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A Study on Nutritional and Functional Properties Analysis of Jackfruit Seed Flour and Value Addition to Biscuits

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***Abstract* - The study was conducted to analyze functional and chemical properties of jackfruit seed. Seed flour was utilized in composite flour biscuit. Biscuits were prepared with 10%, 20%, 30% and 40% jackfruit seed flour and were compare with plain biscuit (0% seed flour) based on chemical properties and sensory properties. Proximate analysis showed that Jackfruit seeds contain 15.88% moisture, 2.49% crude fiber, 5.78% protein but low in fat (1.77%). Among functional properties jackfruit seed flour had higher fat absorption capacity (72%) than water absorption capacity (86%). Jackfruit seed flour also showed 33% dispersibility, 2.31% solubility and 1.46 g/g swelling power. Research revealed that the protein and carbohydrate contents of prepared biscuits decreased with higher replacement of jack seed flour. But moisture, fat, crude fiber and ash content increased with higher replacement of jack seed flour. The sensory parameter indicated that up 20% level incorporation biscuits were not significantly different with 0% jackfruit seed flour (plain biscuit) biscuit based on all sensory parameters. But higher level of jackfruit seed flour biscuit rejected by the panelist as it was dark color and hard texture.**

Keywords : Jackfruit seeds, Seeds, Biscuits, Jack, Flour, Bakery, Properties, Seed Flour

I. INTRODUCTION

Jackfruit is found all over in Bangladesh; but mainly in the month of Jaishtha and Ashar. It grows in plenty on the hilly areas of Chittagong and Sylhet and on the highland of Dhaka, Mymensingh, Comilla and Jessore. Beside these, it grows in India, Srilanka, Burma and Brazil. It has a rough and prickly skin. Inside the skin the fruit is found to be composed of many juicy flakes. When it becomes ripe, it turns out to be delicious and succulent to eat. It is also a very nutritious fruit. Jackfruit seeds contain vitamin ‘’A’’ and “C’’. Various types of products can be prepared by jackfruit cell.

The young fruit is called polos in Srilanka and idichakka or idianchakka in Kerala: those having firmer, sweeter fruit are called 'varikkachakka ; those having lesser firmness and sweetness are called koozhachakka. They are used in curry dishes, with spices to replace meat, in Sri Lankan, Andhran, eastern-Indian (Bengali), and Keralan cuisine. The skin of unripe jack fruit must be peeled first and discarded, then the whole fruit can be chopped into edible portions and cooked to be eaten. The raw young fruit is not edible. Young jackfruit has a mild flavour and distinctive poultry-like texture. The cuisines of India, Nepal, Bangladesh, Sri Lanka, Indonesia, Cambodia, Thailand and Vietnam use cooked young jackfruit. In Indonesia, young jackfruit is cooked with coconut milk as gudeg. In many cultures, jackfruit is boiled and used in curries as a staple food. In northern Thailand, the boiled young jackfruit is used in the Thai salad called tam kanun.

Seeds from ripe fruits are edible and are prepared by boiling in salted water for about 25 minutes. They have a milky, sweet taste. In many parts of India, roasted salted seed is also eaten and considered a delicacy.

Seeds extracted from fully matured fruits are washed in water to remove the slimy part. Seeds are encouraged to be stored immediately in closed polythene bags for one or two days to avoid them from drying out. Germination is improved by soaking seeds in clean water for 24 hours. During transplanting, sow seeds in line with 30 cm apart in a nursery bed filled with 70% soil mixed with 30% organic matter. The seedbed should be shaded partially from direct sunlight in order to protect emerging seedlings.

Cutting a jackfruit may seem quite a challenging task but once cut opened, the rest is easy and enjoyable. Jackfruit appears in the market in spring and continues until summer. The interior of ripe fruit consists of large, pleasant flavoured yellow sweet bulbs (fully developed perianths) massed among narrow ribbons of thin, though undeveloped perianths and a central pithy core constitute 25-30 per cent of the total fruit. Each bulb encloses a smooth, oval, light brown seed (endocarp) covered by a thin white membrane (exocarp). The seed is 2-4 cm long and 1.5 – 2.5 cm thick. There may be 100-120 or upto 500 seeds in a single fruit comprising 5-6 per cent of the total fruit.

The pump (bulb) color ranges from thin white, cream, yellow to bright orange. The size of the fruit lets ranges widely from small to big and thickness of pulp ranges from thin wafery to as thick as 0.5 cm while the sweetness ranges from slightly insipid to very sweet, the texture of the pulp ranges from soft to crispy. The pulp flavor ranges from very mildly scented to strongly scented and the size of the whole fruit ranges from 8

inches to 3 ft, as big as one weighing 20-50 kgs similarly the tree height also ranges from 50 to 60 ft.

The tender jack fruit is a popular vegetable and used in making soup and pickles. Chips and papads are also prepared from ripe and unripe pulp. The juicy pulp of the ripe fruit is eaten fresh or preserved in syrup and has wide potential for preparing jam, jelly due to the presence of pectin and used in the preparation of inumerous value added products. There is good market for these processed products in U.S., U.K. and gulf countries. The rind or skin of the fruit and leaves are excellent cattle feed. The yellow hard wood of the tree is valued timber for making of furniture's. Jackfruit trees are also grown for shade to betel, pepper and cardamom plantations.

There are various researchers worked on the basis of food products incorporations like;

George and Boskou (1975) analyzed the chemical composition of tomato seeds. The seeds contained 24.5 per cent protein, 28.1 per cent fat, 2.9 per cent of total sugars (as glucose), 5.4 and 19.1 percentage of ash and crude fiber, respectively. Higher mineral contents (mg/100 g) for potassium (780), phosphorus (690), magnesium (300), Calcium (160), sodium (110) and ferrous (17) were reported. In the year 1975, Oyenuga and Fetuga evaluated the nutritive value of two local varieties of watermelon seed flour. Bara and Serewe, the two local varieties documented good amount of protein (35.70 and 30.60 %), crude fiber (2.40 and 3.10%), ether extract (54.20 and 56.90%), total ash (4.20 and 3.40 %) and carbohydrates (3.50 and 6.00 %), respectively.

Fleming et al. (1976) determined the composition of sunflower seed flour. The defatted flour contained protein (53.00%), crude fat (1.80%), higher levels of crude fiber (3.60%) and ash (8.20%).

Bobbio et al. (1978) reported the proximate composition of jack seeds. Jack seeds contained 61.50 per cent moisture, 12.30 per cent protein, 25.10 per cent carbohydrates and 0.50 per cent crude lipids.

Carlson et al. (1981) investigated the nutritional composition of tomato seed. The mean values of moisture (9.60%), crude fat (22.20%), crude fiber(18.30%) and crude protein (33.90%) were documented.

A study was conducted by Akobundu et al. (1982) to analyze the chemical compositions of egusi (cucurbitaceae) seed kernels. Study revealed that, hull-free kernels contained protein (28.40%), lipid (52.00%), crude fiber (2.70%), ash (3.68%) and carbohydrate (8.21%). Egusi seed flour had good quantities of minerals (mg/100g) viz., sulphur (580), calcium (354), potassium (1442) and phosphorus (1950). Besides, seed flour also recorded significant amounts of vitamins, especially thiamine (4.16 µg/g) and niacin (35.40 µg/g)

Dingra and Kapoor (1984) documented the composition of mango seed kernel. The seed kernels constituted 5 per cent protein (g), 6-7 per cent crude fat (g), tannins (0.19 -0.44%), oleic acid (42.00%) and stearic acid (39.00%).

Nutritional and fatty acid contents of pumpkin and melon seed flour was documented by Lazos (1986). The data obtained for pumpkin and melon seeds on a dry basis were, crude oil (45.40 and 37.80%), crude protein (32.30 and 25.20g%), crude fiber (12.10 and 15.40g%) and ash (4.65 and 3.85g%), respectively. The major fatty acid of both oils was linoleic acid (18:2), in concentrations of 43.10 and 64.60 per cent, respectively followed by oleic acid (18:1), 37.8 and 20.10 per cent, respectively. Mineral content (mg) indicated rich sources of K (1111.00 and 1288.00%), P (852.00 and 557.00%) and Mg (205.50 and 256.00%), respectively.

Yanez et al. (1986) analyzed the chemical composition of amaranth seed flour. The mean values (g) for moisture (9.67%), protein (2.69%), ash (2.80%), fat (7.15%) fiber (3.34%), and carbohydrates (62.30%) were documented.

Hemavathy et al. (1987) studied the polar lipids of Alphonso mango kernel. Total lipid (g) in the kernel of alphonso mango extracted, amounted to 11.60 per cent of the dry kernel. Total lipid consisted of 96.10 per cent of neutral and 3.90 per cent of polar lipids which comprised 2.90 per cent glycolipids and 1.00 per cent of phospholipids.

A study was conducted by Kumar et al. (1988) on the proximate composition of jackfruit seed flour. The seeds of Kathari and Bharat Baramasi varieties of jackfruit were found good sources of carbohydrates (28.01 and 26.83g %), protein (6.75 and 6.25g %), fat (0.78 and .89g %) and ash (1.27 and 1.16g %), respectively. The calorific value of both Kathari and Bharat Baramasi were found as 146.06 and 140.33 KCal/100g, respectively. Kathari variety was observed to be nutritionally excelling, compared to the Bharat Baramasi variety on the basis of most of the constituents analyzed.

In a review, Singhal and Kulkarni (1988) reported the compositions of amaranthus seed flour. The seeds contained moisture, protein, fat, crude fiber, and ash with the mean values (g), 6.20, 13.20, 6.30, 3.60 and 2.80 percentages, respectively.

Giami and Bekebian (1992) investigated the nutritional properties of pumpkin seed flour. The mean values (g %) were 4.20, 28.10, 47.00, 3.10 and 12.90 for moisture, crude protein, ether extract, total ash, crude fiber and carbohydrates, respectively. Iron and total phosphorus contents recorded were 4.50 and 140.00 mg/100g, respectively.

Rajarajeshwari and Jamuna (1999) studied the nutritional profile of the jack seed flour. The flour contained the moisture (4.43 %), protein (21.30g %), fat (2.73g %), total ash (2.00g %), crude fiber (5.69g %) and carbohydrates (63.85g %).

Vishwanathan et al. (1999) analyzed the compositions of Teramnuslabialisspreng. seeds flour documented (g) crude protein, crude fat, ash and nitrogen free extracts constituted 22.86, 6.10, 4.62 and 58.15 per cent, respectively. The calorific value of 100grams dry matter of seed material was 379 K.calories.

In the year 2001, Nagaraj evaluated the nutritional value of defatted cashew kernel flour. The mean values (%) were 63.50, 20.30 and 12.90 for protein, carbohydrate and sugars, respectively.

Tananuwong et al. (2002) reported the chemical compositions of jackfruit seed flour. The major components of the flour were carbohydrates (82.25%), protein (11.17%), lipid (0.99%) and crude fiber (1.67%). The total starch and amylose contents were analyzed and the values recorded as 77.76 and 32.05 g/100g, respectively.

In the year 2004, Akubor conducted a study to investigate the compositions of melon seeds. The seeds documented 6.00 g per cent moisture, 29.30g per cent protein, 54.90g per cent crude fat and 3.00, 2.80 and 4.00g percentages of ash, crude fiber and

carbohydrates, respectively. Further Akubor (2005), evaluated the chemical composition of breadfruit seed flour. The flour documented the proximate compositions (g) such as moisture (8.60%), protein (17.30%), crude fiber (2.50%), ash (2.80%), fat (11.00%) and carbohydrates (62.80%). The calorific value was noted as 419.40 K.calories per 100grams of seed flour.

A study by Amoo (2005) was conducted on the proximate compositions (g) of cashew kernel flour. The kernel flour contained 20.90 per cent protein, 42.80 per cent fat, 8.00 per cent moisture, total ash and crude fiber contents were 2.80 and 1.40 per cent, respectively. The carbohydrate content was noted as 24.10 per cent.

Aremu et al. (2006) assessed the compositional characteristics of cashew nut flour. The mean values of proximate compositions (g %) were moisture (5.70), ash (4.40), ether extract (36.70), crude protein (25.30), crude fiber (1.20), and carbohydrate (26.80). The calorific value was 2243 KJ/100g and fatty acid content was noted as 29.40 per cent. Abundant minerals (mg/100g) constituted were K, Mg, Na and Ca while least were Cu, Zn, and Fe. Amino acid analysis revealed that cashew nut flour contained nutritionally useful quantities of most of the essential amino acids.

The research was conducted under the following objectives;

1.1. OBJECTIVES:

1.1.1. General Objectives:

To Evaluate the functional and chemical properties of jackfruit seed flour and utilize it in composite biscuits.

1.1.2. Specific Objectives:

Hence, the study was undertaken with jack seed with following specific objectives.

1. To assess the physical and functional qualities of seed flour.
2. To determine the nutrient composition of jack seed flour
3. To determine the nutrient composition of composite biscuits.
4. To evaluate the sensory properties composite biscuits.

II. MATERIALS AND METHODS

The continuous research on "Nutritional quality and analysis of jackfruit seeds proximate composition and value addition of jackfruits seeds flour with wheat flour "was continued in various country from early year. The materials and methods used for the study are recorded in this chapter.

2. MATERIALS

2.1.1. Raw materials: The main raw materials in this studies are jackfruit seed flour which is incorporating in wheat flour by replacing different levels (10%, 20%, 30%, 40%)

2.1.2. Other ingredients: There were many other ingredients which used in composite biscuit making i.e. sugar, hydrogenated fat, milk powder, egg, salt, soybean oil.

2.1.3. Chemicals: Various important chemicals were used in compositional analysis i.e. Sulfuric acid, sodium carbonate solution, sodium hydroxide solution, methyl red indicator, digestion mixture, alcohol, ether etc.

2.2. PREPARATION OF SEED FLOUR

2.2.1. Procurement of seed material

The jackfruit seeds were collected from the south-east region in TANGAIL district in Bangladesh during the season.

2.2.2. Seed treatment

The jackfruit seeds (2kg) were cleaned manually and white arils (seed coat) were manually peeled off. Seeds were lye peeled, soaking in 3 per cent sodium hydroxide solution for 3-5 minutes to remove the thin brown spermoderm which covers the cotyledons. The spermoderm layer was removed by rubbing the seeds between the hands and washing thoroughly under running water.

2.2.3. Preparation of jackfruit seed flour

The lye peeled seeds were sliced into thin chips and dried at 80-100° C to constant moisture. The dried chips were powdered in a medium size grinder and sieving and packed in a polyethylene pouches and stored in a refrigerator (<10^0 C) for further analysis.

2.3. Nutrient composition of jackfruit seed flour

2.3.1. Proximate Composition

The seed flour was analyzed for proximate e.g. Moisture, crude protein, crude fat, crude fiber and total mineral matter and expressed in percentage. All the analysis were done in triplicates on moisture free basis except crude protein content

2.3.2. Determination of moisture content in the sample

PRINCIPLE: Moisture is always present in food shifts. Estimation of moisture is done simply by heating at 104-105^{0}C for 3-4 hrs in the oven and is cooled in a desiccators to absorb moisture .The process is repeated for several times until the constant weight shows by the sample.

$$\%\ \text{moisture} = \frac{\text{Initial weight} - \text{final weight}}{\text{Sample weight}} \times 100$$

Equipments: crucible, weighing balance, Desiccators & An oven

Procedure: The crucible was washed and dried up. Then the weight of the crucible was taken and sample plus crucible weight was taken. After that the weight was increased by deducting the crucible weight from sample with crucible weight. Next the sample was placed in an oven at 104-105^{0}Cfor 4 hours. Finally the sample with crucible was placed in a desiccators and weight

N.B: Heating, cooling and weighing were continued until a constant weight was obtained.

Calculation:

$$\%\ \text{of moisture} = \frac{\text{Initial weight} - \text{final weight}}{\text{Sample weight}} \times 100$$

Precautions:

The following precautions were taken during the experimental procedures-

a) The crucible was washed carefully and dried up.
b) The weight was taken carefully.
c) Incubation time and temperature were maintained.

3.3.3. Determination of ash content in the sample

Principle: About 5-10g of the sample are weighed accurately into a proclaim crucible which is previously been heated to about 600^0c and cooled.

The crucible in placed on a clay pipe triangle and heated first over a ion flame till all the material is completely charred followed by heating in a muffle furnace for about 3-4 hrs at about 600 c.

Equipments: Crucible, Weighing balance & Muffle furnace

Procedure: 3-4 g of sample was taken and heated at 105 c for 3-4 hours. Again the sample was heated at 437^0c for 1 hour. Then the sample was allowed to heat at 600^0c for 3-4 hrs. Finally the sample was cooled and ash content of the supplied sample was calculated.

Calculation: % of Ash In The Sample

$$= \frac{\text{The amount of ash in the supplied sample}}{\text{Sample weight}} \times 100$$

Total mineral matter:

Total mineral matter (ash) was determined by igniting samples in muffle furnace at 600^0c for 3-4 hours (anon, 1990). The total mineral matter was expressed as percent.

3.3.4. Determination of Fat content the sample

Principle: Fat is estimated by dissolving food sample into organic solvents (chloroform: methanol) separating the filtrate by filtration. Placing the filtrate into separating funnels and then separated mixture is the dried to measure the extract and finally the percentage of fat is estimated.

$$\% \text{ of sample} = \frac{\text{Weight of the extract}}{\text{Weight of the sample}} \times 100$$

Equipments: Conical Flux, Funnel, Filter Paper, Separating Funnel, Pipette & Weighing Balance

Procedure:

The sample weight was taken and dried to keep moisture free. Then the moisture free dried sample was collected and weighed. After that the dried sample was dissolved in chloroform: methanol solution for overnight. Next day the solution and the filtered solution were dried.

Finally the amount of fat in the supplied sample was calculated.

Precautions:

1. Weighing readings were taken carefully.
2. The sample was allowed to mix with solvent (chloroform: methanol) properly for overnight.
3. Adequate time and temperature were maintained.

3.3.5. Determination of protein content in the sample

Principle: The protein content of food stuff is obtained by estimating the nitrogen content of the material and multiplying the nitrogen factor by 6.25. This is referred to as crude protein content since the non-protein nitrogen present in the material is taken into consideration. True protein nitrogen can be determined by subtracting NPN (which is estimated by precipitating the protein in the sample with trichloroacetic acid, trugstic acid or copper hydroxide and determining the residual nitrogen in the protein free filtrate) from the total nitrogen.

The estimation of nitrogen is done by Kjeldhal method which depends upon the feed that organic nitrogen when digested with sulfuric acid in the presence of a catalyst is converted into ammonium sulfate. Ammonia liberate by making the solution alkaline is distilled into a known volume of a standard acid, which is then back titration.

Reagents:

1. Digestion mixture(98 parts K_2so_4,2 parts $CuSO_4$)
2. Sulfuric acid solution (0.1N)
3. Sodium carbonate solution (0.1N)
4. Sodium hydroxide solution(0.1N)
5. Sodium hydroxide solution (40%)
6. Methyl red indicator.

Procedure:

Digestion: The sample was taken and weighed and placed into a dry Kjeldhal flask. About 5g of digestion mixture and 25ml of concentrate sulfuric acid were added to the sample. And the mixture was digested by heating for 4-5 hrs.

These flasks were heated at low temperature initially and then heating was increased to 60^0C and heating was continued until the solution become colorless. At the end of digestion period the flasks were cooled and diluted with 100ml distilled water.

Distillation: The distillation set of Kjeldhal apparatus was thoroughly washed with distilled water before starting the distillation experiment. 25 ml of (0.1) N sulfuric acid was taken into the receiving 250ml conical flask. In a measuring cylinder 75ml of 40% sodium hydroxide was taken and it was carefully poured down the side of the Kjeldhal flask.

The mouth of the flask was closed with a stopper containing connective tube, which was ultimately connected to the ammonia receiving flask containing (0.1) N sulfuric acid.

The mixture was boiled at such a rate that water and ammonia distilled over at a steady moderate rate.

Titration: The ammonia absorbed in the receiving flask containing (0.1)N sulfuric acid was titrated with (0.1)N sodium hydroxide using 3 drops of methyl red as indicator. Similarly a reagent blank was distilled and titrated.

Calculation:

$$\text{Protein content in the sample} = \frac{(c-b) \text{ x } 14 \text{ x } d \text{ x } 100\text{x}6.25}{\text{Ax}1000}$$

3.3.6. Determination of crude fiber in the sample

Principle: About 2-5ml of moisture and fat free sample are weighed into 500ml beaker and 200ml of boiling 0.255 N (1.25%w/v) sulfuric acid is added .the mixture is boiled for 30 minutes keeping the volume constant by the addition of water at frequent intervals. At the end of this period, the mixture is filtered through a muslin cloth and the residue washed with hot water till free from acid. The material is then transferred to the same beaker and 200ml of boiling 0.313 N (1.25%) NAOH added. After boiling for 30 min, the mixture is filtered through muslin cloth. The residue is washed with hot water till free from alkaline followed by washing with some alcohol and other. It is then transferred to a crucible, dried overnight at 30^0-100^0 C and weighed. The crucible is heated in a muffle furnace at 600^0C for

2-3 hrs. Cooled weighed again. The difference in the weight represents the weight of crude fiber.

% of Crude fiber=

$$\frac{\text{Weight residue with crucible (g)} - \text{weight of ash with crucible}}{\text{Weight of sample taken (moisture and fat free)}} \times 100$$

Reagents: Sulfuric acid (0.255N), Sodium hydroxide (0.313N), Alcohol & Ether

Procedure:

2-3gm of fat and moisture free sample was weight and placed in a 500ml beaker and 200ml of sulfuric acid (0.255N) was added to the sample. Then the mixture was slowed to boil for 30 minutes and water added to maintain the constant volume. After boiling, the mixture was filtered and the residue was washed with hot water for several times to make acid free.

200ml of NaOH (0.313N) was added to acid free residue. Then it was boiled for 30 minutes and was filtered and washed with hot waters to make alkali free residue. Again the mixture was washed with alcohol and other respectively and following the sample was prepared for crude fiber estimation. Next the porcelain crucible was weighed and the residue was kept in and was heated at 105^0C in oven for 3 hours. After that the sample was then cooled in a desiccators. The weight of the sample was taken (a) and placed in a muffle furnace at 600^0C for 3-4 hrs. Finally the sample was cooled in dedicator and taken sample weighed (b).

Calculation:

Crude fiber = a-b

Precaution:

The following precautions were taken during experimental procedure-

1. The weight of sample and reagent were taken carefully.
2. Time and temperature was maintained properly.
3. The mixture was washed with alcohol and ether properly.

3.4. PHYSICAL AND FUNCTIONAL QUALITIES OS SEED FLOUR

**Physical and functional qualities of jackfruit seed flour were determined and recorded.*

3.4.1. Physical characters:

Physical characters such as number of seeds per fruit and seed flour yield were documented. Hundred grams of jack seeds were weighed and number of seeds were counted and recorded.

3.4.2. Flour Yield:

Hundred grams of jack seed was considered for yield calculation. After the processing steps, the total flour was weighed and expressed as percentage. The producing seed flour were taken for analysis which given in figure 1.

Figure 1: Jackfruit seeds powder

3.4.3. Functional qualities

Functional qualities such as water and oil absorption capacities, swelling power, per cent solubility, flour dispersibility and viscosity of the seed Hour were analyzed.

3.4.4. 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 expressed in percent (Austin and Ram., 1971).

3.4.5. Fat absorption capacity

One gram of seed flour sample was taken in a centrifuge tube and weight was recorded. Six milliliters of refined oil was added to the flour and centrifuged at 4000rpm for 25min. Free oil was decanted and weight of the centrifuge tube was noted.

Fat absorption capacity of the seed Hour was calculated as:

$$\% \text{ fat absorption capacity} = \frac{w1-w2}{w} \times 100$$

W1=weight of sample after centrifugation, W2=weight of sample before centrifugation & W=weight of original sample taken

3.4.6. Swelling power and per cent solubility of seed flour

Swelling power and per cent solubility of seed flour was determined according to the method of Schoch (1964).

About 250mg (w1) of jack seed flour was taken in a centrifuge tube and weighed the centrifuge tube with sample (w2) and 10ml (VE) of distilled water was added. Then it was allowed for 30min in a boiling water bath at 100^0c. The contents were cooled and centrifuged at 5000rpm for 10min. The supernatant was carefully decanted in a test tube. The water adhering to the sides of centrifuge tube was wiped well and weight of the centrifuge tube was taken with swollen material (W3). The swelling power of seed flour per gram was calculated by the formula:

$$\text{Swelling power (g/g)} = \frac{W3-W2}{W1}$$

Where,

W1=Weight of seed flour sample, W2=Weight of the centrifuge tube with seed flour sample & W3=Weight of the centrifuge tube with swollen material

For percent solubility of seed flour, the dried petriplate was weighed (W4) and 10ml of supernatant (VA) was pipetted into the petriplate. Then it was dried at 105°C in a hot air oven till constant weight was attained and cooled in a desiccators and again weighed the petriplate with dry solids (W5).

The per cent solubility of the supernatant was calculated by,

$$\% \text{ Solubility} = \frac{W5-W4}{VA} \times \frac{100}{W1}$$

Where,

W1=Weight of seed flour sample, W4=Weight of the petriplate, W5=Weight of the petriplate with dry solids, VE=Volume of water added & VA=Volume of supernatant taken

3.4.7. Flour Dispersibility

Dispersibility was measured by placing 10 grams of seed flour sample in 100ml stoppered measuring cylinder. Distilled water added to the volume of 100ml, 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.

3.5. SENSORY EVALUATION OF BISCUITS

The various characteristics of biscuits like appearance, color, texture, taste, aroma and overall acceptability by scoring method using 9 point hedonic scale are determined / evaluated. The evaluation was achieved by selected partially trained judges from Department of Food Technology and Nutritional Science in MBSTU. The judges were given a score card, instructed individually and requested to evaluate the biscuits. The most acceptable proportion of jack seed flour biscuit was considered for the consumer acceptability trail. The experiment was conducted in duplicates.

3.5.1. Consumer Acceptability

The accepted proportion of jack seed flour biscuit by the panelists was considered to assess the level of consumer acceptability. Ten persons in different ages in the Department of Food Technology and Nutritional Science in MBSTU were considered for the evaluation of biscuits by scoring method using 9 point Hedonic Scale.

3.8. Data Analysis:

All the data were collected including chemical composition, functional properties which statistically analyzed and SPSS Software were used to evaluate the sensory parameter of composite biscuits.

III. RESULTS & DISCUSSIONS

Jackfruit is the national fruit in Bangladesh and it is liked by all. A good source of minerals, proteins and carbohydrates, the jackfruit seeds have special importance for value addition. The result of the studies on jackfruit seed flour in terms of physical and chemical properties, nutritional and functional properties and finally consumer acceptability of value added products are presented in this section.

4.1. PHYSICAL AND FUNCTIONAL PROPERTIES OF SEED FLOUR

The physical and functional parameters considered are as follows.

4.1.1. Yield

It is evidenced that, 100 grams of jack seed consisted of 27 fresh seeds on the dry basis. After removal of white arils, the weight of the seeds reduced to 96 grams conversely, 4 percent reduction in seed weight was observed. The weight of the brown spermoderm recorded 10 grams, thus reducing the seed weight to 86 grams. The lye peeled and dried seeds were grinding into flour, the weight of the flour recorded 75 grams. The total crude yield of the flour, exclusive of weight of the white arils, brown spermoderm and handling losses represented 75 per cent. Therefore, the total yield of the flour was recorded as 75 per cent.

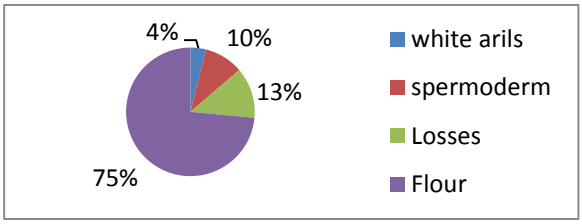

Figure 2: Flour yield from 100gram of seeds

4.1.2. Functional properties of jack seed flour

The functional properties are important in the food systems tor the creation of new products. The jackfruit seeds are very essential to get the characteristics of various properties.

Applying various important analysis to determinedthe water and oil absorption capacities, dispersibility, swelling power and per cent solubility of jack seed flour. The mean value for the water absorption capacity of the flour recorded 72ml/100g where as, higher value (86ml/100g) was recorded for oil absorption capacity. The dispersibility of the seed flour noted 33 per cent. The swelling power (1.46 g/g) of the seed flour was higher than the per cent solubility (2.31 %).

4.1.3. Functional properties of jackfruits seed flour

Properties	Values
Water absorption capacity (ml/100gm)	72.00±0.20
Fat absorption capacity (ml/100gm)	86.00±0.50
Dispersibility (%)	33
Swelling Power (g/g)	1.46
Percent solubility (%)	2.31

Table 2: Functional properties of jackfruits seed flour

5. NUTRIENT COMPOSITION OF SEED FLOUR

Jack seed has a great potential in the product formulation.

Composition	Percentage (%)
Moisture	15.88±1.26
Protein (g)	5.78±0.04
Fat (g)	1.77±0.02
Crude fiber (g)	2.49±0.02
Total mineral matter (g)	2.62±0.26
Total carbohydrates (g)	71.46±0.15

Table 3: Chemical composition of jackfruit seeds flour

4.2. Composition of Composite Biscuits

Variables	Moisture (%)	Protein	Fat	Crude fiber	CHO	Ash
Control	4.8	9.1	21.5	.44	63.01	2.65
Jack seeds-10%	5.4	8.5	24.7	0.77	57.94	2.79
Jack seeds-20%	5.4	8.7	28.36	0.78	53.76	2.78
Jack seeds-40%	5.6	7.6	30.5	0.89	50.83	2.88

Table 4: Composition of Composite Biscuits

4.4. UTILIZATION OF SEED FLOUR IN CONVENIENCE FOODS

There are many bakery products in Bangladesh which all of them are most popular in our country. Those bakery products are made from various flour including wheat flour. The bakery products such as biscuits and bread have become very popular in Bangladesh in all socio-economic section of population. Thus for potential and economic exploitation, jack seed flour in biscuit preparation is more practical and hence an effort was made to blend wheat flour with jack seed flour. The preliminary product development studies indicated use of non-gluten flour in biscuit beyond 50 per cent was not acceptable though lower level of gluten protein is adequate for acceptable biscuit texture profile. Conversely, an attempt was made to blend 10-40 per cent jack seed flour for biscuit preparation on wheat flour replacement basis. Another important bakery product, bread fortified with tomato seed meal revealed a slight increase in loaf weight after baking due to the enhanced absorption of water. The crust and crumb of the breads fortified with 5 per cent tomato seed meal were golden and at higher levels of supplementation breads were darker and the taste scores decreased as the level of tomato seed meal increased according to Yaseen et al. (1991). The top color are whiter than the bottom surface of the biscuits. This change is due to higher temperature perforated in the bottom side of the biscuits. Though acceptable, the texture values varied between control and upto 40 per cent replacement in biscuits with jack seed flour. The texture was similar to control upto 20 per cent seed flour replaced biscuits. While rest of the biscuits were harder than the rest. But these observations are obvious because the protein and gluten content decreased with higher replacement of non-glutenous flour such as jack seed flour.The gluten content upto 8 per cent seemed adequate for good texture of biscuits, further decrease made biscuits harder. The flavour characteristics of biscuits viz., taste and aroma recorded similar picture. Both sensory parameters did not make difference upto 20 per cent of seed flour incorporation. This is particularly true with flour such as jack seed flour is bland with insipid. It was interesting to notice that upto 40 per cent incorporation of jack seed flour, the overall acceptability did not make negative impact and hence 40 per cent incorporation was considered for consumer trial. Based on the above observations, it can be concluded that jack seed flour can be a good substitute upto 40 per cent in salt and sweet biscuits and can comfortably enter commercial bakery sector. The seed being perishable can be converted into flour and used potentially in bakery industry. However, following indepth studies are required for optimum utilization.

4.5. SENSORY EVALUATION OF COMPOSITE FLOUR BISCUITS

All the panelists were having excellent capability to evaluate the sensory evaluation of composite biscuits. They detected our composite biscuits characteristics on the basis of different properties which given in Table. The sensory quality scores biscuit with seed flour incorporated with wheat flour decreased with increase in the substitution of flax seed flour according to Hussain et al. (1999) as that of jack seed flour incorporated biscuits.

The diverse combinations of texture and taste have made biscuits an universal appeal and gain unique status. Thus, but it is natural for any food scientist to attempt and appreciate the utilization of jack seed flour in making biscuits. The bland flour of jack seed and wheat upto 40 per cent did not make any significant difference between each other with respect to color and appearance when evaluated by sensory profile. The control biscuits were significantly whiter than the rest and biscuits upto 30 per cent jack seed flour replacement made very little difference. While, biscuits with 30 and 40 per cent seed flour incorporated biscuits were significantly darker than the rest. As the judges were partially trained minute difference was not identified between the samples.

SENSORY EVALUATION OF COMPOSITE FLOUR BISCUITS

***10 panelists given score which are evaluated in 0.05 level significance*

4.5.1. Grain: The grain of control biscuit were 7.8 whereas the grain of 10, 20, 30 & 40 percent jackfruit seed powder incorporation were 7.1, 6.8, 5.9 & 4.8 which indicate the characteristics of various incorporation of jackfruits seeds powder biscuits. However, statistical test revealed that all of the value of are not significant except 40% incorporation biscuits and upto ant incorporation of jack seed flour significant. The value of grain of 0% and 10% incorporation biscuits are 7.5 and 7.1 and between them there is no significant difference but two of them are significantly difference with 40% incorporation biscuits.

4.5.2. Color: The color and appearance of control biscuits recorded the highest value of 8.5 for its very good color and appearance. Even though 10 and 20 per cent seed flour based biscuits scored the lower values (7.4 and 6.9, respectively) but recorded very good color and appearance as that of control. It is interesting to note that the 30 and 40 per cent seed flour incorporated biscuits recorded the value of 6.7 & 5.00 for their very good color and appearance. However, the statistical test revealed that, there were no impact of substitution of jack seed flour upto 40 per cent and all the proportions of biscuits are not significant with each other at 5 per cent level of significance. The value of color of 0% and 10% are 7.5 and 7.4 and there is no significant difference between them. Again 20 and 30% incorporation biscuits value most same as there is not also significant difference. But 10% and 0% are significantly difference with 40% incorporation of jack seeds flour.

4.5.3. Texture: According to the texture scores of biscuits with 10 per cent seed flour recorded the similar value of 7.5 as that of control for their very good texture profile. Further, the 20 and 30 per cent seed flour based biscuits recorded the values of 6.2 and 5.5, respectively for their moderately good and good texture. The 40 per cent seed flour based biscuits documented the values of 4.3 respectively and recorded fair texture profile. The statistical test revealed that not-significant difference was observed between the control and 30 per cent seed flour based biscuits. The non-significant difference was observed also between 20 and 30 per cent and significantly difference between 10 and 40 percent incorporation biscuits. The value of 0 and 10% jack seed incorporation biscuits are same but they are significantly difference from 40% jack seeds incorporation biscuits.

4.5.4. Taste: The taste of 10 per cent seed flour incorporated biscuits recorded the similar value of 6.9 as that of control biscuits. Further, the 20 and 30 per cent seed flour based biscuits recorded the values of 6.3 and 5.4 for their moderately good and good taste. The 40 per cent seed flour based biscuits recorded the value of 4.4. The statistical test revealed that, the significant difference was observed between the control and 30 per cent seed flour incorporated biscuits. The 20 and 30 per cent and 30 and 40 per cent seed flour based biscuits were not significant with each other at 5 per cent level of significance.

4.5.5. Aroma: The aroma of control biscuits recorded the highest value of 8 and 10 per cent seed flour based biscuits documented the value of 7.1 for their very good aroma. The 20 per cent seed flour based biscuits documented the moderately good (6.21) aroma. Further, the 30 per cent and 40 per cent seed flour incorporated biscuits recorded the value of 5.7 and 4.1 for their good and fair aroma, respectively. The statistical test revealed that, significant difference was observed between control and 30 per cent seed flour based biscuits. Similarly, the significant difference was observed between the 20 and 40 per cent seed flour incorporated biscuits.

4.5.6. Overall Acceptability: The overall acceptability of biscuits showed that, the control biscuits scored the highest overall acceptability value of 7.9 for its moderately good acceptability. The 10 per cent seed flour incorporated biscuits scored the value of 6.9 and recorded moderately good acceptability. It is also note that the 20 per cent seed flour based biscuits scored 6.0 and 30 and 40 percent scored were 5.3 and 3.79 The statistically data displayed that there is no significant 10-30% incorporation biscuits but up to 40% biscuits are more significant and may not be acceptable.

Figure 4: Upper Portion Of Various Biscuits Sample

All of the above biscuits in figure 6 are presented in different percentage incorporation of jackfruit seed biscuits. All of the biscuits upper portion are same color except 0% and 10% incorporation. The color of 10 percentage incorporation are brighter than other sample and are more acceptable to the panelist. The top left side biscuits is normal and top right side biscuits is 10% level of jack seed incorporation which have similar color but middle and bottom left and right side biscuits are 20%, 30% and 40% incorporation and their color are deep except top biscuits.

Figure 5: Lower portion of jackfruit seeds biscuits sample

All of the above biscuits in figure 7 are presented in different percentage incorporation of jackfruit seed biscuits. All of the biscuits lower portion are same color except 0% and 10% incorporation. The color of 10 percentage incorporation are brighter than other sample and are more acceptable to the panelist. The top left side biscuits is normal and top right side biscuits is 10% level of jack seed incorporation which have similar color but middle and bottom left and right side biscuits are 20%, 30% and 40% incorporation and their color are deep except top biscuits.

IV. CONCLUSION

The research was conducted to analyze chemical and functional properties of jackfruit seed powder. Composite flour biscuit were prepared by incorporating different level jackfruit seed powder. Jack fruit seeds were procured from the area of Tangail District in Bangladesh during the season. White arils of the seeds were removed manually and further lye peeled to remove the brownspermoderm. Seeds were dried and milled into flour. The functional properties viz., water and oil absorption capacity, flour dispersibility, swelling power and percent solubility of the jack seed flour were documented using standard procedures.

The proximate compositions of the seed flour wereanalyzed by standard AOAC methods. The seed flour was packed in food grade polyethylene cover, heat sealed and stored both at ambient temperature and refrigerated conditions. The seed flour was utilized in the preparation of convenience food viz., normal biscuits at different proportions to ascertain the acceptable level of incorporation by sensory parameters. The total yield of the flour exclusive of weight of the white arils (4%), brown spermoderm (10%), and handling losses represented 13 per cent. The functional properties of jack seed flour had 72ml/100g of water absorption and 86ml/100g of oil absorption capacity with 33 per cent of flour dispersibility. The swelling power of the seed flour documented higher value (1.46 g/g) than the per cent solubility (2.31%). The analyzed value for proximate composition of seed flour were as follows 15.88% moisture, 5.78% protein, 1.77% of fat, 2.49% of crude fiber, 2.62% of total mineral matter and 71.46% of carbohydrates.

It was observed that the protein and carbohydrate contents of prepared biscuits were decreased with higher replacement of jack seed flour. But moisture, fat, crude fiber and ash are increased with higher replacement of jack seed flour. The sensory quality of jack seed flour based biscuits decreased with increase in incorporation level of seed flour. The incorporation above 40 per cent in biscuits was not acceptable by the based on sensory quality parameters. It was observed that 10, 20& 30 per cent seed flour incorporated biscuits were not significantly difference with control with respect to sensory qualities. But 40 per cent seed flour based biscuits scored lowest values for all the quality parameters.

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