

Jackfruit Seed Powder – A Healthy Nutritional Alternative to Flours

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Abstract

Jackfruit (*Artocarpus heterophyllus Lam.*), widely grown in South Asian countries is the national fruit of Bangladesh. The objective of the study is to compare some Results: physicochemical properties and nutritional parameters of five types of grain flours to that of jackfruit seed powder from Bangladeshi origin. We have analyzed the mineral contents of all these flours in Atomic Absorption Spectrophotometer. Vitamin A and Vitamin C were measured in UV spectrophotometry. Riboflavine and Thiamine contents were determined in the flours in High Performance Liquid Chromatography method. The nutrient content in five types of flours have also been analyzed to see whether there is any difference in them at significance level of 5% (P < 0.05). Comparing to other flours, we have found that the jackfruit seed powder is highly nutritious and contains substantial amount of nutrients like the common flours. Jackfruit seed powder can be used as a potential nutritional alternative to flours in different food products.

Keywords: Jackfruit, Rice, Wheat, barley, Maize, Nutrition

Introduction

Jackfruit (*Artocarpus heterophyllus Lam.*) is the national fruit of Bangladesh and one of the most abundantly-grown tropical fruits¹. It is also being produced in the Amazon region and the tropical region of Brazil, as it grows spontaneously in tropical temperature²⁻⁴. The ripe fruits are consumed usually and they can also be processed into canned food products and snacks. Seeds are wrapped in a thin brownish spermoderm layer enclosing a white aril^{2,4-7}. The seeds are often consumed as boiled or roasted or as curry. But large portion of these seeds are usually not utilized properly due to proper processing and storage and even limitations to use properly^{3,8}. Jackfruit seeds are highly rich in nutrients and already being used as functional food in combination with rice flour, wheat flour, maize powder, barley powder and so on^{9,10}.

Rice (*Oryza sativa*) is consumed as main source of carbohydrate for 90% of the Asian people and over half of the world's total population⁹. Rice has been long researched for the nutritional values. Rice powder is

also used for making rice cakes and different food products¹¹⁻¹³. Wheat (*Triticum aestivum*) is one of the mostly consumed grains and takes the next position after rice. Wheat powder or flour is important for the production of bakery products and various food items. It also has high nutrition value¹⁴⁻¹⁶. Maize (*Zea mays*) is most widely known as corn and rich in nutrient. It is also used as staple food in many parts of the world like South Africa^{10,17}. It is used to make cornmeal, sweeteners and breads. Barley (*Hordeum vulgare*) is another grain that is widely consumed and highly nutritious^{10,18}. It is one of the top most produced grains in the world, and consists of 12% of total cereal produced. It comes fourth among cereal grains after wheat, rice, and maize. Barley is highly recommended as a source of carbohydrate for healthy life.

In the last decade, there had been intense research in nutraceuticals or functional foods to improve the nutrition portion of the world food habit^{19,20}. Jackfruit seed powder is highly rich in nutrition and being researched to be used in bakery products and various food items^{4,5,21-24}. It is also being researched for its

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application in pharmaceutical, cosmetics, food, paper and other industries²⁵. The objective of our study is to compare the nutritional value of jackfruit seed powder with rice powder, wheat flour, maize powder, barley powder. We have also investigated its potential use as a functional food. Different locations might have different seed contents^{3,4,22}. In this research, we have analyzed the nutritional value of jackfruit seed powder of Bangladeshi origin.

Preparation of the powders

Jackfruit seeds were soaked in water for 10 minutes. Then the seeds were scraped by a knife to separate the brown layer of spermoderm. The cotyledon parts were then cut into pieces. Then they were dried at 50^o - 60^o C for 24 hours. The dried chips were then ground in a blender and sieved. Then the seed powder was packed. Rice powder was prepared by first soaking the rice in water for 10 minutes. Then it was milled and dried at 60^o C for 24 hours. Barley powder, maize powder and wheat powder were prepared from barley, maize and wheat grains respectively by washing them in water. They all were dried at 50-60^oC for 24 hours. Then the barley, maize and wheat were milled and sieved. All the powders were packed in air-tight glass containers and stored at < 5^oC temperature for further study. Quintuplicate sample of every grain powder were taken for the determination of nutrient, vitamin and mineral content of the flours.

Evaluation of Physicochemical Properties

Determination of carbohydrate

Carbohydrate content in the five types of powder was determined by Phenol- Sulfuric Acid Method suggested by Dubois et al (1956)²⁶⁻²⁸. 1 gram of powder taken and 1 ml of 80% phenol solution was added and shaken well. Then, 5 ml of 96% sulfuric acid was added and again shaken well. Next it was heated in water bath at 25^oC–30^oC for 20 minutes. The absorbance was taken at 490 nm in UV spectrophotometer^{29,30}. The quantification was done with the help of a calibration curve using glucose as standard and calculations were performed with the linear regression equation obtained from the calibration curve.

Determination of protein

Protein content was determined indirectly through relating to nitrogen content by Kjeldahl method³¹. 1 gram sample was taken and transferred into Kjeldahl digestion flask. 0.7g HgO, 15g powdered K₂SO₄ and 25 ml of concentrated H₂SO₄ were added. After 2.5 hour of digestion, 80 ml of sodium hydroxide solution was added to the flask. Total nitrogen was measured titrimetrically with standardized hydrochloric acid³².

Determination of fat

AOAC method 7.045 (2000) was used to determine the fat content of the flours³³. Five grams sample was taken into thimble attached to the Soxhlet apparatus. The apparatus was attached with a round bottom flask containing 200 ml ether. The fat extraction process was run for six hours. The ether was evaporated at 80^oC until the flask completely dried and the fat content was calculated.

Determination of vitamins

Vitamin A and Vitamin C were measured in UV spectrophotometry³⁴. Riboflavin and Thiamine were determined in the flours by the method described by Batifoulier et al (2006). The vitamins were extracted first using enzymatic treatment method as described by Ndaw et al (2000)³⁵ and then analyzed in high performance liquid chromatography (HPLC) by the method described by Batifoulier et al (2006) using a reversed-phase C-18 column with fluorescence detector³⁶.

Determination of fibre

Fibre content in all the five types of flour were analyzed according to the enzymatic-gravimetric method of AOAC method 991.43^{18,37}.

Estimation of minerals

Sodium and Potassium was analyzed in Flame Photometer by method described by Chen M-J *et al* (2005)³⁸. Calcium, iron, magnesium, manganese, copper and zinc were determined using Flame Atomic Absorption Spectrophotometer (FA-AAS)^{39,40}. Phosphorus was analyzed in UV-spectrophotometer in

the method described by Szydłowska-Czerniak et al (2003)⁴¹.

Determination of moisture content

5 gram of sample was taken and dried in oven at 105^o C for 3 hour. Then it was cooled to room temperature in desiccators. The loss in weight was determined as moisture content(%)^{15,42}.

Determination of ash content

Ash content was determined by AACC method 08–01⁴³. 10 gram of the sample was weighed into a pre-weighted crucible. Then it was kept in a muffle furnace at 550-600°C for 24 hours. Then it was cooled in desiccators and weighed again to get the ash content¹⁵.

Statistical analysis

The obtained data were analyzed statistically using One-way ANOVA procedures to assess level of

significance of variation at 95% confidence interval. Quintuplicate sample of every grain powder were taken for the determination of each parameter. Post hoc “Tukey” test was conducted to identify the variation within the sample groups. The statistical analysis was conducted for at 5% level of significance (P< 0.05).

Results and Discussion

Table 1 represents the basic nutrient content (%) of five types of flours. All the flours showed significant differences in nutrient content. Difference in carbohydrate content in jackfruit seed powder, barley powder, wheat flour and maize powder is not statistically significant. Jackfruit seed powder is highly rich in protein (17.04 ± 3.61%) which is significantly higher than rice powder, wheat flour and maize powder. It contains significantly higher amount of dietary fibre than rice and wheat whereas the fat content difference is not statistically significant among them.

Table 1. Nutrient content of Five types of flours

Nutrients	Types of Flours					P-value
	Jackfruit Seed Powder (JFP)	Rice Powder (RP)	Barley Powder (BP)	Wheat flour (WF)	Maize Powder (MP)	
Carbohydrate (g/100g)	73.75±5.23 ^a	82.41±5.25 ^b	77.42±3.65 ^a	68.72±6.53 ^a	74.41±3.25 ^a	<0.001***
Protein (g/100g)	17.04±3.61 ^a	5.74±0.17 ^b	13.32±2.36 ^a	10.21±2.25 ^c	10.48±2.37 ^c	<0.001***
Fat (g/100g)	0.87±0.11 ^a	0.48±0.23 ^a	2.46±0.21 ^b	0.38±0.11 ^a	4.41±1.48 ^c	<0.001***
Fiber (g/100g)	7.15±0.04 ^a	3.36± 1.93 ^b	35.75±2.92 ^c	4.24±0.32 ^b	6.26± 1.25 ^a	<0.001***
Moisture content (g/100g)	8.58±2.56 ^a	7.08±0.46 ^{bd}	10.56±3.20 ^{ad}	12.45±1.48 ^c	10.95±3.92 ^a	<0.001***
Ash content (g/100g)	1.57±0.25 ^a	1.23±0.76 ^a	6.57±0.21 ^b	1.15±0.12 ^a	2.41±0.92 ^c	<0.001***

Note. Values were recorded in five replicates (n=5). Values are expressed as ME±SD of data. ME= Mean, SD= Standard Deviation. Means in a row with same superscript are not significantly different at (p < 0.05) for the respective samples. * = Significant (P< 0.05); ** = Significant (P< 0.01); *** = Significant (P< 0.001); NS = Non-significant.

Table 2 represents the comparison of vitamin contents among jackfruit seed powder, and rice flours, wheat flours, maize powders, barley powder. The table shows that jackfruit seed powder contains significantly higher amount (8.57 ± 0.52 mg/ 100 gram) of Vitamin C in comparison to other flours. Jackfruit seed powder contains Difference in vitamin A content in jackfruit

seed powder (16.58 ± 0.46 mg/100 gram), wheat flour and maize powder is statistically insignificant. Jackfruit seed powder is rich in thiamine and riboflavin. Riboflavin content difference in jackfruit seed powder (0.18 ± 0.03 mg/100 gram) and wheat flour is statistically insignificant.

Table 2. Vitamin composition of Five types of flours

Vitamins	Types of Flours					P-value
	Jackfruit Seed Powder (JFP)	Rice Powder (RP)	Barley Powder (BP)	Wheat flour (WF)	Maize Powder (MP)	
Vitamin A (mg/100g)	16.58 ± 0.46^a	2.08 ± 0.73^b	18.56 ± 3.16^c	12.45 ± 0.82^a	10.95 ± 0.06^a	<0.001***
Vitamin C (mg/100g)	8.57 ± 0.52^a	1.23 ± 0.15^b	2.57 ± 0.48^b	1.15 ± 0.13^b	1.41 ± 0.52^b	<0.001***
Vitamin B1 (Thiamine) (mg/100g)	0.27 ± 0.04^a	0.11 ± 0.01^c	0.53 ± 0.03^b	0.56 ± 0.02^b	0.17 ± 0.02^d	<0.001***
Vitamin B2 (Riboflavin) (mg/100g)	0.18 ± 0.03^a	0.03 ± 0.007^b	1.21 ± 0.03^c	0.12 ± 0.004^{ac}	0.04 ± 0.01^{bc}	<0.001***

Note. Values were recorded in five replicates (n=5). Values are expressed as ME \pm SD of data. ME= Mean, SD= Standard Deviation. Means in a row with same superscript are not significantly different at ($p < 0.05$) for the respective samples. *= Significant ($P < 0.05$); **=Significant ($P < 0.01$); ***=Significant ($P < 0.001$); NS= Non-significant.

Table 3. Mineral composition of five types of flours

Minerals	Name of Flours					P-value
	Jackfruit Seed Powder (JFP)	Rice Powder (RP)	Barley Powder (BP)	Wheat flour (WF)	Maize Powder (MP)	
Sodium (mg/100g)	3.31±0.31 ^a	2.13 ± 0.05 ^a	19.60±1.48 ^b	6.10±0.25 ^c	11.18±0.08 ^d	<0.001 ***
Potassium (mg/100g)	446±5.92 ^a	127 ± 0.52 ^b	440±3.52 ^a	197.13±1.6 ^c	285.35±4.5 ^d	<0.001 ***
Calcium (mg/100g)	37.54±0.25 ^a	10.11±0.15 ^b	32.05±0.42 ^c	12.58±0.42 ^d	8.63 ±0.31 ^e	<0.001 ***
Magnesium (mg/100g)	16.12±1.42 ^a	32.67±3.51 ^b	91.67±1.45 ^c	114.3±1.35 ^d	92.14±7.2 ^e	<0.001 ***
Iron (mg/100g)	1.02 ±0.03 ^a	0.78±0.04 ^a	2.3±0.03 ^b	4.12 ±0.21 ^c	2.73±0.19 ^d	<0.001 ***
Phosphorus (mg/100g)	78.0±3.16 ^a	52.01±4.58 ^b	282.43±7.12 ^c	504±3.16 ^d	78.54±0.68 ^a	<0.001 ***
Zinc (mg/100g)	0.13±0.18 ^a	1.18±0.04 ^b	2.15±.13 ^c	2.93±0.05 ^d	1.56±0.15 ^e	<0.001 ***
Manganese (mg/100g)	0.16±0.05 ^a	1.24±0.46 ^b	1.03±0.14 ^b	0.64±0.14 ^c	0.16±0.04 ^a	<0.001 ***
Copper (mg/100g)	1.45±0.06 ^a	0.28± 0.05 ^b	1.58±0.04 ^b	0.84±0.02 ^c	0.25±0.06 ^b	<0.001 ***

Note. Values were recorded in five replicates (n=5). Values are expressed as ME±SD of data. ME= Mean, SD= Standard Deviation. Means in a row with same superscript are not significantly different at (p < 0.05) for the respective samples. * = Significant (P < 0.05); ** = Significant (P < 0.01); *** = Significant (P < 0.001); NS = Non-significant.

Table 3 represents the comparison of mineral contents among jackfruit seed powder, and rice flours, wheat flours, maize powders, barley powder. The table shows that jackfruit seed powder contains 3.31±0.31mg sodium per 100 g powder and the content is statistically similar to that of rice powder (2.13 ± 0.05 mg/100 g). Jackfruit seed powder contains a high potassium content (446±5.92 mg/100 g) which is significantly higher than that of rice, wheat and maize powder. The calcium content (37.54±0.25 mg/100 g) is significantly higher than that of other flours. The table shows that jackfruit seed powder also contains a good amount of magnesium, iron, phosphorus, zinc, manganese and copper. So, it has a rich mineral content.

Conflict of Interest

This research has no conflict of interest.

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Conclusion

Jackfruit seed powder is highly nutritious. In our study, we have found that the nutritional values of jackfruit are comparable and satisfactory. In Bangladesh,

jackfruit is produced in huge scale. But due to perishable nature of the fruit, seeds are not being yet utilized properly. The jackfruit seeds are collected and stored properly; they can be used as potential source of nutrition.

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