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Research article

Physico-chemical, functional properties and storage characteristics of jackfruit seed flour

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A B S T R A C T

The aims of the present study were to determine the physico-chemical, functional properties and the storage qualities of jackfruit seed flour. The jackfruit seeds were removed from fruits, peeled and dried up as sliced seeds at 600C for 24 hours and grinded to produce flour. The flour produced from seeds was 60%, of the total weight. The flour had high water absorption capacity, fat absorption capacity and dispersibility, which were 11%, 12.4% and 28%, respectively. The highest viscosity - 1019 cps was in 10% concentrated cold paste compared with hot slurry (812 cps). The seed flour with brown spermoderm contained more crude fibre (2.87%), ash (3.92%) and crude fat (1.98%) than the flour without it. The seed flour was stored for three months at ambient (21 to 300C) and refrigerated conditions (60C) and the moisture content was checked at monthly intervals. After three months of storage, the moisture content of flour at the refrigerated condition increased slowly than that observed at the ambient temperature. The evaluated sensory parameters showed that the stored flour did not have any noticeable change.

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INTRODUCTION

Jackfruit *(Artocarpus heterophyllus L.),* also known as jaca or breadfruit, is primarily grown in Asia, Central Africa and South America. It belongs to the family Moraceae. During ripening the fruits turn brown and deteriorate quickly in post ripening stage. Ripe jackfruits consist of 29% pulp, 12% seeds and 54% rind (Aziz, 2006). The seeds are edible and nutritious and fresh seeds are high in starch, low in calcium and considered as a good source of vitamin B1 and B2 (Fernandes *et al.,* 2011). High carbohydrate and other nutritional content of the seed make it a suitable ingredient in bakery products, such as bread to increase fibre content (Amin, 2009).). Jackfruit seeds were used in noodles that resulted in more protein content and improvement of overall nutritional value of the noodles (Amin, 2009). The seeds may be boiled, or roasted and preserved in syrup like chestnuts. Roasted, dried seeds were ground to produce flour which was blended with wheat flour for baking (Airani, 2007). Jackfruit seeds are a good source of starch and dietary fiber (Hettiarachchi *et al.,* 2011). Foods that contain low-calorie sugar and fat-replacers are popular due to increase in nutritional and health awareness in the calorie reduction in the diet (Dilek *et al.,* 2007). Jackfruit seed contains lignans, isoflavones, saponins, all phytonutrients and their health benefits are wide-ranging, from anti-cancerous to antihypertensive, anti-aging, antioxidant, antiulcer, and so on (Omale and Friday, 2010).Jackfruit has been observed to have high levels of protein, starch, calcium and thiamine (Ocloo *et al.,* 2010). Jackfruit seed powder contains manganese and magnesium elements, and also 2 lectins: jacalin and artocarpin (Barua and Boruah, 2004). Jacalin is useful for the evaluation of the immune status of patients infected with the human immunodeficiency virus 1 (Haq, 2006). Some functional properties of jackfruit seed flour were conducted in some earlier studies. Overall, jackfruit seed flour has a great potential to the food industry, especially as thickener and binding agent in various food systems (Tananuwong *et al.,* 2002 and Odoemelam, 2005). However, very limited work pertaining to the physico-chemical and functional properties of jackfruit seed flour was carried out in Bangladesh. Thus, the present study was aimed to prepare jackfruit seed flour with and without brown spermoderm to assess the functional and physico-chemical properties of flour, to observe the storage characteristics of the flour and to evaluate sensory qualities after storage period.

MATERIALS AND METHODS

Sample preparation

The seeds were removed from the fruits, cleaned and the white arils were removed manually. Half of the seeds were lye-peeled by soaking with 3% NaOH solution for 3-5 minutes to remove brown spermoderm which covers the cotyledon. The seeds with and without brown layer were sliced, dried at 600C for 24 hours and grinded separately into powder and passed through 105 ? mesh sieve and stored at refrigerated condition (60C) for further uses.

Physical character

Hundred grams of jackfruit seed were considered for yield calculation. After the processing into flour the total flour was weighed and expressed as percentage.

Physico-chemical analysis

The percentage of moisture content, ash content, crude protein, crude fat and crude fibre content were analyzed by AOAC (2004) method. The total carbohydrate was calculated by subtracting percentages of moisture, ash, protein and fat content from 100 (Pearson, 1976). The calorific value was computed by summing up the values obtained by multiplying the values of carbohydrate, crude protein and crude fat with the factors 4.1, 4.1 and 9.3, respectively and expressed as Kcal per 100 grams sample.

Functional properties

Water absorption capacity

Twenty grams of seed flour was taken and required quantity of water added to get dough of moderately stiff consistency. The amount of water required was noted and calculated as percentage (Airani, 2007).

Oil absorption capacity

One gram of seed flour sample was taken in a centrifuge tube and weight was taken. Six ml of refined oil was added to the flour and centrifuged at 4000 rpm for 25 minutes. Free oil was decanted and weight of the centrifuge tube was taken (Airani, 2007). Percentage of fat absorption capacity was calculated by the following formula:

Fat absorption capacity (%)

$$\frac{\text{Wt. of sample after centrifugation - Wt. of sample before centrifugation}}{\text{Wt. of original sample}} \text{ X 100}$$

Dispersibilty

Dispersibility was measured by placing 10 grams of jackfruit seed flour sample in 100 ml stopper measuring cylinder and then distilled water was added to the volume of 100 ml, stirred vigorously and allowed to settle for three hours. The volume of settled particles was subtracted from 100 and the difference was reported as percentage dispersibility (Airani, 2007).

Viscosity

The viscosity of cold and hot seed flour paste was tested at 5 and 10 percent slurry concentrations (100 ml) using viscometer at 100 rpm with spindle number two (Brooke field viscometer) (Airani, 2007).

Storage studies

Twenty five grams of seed flour was weighed and packed in food grade polyethylene pouches, and heat-sealed. The samples were kept at both ambient and refrigerated conditions. The stored samples were drawn at monthly intervals for 3 months and moisture content was checked by AOAC method (2004). The sensory attributes were evaluated after 3 months.

RESULTS AND DISCUSSION

Physical character

The weight of 20 jackfruit seeds was 100 gm. After removal of white arils, the weight of the seeds decreased to 98 gm. The weight of the brown spermoderm recorded to be 9 gm, thus reducing the seed weight to 89 gm. The lye peeled and dried seeds were milled to produce flour, the weight of the flour was 68 gm. The total crude yield of the flour, exclusive of weight of the white arils, brown spermoderm and handling losses represented 68 percent. Therefore, total flour yield from 100 gm seeds through 100µ sieves was found to be 60% (Figure 1). The result was similar to those estimated by Airani (2007).

Functional properties

Results of the water and oil absorption capacities, dispersibility for white seed flour are outlined in Table 1. The value for the water absorption capacity of the flour was 1.10 ml/g, whereas, higher value (1.24 ml/ g) was found for oil absorption capacity. The dispersibility of the seed flour was found to be 28%. These results agree with those from Airani (2007) who revealed that the water absorption, oil absorption and dispersibilty could be 112.00 ± 0.20 ml/100 g and 126.90 ± 0.60 ml/100g, respectively. But the water absorption capacity was lower than 2.3 ml/ g than that reported for raw jackfruit flour by Odoemelam (2005). For tiger nut flour the values have also been reported as 1.26 - 1.37 ml/g by Oladele and Aina (2007). The estimate observed in the study was however lower than that reported by Tananuwong *et. al.* (2002) from whole jackfruit seed flour and jack fruit seeds without brown spermoderm. As fat gives the flavor and improves the texture of food items, so the fat absorption is an important property for food formulations. The result obtained from the present study was similar to Odoemelam (2005) whose estimate was 2.8 g/ml for raw jackfruit flour; values of 1.07 -1.13 ml/g were however found for tiger nut flour by Oladele and Aina (2007). The dissimilarities observed could be attributable to the method used as well as the varietal differences.

Table-1: Functional properties of white jackfruit seed flour

Functional Characteristics	Values (%)
Water absorption capacity	11.0
Fat absorption capacity	12.4
Dispersibility	28.0

Table-2: Viscosity of white jackfruit seed flour

Concentration Hot Slurry (900C)	centipoises (cps)
5%	380
10%	812
Cold Paste (250C)	
5%	538
10%	1019

The viscosity of 5% jackfruit seed flour paste had lower value (538 cps) compared to 10 per cent paste (1019 cps) at ambient temperature for cooked paste. Similar observations were also recorded at hot temperature (900C); the 5% slurry was less viscous (380 cps) than the 10% (812 cps). As expected, the cold pastes had the higher viscosity values than the hot slurries (Table 2). Airani (2007) found the viscosity of hot slurry and cold paste of jackfruit seed flour as 384, 816 cps and 541, 1028 cps for 5% and 10% concentration, respectively. Singhal and Kulkarni (1991) evaluated the functional properties of *Amaranths paniculates* seed flour. The authors found the range of viscosity 144.4-247.3 cps. On the other hand, the viscosity (approximately 1000 cp) of different flour for baking purpose was obtained by Rai *et al.* (2012).

Physico-chemical properties

The moisture content of the seed flour was 8.1% and 9.1% in with- and without brown layer containing seed flour, respectively (Table 3). Ocloo *et al.* (2010) found the value 6.09%. Moisture content of flour is dependent on the duration of the drying process. The ash, protein, fat, crude fibre and total carbohydrate were found to be 3.92%, 11.43%, 1.98%, 2.87% and 74.57%, respectively for brown spermoderm containing flour. On the other hand, moisture (9.1%), protein (11.9%) and total carbohydrate (75.25%) of without brown spermoderm containing flour had higher values than that. But ash (2.7%), fat (1.05%) and crude fibre (1.53%) were less in white seed flour compared to brown spermoderm containing flour. The finding is agreed with the results found by Tananuwong *et al.* (2002) who reported percentages of moisture, ash, protein, fat, crude fibre and total carbohydrate in brown-layer containing seed and without it 7.70 versus 8.57, 3.97 versus 3.92, 11.02 versus 11.17, 1.01versus 0.99, 2.36 versus 1.67 and 81.64 versus 82.25, respectively.

Table-3: Physico-chemical properties of jackfruit seed flour

Components	Jackfruit Seed Flour With Brown Spermoderm	Jackfruit Seed Flour Without Brown Spermoderm
Moisture (%)	8.1	9.1
Ash (%)	3.92	2.7
Protein (%)	11.43	11.9
Crude Fat (%)	1.98	1.05
Crude Fibre (%)	2.8	1.53
Total Carbohydrate (% by difference)	74.57	75.25
Calorific Value (kcal/ 100 g)	371.014	367.08

The caloric value (energy) of the brown spermoderm containing seed flour was 371.014 kcal/100 g, which is higher than white seed flour (367.08 kcal/100 g) (Table 3). This value is higher than that reported by Akinmutimi (2006) for jackfruit seed (292 to 313 kcal/100 g). Some disparities could be obtained due to methods used as well as varietal differences, maturation of the seeds and environmental conditions.

(8.1%) to 9.35% in ambient temperature and 8.57% at refrigerated conditions, respectively, after 3 months. According to Airani (2007) the moisture content could increase from 7.16 % to 11.03% at ambient temperature and 8.39% at refrigerated condition, an agreement with the present study. Moisture content is an index of storage stability of the flour. Moisture indicates a measure of the water content of the flour, and for that, it matters its total solid content. The lower is the moisture contents of flour, the better is its shelf life.

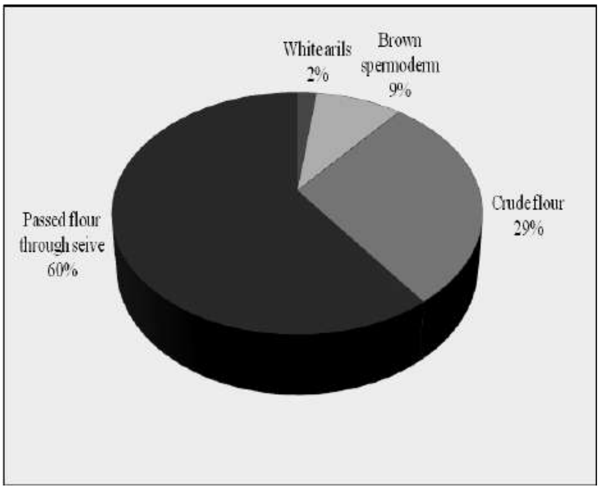

Figure-1: Yield from jackfruit seeds

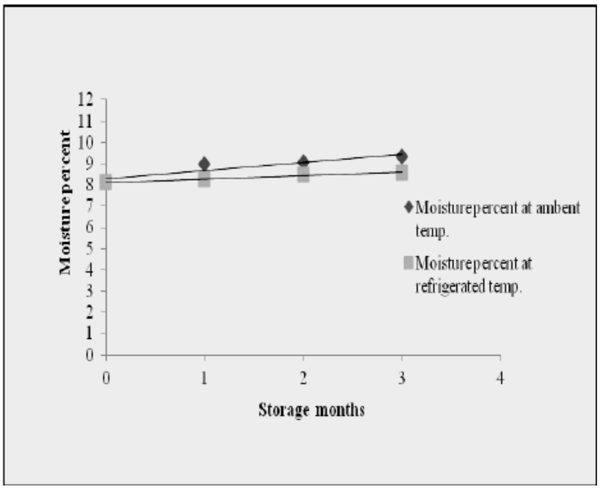

Figure-2: Moisture content of stored jackfruit seed flour

Sensory profile of stored jackfruit seed flour

The increase in moisture level in the stored samples did not reveal any change in sensory profile - in terms of color, flavor and texture during the observation of a period of three months.

CONCLUSION

The results of the study suggest that the jackfruit seed flour has a good ability to bind water, and is high flavor-retainer. Therefore, jackfruit seed flour can be used in bakery industry and useful in the application to food industry because of its demonstrated potentials in the present study. Further studies are suggested by incorporating various level of flour in food formulation to enrich food quality.

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