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Nutritional & Microbiological quality assessment of dehydrated jackfruit (*Artocarpus heterophyllus*) seed powder

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ABSTRACT

The aim of the research was to develop a self-stable dehydrated jackfruit seed powder by dehydration which can be used in making bakery products. Solar, mechanical and oven drying method was used to make dry powder of jackfruit seed, packed in plastic container and observed their storage life. The moisture content increased gradually during storage period. The nutritional and microbiological quality of seed powder was observed up to three months from preservation. Nutritional values vary according to dehydration process. The result showed significant increase in all nutrient parameters in the dried samples of the seeds making them a concentrated source of nutrients.

INTRODUCTION

Jackfruit (*Artocarpusheterophyllus*) is the largest edible fruit in the world and is the national fruit of Bangladesh. It is a very popular fruit in Bangladesh. The jackfruit belonging to the family Moraceae and commonly known as 'Kathal' (Gupta et al., 2011). 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 (Islam et al.,2015). The poor people of Jackfruit growing area, used to eat this fruit instead of rice, for one of their daily meals. Hence, Jackfruit is called “poor man's food”. People consumed it mostly as a fruit when ripe but also as vegetable in the unripe stage.

The jackfruit significantly contributes to the nutrition of the people of our country as a source of vitamins, minerals and calories (Molla et al.,2008). Jackfruit seeds make up around 10 to 15% of the total fruit weight (30-365/fruit) and have high carbohydrate and protein contents (Hossain et al.,2014). The seeds of this plant have medicinal properties. Jackfruit seeds are less popular as vegetable and are eaten when boiled or roasted. These are believed to be digested with difficulty. The composition of jackfruit seeds has been reported and found to contain similar compositions as that of grains. A major protein, Jacalin has been isolated from jackfruit seeds and possessed immunological properties. Jackfruit seeds are not much explored in terms of nutrition and antioxidant properties. Chemical composition and mineral content of jackfruit seeds have been studied (Gupta et al., 2011). Soong and Barlow, 2004 have evaluated antioxidant properties of jackfruit seeds and found to show more than 70% contribution to the total antioxidant activity and phenolic content. Investigation of various nutritional components & microbiological activity present in the powder of dehydrated seeds of jackfruit was the aim of our study in order to understand their nutritional and other health benefits.

MATERIALS AND METHODS

Sample collection

The study was carried out from August 2014-February 2015. Fresh jackfruit seeds were collected from Puran Dhaka local bazar. Then the jackfruit seeds were weighted.

Washing

Fresh seeds were washed thoroughly in clean water to remove the adhering soil, dead seed and to reduce the number of contaminated microorganisms.

Blancing

Fresh seeds were boiled with 80°C water for up to 10 minuteswhich needed for destruction of enzyme of food and undesirable changes in texture.

Cooling and Sulphiting

These seed were cooled and kept in room temperature for 1 hour in 0.4% sodium metabisulphite solution.

Drying Methods

Solar Drying

A direct absorption type solar drier was used which consist of a box with single transparent cover (polythene) and blackened interior surface. Ventilation holes were made at both font and back side of the drier to facilitate air circulation. There is no temperature control system. So, the effect of temperature on the rate of drying cannot determine. The jackfruit seeds in trays were directly exposed in the drier in which the solar radiation is transmitted into drier box through transparent polythene. The seeds were dried about 16-18 hours for 3 days in solar drier. Solar radiation is absorbed by the black surface of the drier and converted to heat. Moisture of the seeds was evaporated by the heat. The dried seed were grinded to make powder separately through a blender and sieved. The seed power were packed in polythene bag and stored at room temperature.

Mechanical Drying

Hot air flow mechanical drier (Wessberg &Tolanderptv. Ltd. Sydney, N.S.W, No.3571) was used for dehydration of jackfruit seed. The drier consist of a chamber in which trays were placed with products. In dryer chamber air was blown by a fan pass through a heater and then across the trays of products to be dried at 55-60°C. The seeds were dried about 5-6 hours in mechanical drier.The dried seed were grinded to make powder separately through a blender and sieved. The seed power were packed in polythene bag and stored at room temperature (28-30°C).

Oven drying

Oven drying is one of a method for food preservation. The oven drier (wisel, Model-msh-30A) consists of a chamber in which trays with jackfruit seeds were placed at a control temperature (70-75°C). Drying was commenced in the oven for a period of 10-12 hours. The dried seeds were grinded and sieved. The dried powder was packed in polythene bag and stored at room temperature (28-30°C).

Nutritional analysis

The proximate of raw material and final product (jackfruit seed) of this research work was determined according to the method described by S. Ranganna.

Determination of moisture content

Moisture content of the sample was determined by Oven drying

method. Sample was dried in an oven at105°C for 4-5 hours to obtain moisturecontent by weighing the samples before and after drying. Moisture content was estimated using the formula:

$$\text{Moisture (\%)} = \frac{\text{Weight of sample before drying - weight of sample after drying}}{\text{Weight of sample before drying}} \times 100$$

Determination of ash

Ash content was determined in muffle furnace at 600°C for 4-6 hours by AOAC method, 2005. The ash content was calculated by using the following formula:

$$\text{Ash content (\%)} = \frac{\text{Weight of the ash (g)}}{\text{Weight of sample (g)}} \times 100$$

Determination of protein

The protein content was determined by micro Kjeldahl method (AOAC method, 2005). Percentage of nitrogen (N) was calculated using the following equation:

$$\text{Nitrogen (\%)} = \frac{(S-B)\times N\times 14.007\times D\times 100}{W\times V}$$

Here, S=Sample titre, B=Blank titre, N=Normality of HCl, D=Dilution factor, W=weight of sample, 14.007 is the equivalent weight of nitrogen. Protein was estimated by multiplying the corresponding total nitrogen content by a conventional factor of 6.25. Thus crude protein (%) = % of N × 6.25.

Determination of fat

The fat content was determined by Soxhlet extraction method(AOAC method, 2005).Percentage of fat content was calculated by using the following formula-

$$\text{Fat (\%)} = \frac{\text{Weight of fat in sample}\times 100}{\text{Weight of dry sample}}$$

Determination of crude fiber

The crude fiber content was determined by Digestion flask method (AOAC method, 2005).Percentage of crude fiber content was calculated by the following equation

$$\text{Crude fiber (\%)} = \frac{(\text{Weight of residue - Weight of ash})\times 100}{\text{Weight of the sample}}$$

Determination of carbohydrate content

The carbohydrate content was determined by Difference method. It was calculated by subtracting the sum of percentage of moisture, fat, protein and ash contents from 100% according to AOAC, 2005.

Carbohydrate= 100-(moisture+ash+protein+fat+crudefibre)

Determination of Energy

The energy content was measured by the following formula-

Energy= (protein×4.1) + (fat×9.3) + (carbohydrate×4.1)

Microbiological analysis

Total plate count

The samples were analyzed for total bacterial count (TBC) using pour plate technique. Total bacterial load was enumerated on plate count agar (PCA) medium(Richter et al., 1992). The plates were incubated for 24 hours at 37°C.

Total coliform

Enumeration of total coli form count was carried out by using three-tube most probable number method (BAM, 2002). The tubes were incubated at 37°C for 24 hours.

Total Fungus

Total fungus count was carried out by spread plate technique on potato dextrose agar (PDA) media. The plates were incubated at 25°C for 5 days.

RESULTS

Jackfruit seeds were found to be rich in proteins, starch and carbohydrates. Crude fat, fibre and ash content were found to be very low. The chemical composition of raw jackfruit seed was- 63.62% moisture, 7.67% protein, 0.33% fat, 2.21% fiber, 1.63% ash, 14.04% starch, 10.5% carbohydrate and 77.57% energy.

Nutritional composition of solar dried jackfruit seed powder

Nutritional composition (moisture, protein, fat, fiber, ash, starch, carbohydrate and energy) of final product were analyzed for 0 month to 3rd month. The data was presented in Figure-1.

Nutritional composition of mechanically dried jackfruit seed powder

Nutritional composition (moisture, protein, fat, fiber, ash, starch, carbohydrate and energy) of mechanically dried jackfruit seed powder were analyzed for 0 month to 3rd month. The data was presented in Figure-2.

Nutritional composition of oven dried jackfruit seed powder

Nutritional composition (moisture, protein, fat, fiber, ash, starch, carbohydrate and energy) of oven dried jackfruit seed powder were analyzed for 0 month to 3rd month. The data was presented in Figure-3.

Microbiological analysis of jackfruit seed powder

Total bacterial count, Total fungus count and Total Coliform count of solar, mechanical and oven dried jackfruit seed powder was presented in Table-1, 2 & 3.

DISCUSSION

The consumption of jackfruit has grown in recent years due to its reported health benefits. Jackfruit, its pulp and seeds are rich sources of several high value compounds with potential beneficial physiological activities. The rich bioactive profile of jackfruit makes it a highly nutritious and desirable fruit crop. Jackfruit seed is nutritious food as it contains many vitamins and minerals that are useful for the health of the body.

Fruit and vegetables are usually do not survive in a long storage and jackfruit seeds are vulnerable to damage. Bacterial and fungal growth is one of the major problems that often arise on the surface of seeds. As it is a seasonal fruit, it is widely found in summer season and price is relatively cheap at the time of harvest. On the other hand, it is usually found rare and cost is very high which is out of control to general people. So people need to make seeds durable. But in Bangladesh the storage system is not so abundant. So we lost a lot of jackfruit seeds every year.

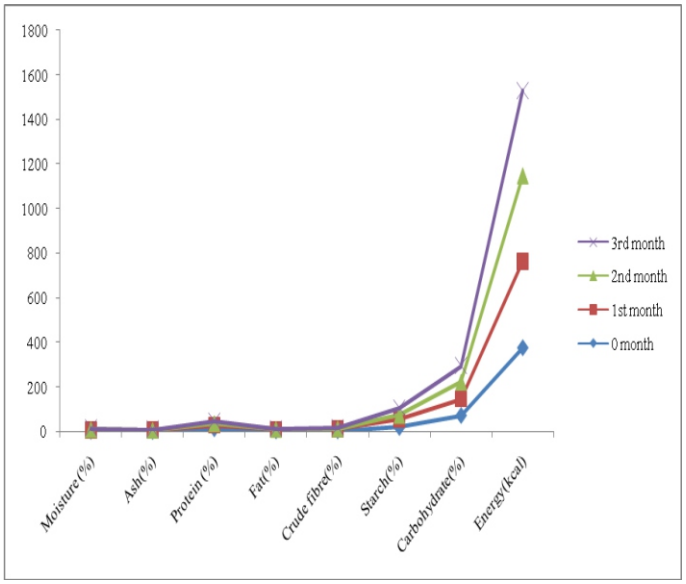

Figure 1. Nutritional composition of solar dried jackfruit seed powder.

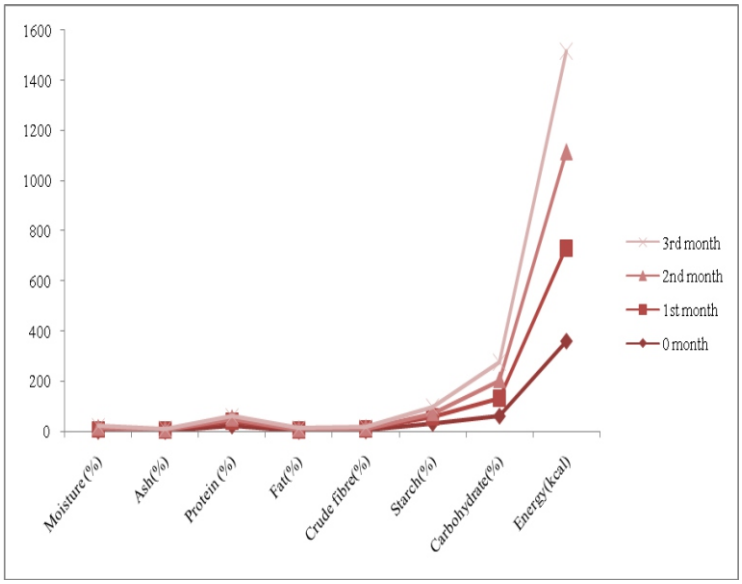

Figure 2. Nutritional composition of mechanically dried jackfruit seed powder

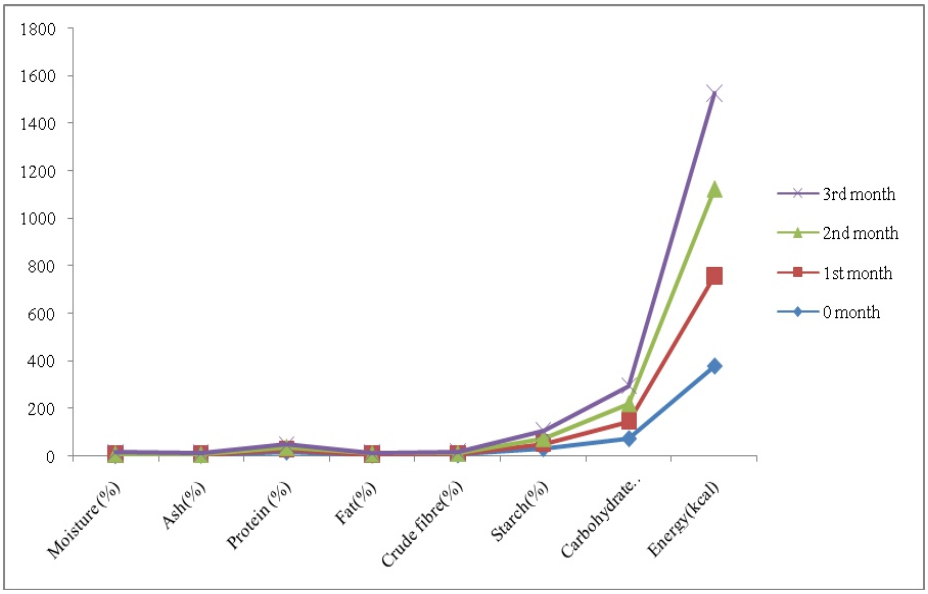

Figure 1. Nutritional composition of oven dried jackfruit seed powder.

Table 1. Total bacterial count of solar, mechanical and oven dried jackfruit seed powder.

	Solar dried		Mechanical dried		Oven dried	
Month	Raw (cfu/g)	10^{-3} dilution (cfu/g)	Raw (cfu/g)	10^{-3} dilution (cfu/g)	Raw (cfu/g)	10^{-3} dilution (cfu/g)
0 month	4	Absent	34	Absent	3	Absent
1st month	7	Absent	12	Absent	2	Absent
2nd month	**4×10^3**	**19**	7	Absent	2	Absent
3rd month	1	Absent	5	Absent	**1×10^3**	**5**

Table 2. Fungus count of solar, mechanical and oven dried jackfruit seed powder.

Month	Solar dried (cfu/g)	Mechanical dried (cfu/g)	Oven dried (cfu/g)
0 month	Absent	2	1
1st month	1	2	1
2nd month	2	1	Absent
3rd month	2	2	1

Table 3. Total Coliform count of solar, mechanical and oven dried jackfruit seed powder.

Month	Solar dried (MPN/g)	Mechanical dried (MPN/g)	Oven dried (MPN/g)
0 month	Absent	Absent	Absent
1st month	Absent	Absent	Absent
2nd month	Absent	Absent	Absent
3rd month	Absent	Absent	Absent

Seed powder making is one of the best ways to preserve jackfruit seed. Fresh seeds have resistance of 15 days; whereas seed powder has the endurance is longer 6 months. This is because the dehydration can reduce the oxidation process, so that it will prevent the relationship between fruit with external oxygen and oxygen is required for necessities of life of harmful microbes.

By determining moisture content of jackfruit seed powder it was observed that in figure-1,2,3 moisture content increases during storage period in plastic container. Similar results were found on ginger powder by shirshiret al, (2012). They also found that the keeping quality of ginger powder decreases with increase in moisture content.

It was observed that in Fig- 1,2,3, the protein, starch and carbohydrate contents of mechanical dried jackfruit seeds powder were higher than the solar and oven dried seeds powder which are comparable with the finding of Abedin et al., (2012). He worked on the nutritional composition of locally available jackfruit seed in Bangladesh, reported good amount of protein content of sun dried jackfruit seeds.

The fat, ash and fiber content of mechanical, solar and oven dried jackfruit seed powder did not vary significantly upto 4months. The ash content of jackfruit seed powder in mechanical, solar and oven was 2.61-2.62, 2.58-2.60, 2.59-2.60 which were higher than the findings of Awal et al., (1991) and purseglove(1968) who recorded ash as 1.8% and 1.5% respectively. Pruthi(2001) reported that the ash content of dried ginger was 5.0%.

Starch content were found 35.45, 34.90, 35.20 in mechanical, solar and oven dried seeds powder respectively, Bhatia et al., (1955) reported 57.09% starch which was higher than present experiment.

Water content in food ingredients affects the durability of food against the microbial attack. The higher the water content, the more likely the food is easily damaged, where the high water content can be utilized by microorganisms, especially mold to grow and multiply so as to endanger the health of the body due to poisoning (Fellows and Hampton, 1992 &Astaman, 2007). Drying of food can lead to impaired growth of microorganisms decay (Kolawole et al., 2009).

In addition, water content in food or food ingredient may affect the texture, taste, freshness, durability of materials and consumer acceptance (Winarno, 1981). In determining the standard of food that is used, water content is one of the criteria that usually determine the maximum and minimum limits for water content of food or processed food.

CONCLUSION

The research was conducted to analyze nutritional and microbiological properties of jackfruit seed powder. This seed powder was dried by solar, drier and oven drying method.Nutritional composition (moisture, protein, fat, fiber, ash, starch, carbohydrate and energy) of dried seed powder were analyzed for 0 month to 3rd month. No significant microbial contamination was found. This powder can be used as a value added food or functional food e.g. - in bread, biscuits or bakery products.

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Disclosure statement

No potential conflict of interest was reported by the author.

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