consumers who are more health conscious on their food habit.

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