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# Studies on Production of Gluten Free Products from Breadfruit Flour

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## Abstract

Gluten is the composite of storage proteins gliadin and glutenin and is conjoined with starch in the endosperm of various grass related grains. Celiac sprue is considered to be a specific disorder characterized by gluten intolerance with remarkable symptoms including weight loss, diarrhea, chronic fatigue, nutritional deficiencies etc. These symptoms can be reduced by intake of gluten free products. Considering this, studies were done on production of gluten free products with good nutritional content. Breadfruit (*Artocarpus altilis,* Moraceae), is a traditional starch crop widely used in many of the countries for its richness in minerals and carbohydrates. In this study, the flour obtained by processing of this is completely gluten free and is used in the production of various indigenous food products including Noodles, Manchuria, Phulka and Halwa etc. During the course of study it has been observed that the products obtained have the potential to replace other gluten containing products. The studies on this can be considered as an initial step towards a gluten free life.

**Keywords:** Gluten; Breadfruit; Noodles

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## Introduction

### Gluten

Gluten (from Latin *gluten*, "glue") is a protein composite found in wheat and related grains, including barley and rye. Gluten gives elasticity to dough, helping it rise and keep its shape and often gives the final product a chewy texture. Gluten is used in cosmetics, hair products, and other dermatological preparations. Gluten is the composite of the storage proteins *gliadin* and a *glutenin*, and is conjoined with starch in the endosperm of various grass-related grains. The prolamin and glutelin from wheat (gliadin, which is alcohol-soluble, and glutenin, which is only soluble in dilute acids or alkalis) constitute about 80% of the protein contained in wheat fruit. Being insoluble in water, they can be purified by washing away the associated starch. Worldwide, gluten is a source of protein, both in foods prepared directly from sources containing it, and as an additive to foods otherwise low in protein [1-4].

Gluten intolerance is a growing epidemic in the U.S. and, increasingly, worldwide. Celiac sprue is a more specific disorder, characterized by gluten intolerance along with auto antibodies to the protein, transglutaminase, which builds crosslinks in undigested fragments of gliadin, a major constituent of gluten [5]. The auto antibodies are produced as an immune response to undegraded fragments of proteins in gluten. A remarkable set of symptoms develop over time in association with celiac disease, including weight loss, diarrhea, chronic fatigue, neurological disorders, anemia, nausea, skin rashes, depression, and nutrient deficiencies.

### Breadfruit

Breadfruit (*Artocarpus altilis*) is a species of flowering tree in the mulberry family, Moraceae. It has long been an important staple crop and a primary component of traditional agroforestry systems in Oceania, where numerous varieties are grown. The fruit can be cooked and eaten at all stages of maturity, is high in carbohydrates, and is a good source of minerals and vitamins. In addition to producing abundant, nutritious, tastyfruits, this multipurpose tree provides medicine, construction materials, and animal feed. The attractive, ever green trees grow to heights of 15 to 21m (48 to 70ft) or more and the trunks may be as large

as 2m (6.6ft) in diameter at the base. The trees begin bearing in 3-5 years and are productive for many decades. They are easy to propagate, require little attention and input of labor or materials, and can be grown under a wide range of ecological conditions [6-15]. Most breadfruit is produced for subsistence purposes and small quantities are available for sale in town markets as fresh fruit or chips [16].

A close relative of the breadfruit and breadnut is the jackfruit (Artocarpus heterophyllus), known for its enormously large fruit. Not common is St. Vincent, but worth mentioning also is a tree called breadnut or African breadfruit (Treculaia africana) that is grown for the seeds, which are ground into flour. This tree is also in the fig family [17-24].

Breadfruit has been processed into many forms for utilization in the food industry. It has also been processed into starches [22] and into flour [20,24]. Studies on the modification of breadfruit starch involving heat-moisture-treatment and annealing, as forms of physical modification collectively referred to as hydrothermal treatment which entail modification of temperature and moisture content have been carried out and reported by Adebowale et al. [1].

## Noodles

Noodles are important foods throughout the world especially in Asian countries such as China, Korea, Malaysia, the Philippines and Thailand. Breadfruit starch has also been reported to contain high amylose (22.52%) and amylopectin (77.48%) [3]. Studies have shown that moderately high amylose foods are helpful in reducing risk factors for diabetes and cardiovascular diseases [12]. High amylopectin presence in food has also been reported to increase human insulin levels [13]. Furthermore, diets high in complex carbohydrates including high levels of starches according to Behall et al. [14] have been reported to normalize blood insulin and lipid levels in carbohydrate sensitive, diabetic, and hyper lipidemic individuals. Therefore, noodles produced from the blends of breadfruit starch and wheat flour with moderately high amylose and amylopectin might be explored as functional foods for normalizing the blood insulin levels and imparting other health benefits. Hence, the objective of this study is to produce noodles from breadfruit flour and investigate their proximate, culinary and sensory properties.

In this study, the main raw material is the flour made of breadfruit. This Breadfruit flour is used in the production of many food products without any fortification aiming to produce gluten free products. The products thus made were analyzed for its nutritional and mineral content as well as acceptability for the consumption.

## Nutritional content in Breadfruit

Ragone [16] reported Sensory evaluation of fruit quality and nutritional composition of 20 breadfruit (*Artocarpus*, Moraceae) cultivars. Nutrient composition of 20 breadfruit varieties at the National Tropical Botanical Garden, Hawaii [per 100 g (approx. ½ cup) of edible portion] **(Table 1).**

# Materials and Methods

The gluten free products from breadfruit are obtained from processing of fresh breadfruit to flour by dehydrating breadfruit slices followed by milling/grinding and thus the flour obtained is incorporated with other ingredients in order to produce several varieties of gluten free products such as Noodles, Manchuria, Phulka, Halwa etc. The process for the preparation of these products are similar to that of the regular products only varied with some ingredients and their proportions.

These products are made in different formulations (shown in **Tables 2-5**) fortified with maida, wheat flour, semolina, corn flour in order to check the taste, texture, appearance and overall acceptability, and thus finally to produce products without being fortified with any other materials than using only breadfruit flour.

## Analysis of nutritional content

Proximate analysis and nutritional content of the products are obtained by following different methods. Moisture content of

**Table 1** Nutritional content in Breadfruit.

| Nutrient | Range | Average |
|---|---|---|
| Energy (kcal) | 107-138 | 121 |
| Protein (g) | 0.6-1.3 | 1 |
| Carbohydrate(g) | 25-33 | 29 |
| Fat (g) | 0.1-0.2 | 0.2 |
| Fiber (g) | 2.1-7.4 | 5.2 |
| Water (g) | 65-73 | 69 |
| Calcium (mg) | 10-30 | 20 |
| Iron (mg) | 0.4-1.1 | 0.6 |
| Magnesium(mg) | 20-30 | 24 |
| Phosphorus(mg) | 18-41 | 32 |
| Sodium (mg) | 13-70 | 22 |
| Zinc (mg) | 0.07-0.13 | 0.1 |
| Copper (mg) | 0.04-0.15 | 0.1 |
| Manganese(mg) | 0.04-0.08 | 0.1 |
| α carotene(µg) | 8-20 | 13 |
| Vitamin C (mg) | 2-12 | 4 |
| Thiamin (mg) | 0.09-0.15 | 0.1 |
| Riboflavin (mg) | 0.02-0.05 | 0.03 |
| Niacin B3 (mg) | 0.75-1.4 | 1 |

**Table 2** Formulations for Noodles.

| Maida | | Breadfruit flour |
|---|---|---|
| 1 | : | 2 |
| 1 | : | 3 |
| 1 | : | 5 |
| 0 | : | 1 |

**Table 3** Formulations for Manchuria.

| Maida | | Corn flour | | Breadfruit flour |
|---|---|---|---|---|
| 2 | : | 1 | : | 1 |
| 1 | : | 1 | : | 2 |
| 1 | : | 2 | : | 1 |
| 2 | : | 1 | : | 2 |
| 0 | : | 0 | : | 1 |

the products are estimated by AOAC method, Total ash, Acid insoluble ash, sugars, acidity are estimated by standard chemical procedures. Fat, Crude fibre are determined by soxhlet apparatus and fiber analyzer respectively, Sodium(Na) and potassium (K) are determined by instrumental method Flame photometry, Phosphorus content is determined by Spectro photometry, Iron and Magnesium content is determined by using ICPMS (Inductively coupled plasma-mass spectrometry) method.

## Sensory analysis

The sensory parameters of the products prepared from breadfruit flour are determined by group of panalists [15] in order to determine the appearance, texture, taste, flavor and overall acceptability.

# Results and Discussions

The shelf life of the products can be maintained if store properly under required conditions. After attaining shelf life, products tend to show changes in the characteristics like, change in texture, smell, taste etc. In order to know the actual quality of

**Table 4** Formulations for Phulka.

| Breadfruit flour | | Wheat flour |
|---|---|---|
| 1 | : | 2 |
| 1 | : | 1 |
| 1 | : | 0 |

**Table 5** Formulations for Halwa.

| Semolina | | Wheat flour | | Breadfruit flour |
|---|---|---|---|---|
| 1 | : | 1 | : | 2 |
| 0 | : | 1 | : | 1 |
| 1 | : | 0 | : | 1 |
| 0 | : | 0 | : | 1 |

**Table 6** Shelf life of the products.

| S.no | Product | Storage temperature | Shelf life |
|---|---|---|---|
| 1 | Noodles | Room temperature | 6 months |
| 2 | Manchuria | 3-5˚C | 4 months |
| 3 | Halwa | 3-5˚C | 4 months |
| 4 | Phulka | 3-5˚C | 5 days to 1 week |

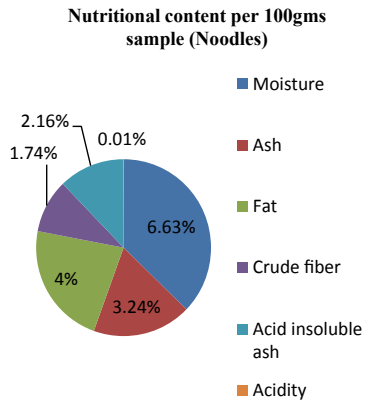


**Figure 1** Noodles.

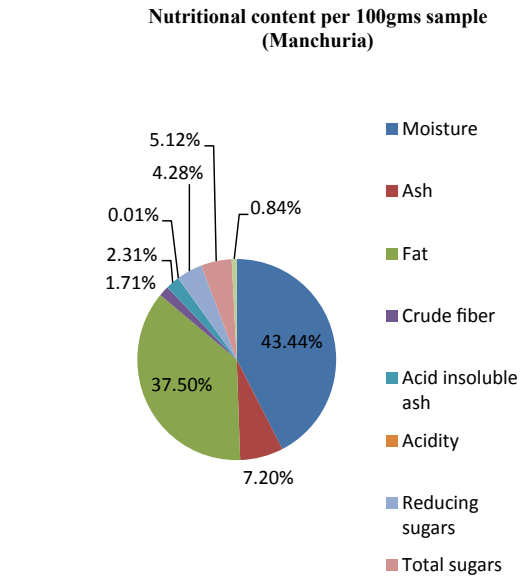


**Figure 2** Manchuria.

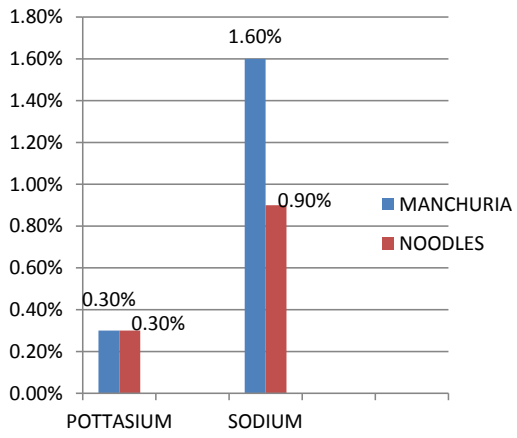


**Figure 3** Amount of Sodium and Potassium content in % unit of measurement per 100gms sample.

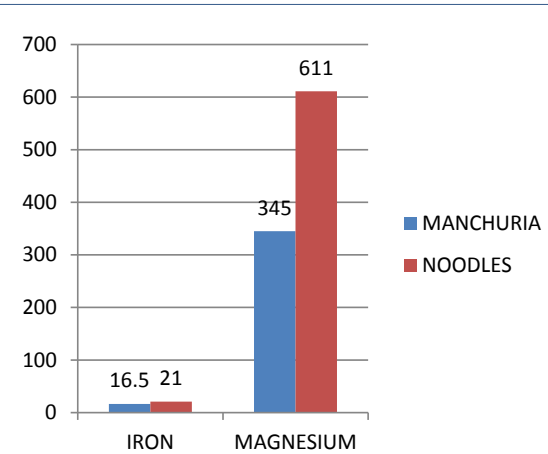


**Figure 4** Amount of Iron and Magnesium in mg/kg unit of measurement per 100 g of samples.

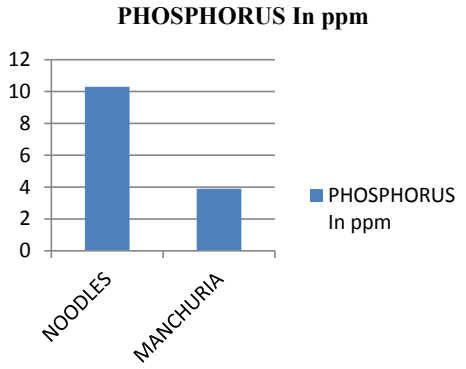


**Figure 5** Amount of Phosphorus in ppm unit of measurement in Noodles and Manchuria.

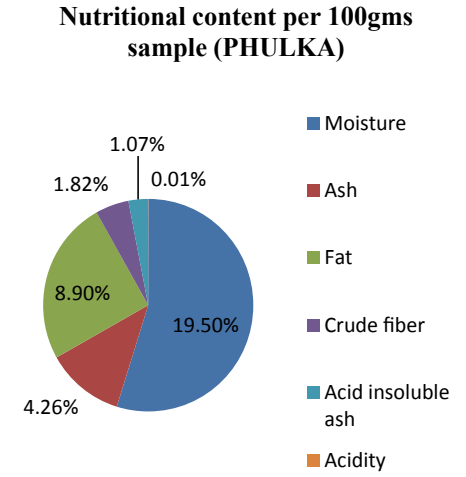


**Figure 6** Phulka.

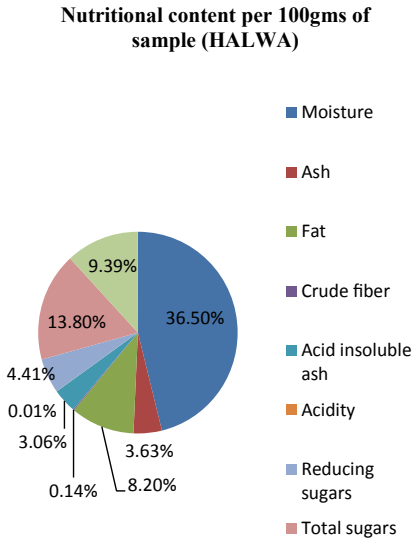


**Figure 7** Halwa.

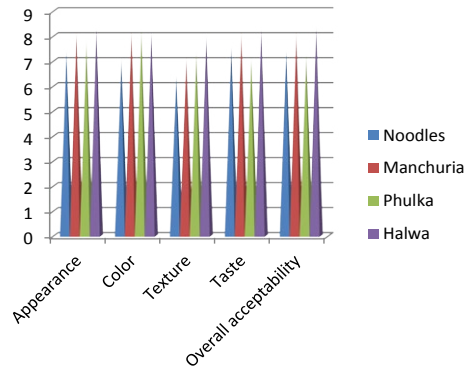


**Figure 8** Sensory Quality.

the products, its nutritional changes, with increasing shelf life from the date of manufacturing, microbial and chemical analysis should be conducted at regular intervals of time **(Figures 1-8) (Table 6).**

## Conclusion

The results of the present study revealed that beneficial gluten free products obtained from breadfruit flour with health promoting factors has superior proximate, culinary and sensory attributes. Since breadfruit is rich in minerals, carbohydrates and gluten free, it is considered as useful product that helps reducing symptoms of chronic constipation, risk of colon cancer and to minimize the symptoms related to celiac disease. Therefore, an inference can be drawn that the products obtained from the breadfruit flour are not just gluten free products but important functional foods.

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