



MAKING BREADFRUIT FLOUR AT HOME

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Fig. 1. Breadfruit tree

Breadfruit tree

Breadfruit (*Artocarpus altilis*) is a tropical evergreen tree spread throughout the globe, generally classified as a seedless variety. Several seedless varieties and hybrids containing seeds are grown on Guam. Breadfruit is commonly known as ‘lemmai’ in the CHamoru language. The breadfruit tree can grow up to 29-68 ft and produce more than one hundred fruits with a yield of above 100 kg (220 lbs) each year (Elevitch et al., 2014).



Fig 2. Breadfruit

Nutrients of breadfruit

Breadfruit is a round, oblong or oval fruit and has a weight of 0.23-5.90 kg (0.5-13 lbs), depending on the variety. During maturation, the skin of the fruit changes from dark-green to yellowish-green, and the bumpy and spiky characteristics of the skin surface become flat and smooth. The major component of the fruit is starch. When baked or roasted, the fruit exhibits a starchy texture and a reminiscent smell of fresh-baked bread.

Breadfruit is a good source of carbohydrates (76% dw) and proteins (3.9% dw) with a full spectrum of amino acids. Breadfruit is also rich in minerals (potassium, magnesium), vitamins (vitamin C, thiamine (B1), vitamin A, pantothenic acid (B5)), carotenoids (zeaxanthin and lutein) and dietary fiber. Breadfruit has a moderate glycemic index. Residents of the Pacific islands consume breadfruit traditionally as a nutritious staple crop.

Consumption of breadfruit

Breadfruit can be consumed fresh (raw) or through preparation by baking, steaming, boiling, frying, cooking over an open fire, etc.. Normally, immature or mature-unripe breadfruit is cooked before consumption. Once cooked, breadfruit can be added to a salad or prepared into dishes. Breadfruit can also be marinated and pickled as a vegetable. Ripe fruit has a unique, exotic flavor and sweet taste. It can be eaten raw or added to various desserts.

Shelf-life of breadfruit

Mature breadfruit has a very short shelf-life after harvest. The fruit will ripen in 1-3 days at room temperature. The ripened fruit has good eating quality but must be consumed quickly. Although storage in the refrigerator can extend the shelf-life of breadfruit for 7 to 10 days, the skin of breadfruit turns to black at the temperature of 4 °C (40 °F).

Breadfruit flour and food security

Breadfruit is an important tropical staple. Unfortunately, the short shelf-life of the fruit limits the use of this tropical resource for consumption. Processing breadfruit fruit into shelf-stable flour will extend the use of fresh breadfruit and create a year-round supply while enhancing food security for the Pacific islands.

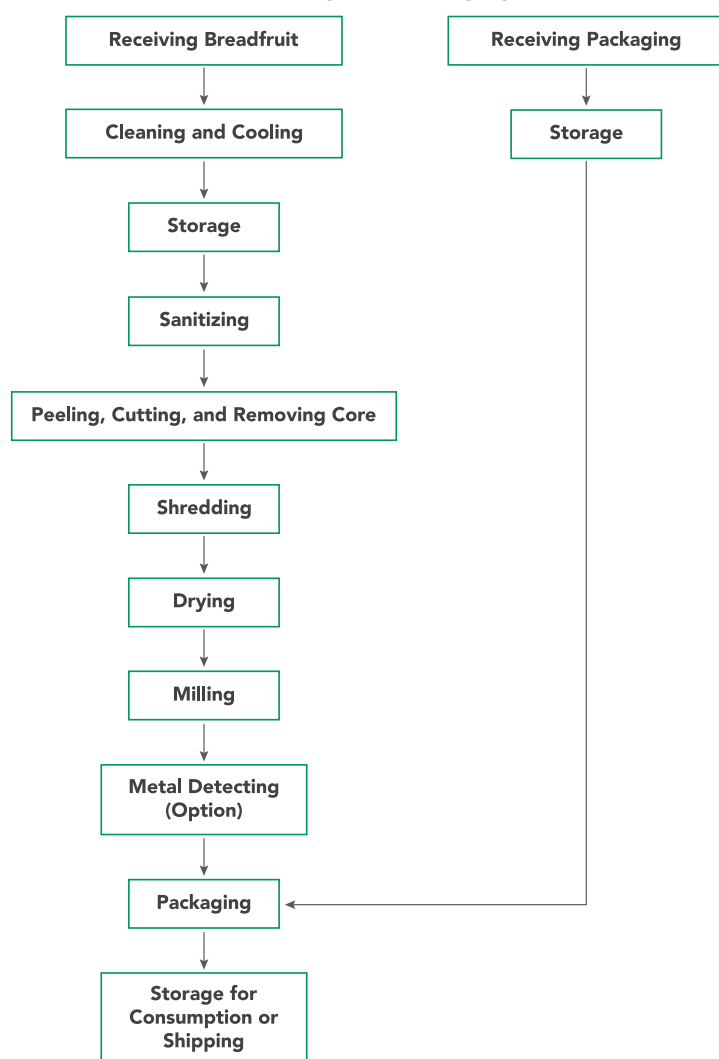
The breadfruit flour contains carbohydrate (76-79%), moisture content (4.5-6.3%), protein (3.8-5.5%), crude fiber (3.0-5.8%), ash (2.1-4.5%) and fat (1.1-1.5%). The shelf-life of breadfruit flour is 6-12 months, which can meet the needs of consumers when the fruit is not in season.

The breadfruit flour can be used as a nutritious and functional ingredient for various food products, such as bread, cookies, noodles, cakes and nutrition bars. Also, breadfruit flour is free of gluten and can benefit people with dietary challenges.

Process breadfruit flour

The processing of breadfruit flour is relatively simple and can be achieved with home equipment. The procedures of processing and packaging breadfruit flour are described in the flow chart (Figure 1). Descriptions and guidelines for making breadfruit flour are also provided following the chart.

The flow chart of processing and packaging breadfruit flour.



Receiving Breadfruit

Obtain fresh breadfruit from farmers or approved suppliers that follow the postharvest breadfruit guidelines to prevent fruit damage, decay, and contamination. When receiving, inspect the fruit, test the firmness and ensure there are no

sunspots, cuts and brown patches on the skin. Only use the firm-mature and undamaged breadfruit for processing breadfruit flour.

To slow the ripening of breadfruit, immerse the fruit in cold water or an ice bath for 10-15 minutes to remove the field heat. Then, use a brush and clean water to remove the dirt, sap, debris and other foreign materials. To reduce microbial contamination, sanitize the fruit in water with 150 ppm total chlorine (2 teaspoons of regular bleach per gallon of water) for 1 minute, then air-dry for storage. Store the fruit in a well-ventilated area or container at a temperature of less than 24°C and relative humidity less than 60% for less than three days. Only mature and firm fruit should be used for processing breadfruit flour.



Fig 3. Preparing breadfruit for dehydration.

Peeling, Cutting, Removing Core, Shredding

Before peeling and cutting the breadfruit, clean and sanitize all the tools and utensils with 200 ppm chlorine solution (1 tablespoon of regular bleach per gallon of water) and air-dry before use.

To prepare the breadfruit, first, remove the stem of the fruit and peel the fruit using a knife, a vegetable peeler or an electronic peeler. Then, cut the fruit into quarters and remove the core with a knife. Cut quartered breadfruit into chunks, shred the fruit with a food processor or cut into thin slices less than 0.64 cm (1/4 inch) for drying.

Drying

Place a single layer of shredded or sliced breadfruit on trays of a food dehydrator then dry them at 71°C (160°F) for 6-8 hours until breadfruit pieces are crispy. The moisture content and the water activity of dried breadfruit should be less than 10% and 0.65, respectively.



Fig 4. Drying sliced breadfruit with food dehydrator.

Milling and packaging

After dehydration, mill the dried breadfruit with sifter screens to make particle sizes of flour that meet your application. If the mill does not incorporate a sifting screen, sieve the ground flour manually with sieves at a size of 0.250 – 0.420 mm (Mesh No. 60-40) to meet your needs. The larger pieces of breadfruit can be re-milled to a fine powder.



Fig. 5. Mill dried breadfruit into flour.

For packaging, fill the breadfruit flour in food-grade polyethylene bags or food-grade containers with lids, which are compatible with flour or dried storage of food products. Seal the bags or containers; label the finished products with the appropriate date.

Storage

For long-term storage, store the bags in an air-tight container in a dry and cool area, which have a relative humidity less than 60% and a temperature less than 24 °C. The finished

breadfruit flour will have a shelf-life of 6-12 months. For transportation, use clean and sanitary vehicles to deliver the breadfruit flour to customers.

Usage of breadfruit flour

Breadfruit flour can be used in a variety of ways. Regular flour can be substituted with breadfruit flour or blended with wheat flour to make breakfast meals, pastries, bread, cookies, cakes, pancakes, and pizza dough. It can also be used as coating ingredients or batter for frying, as well as gluten-free flour to make nutrition bars. The recipes for making a nutrition bar and cake with breadfruit flour are provided in Table 1 and Table 2.



Fig. 6. Breadfruit Flour

Table 1. Recipe to make breadfruit nutrition bar.

Main ingredients		Optional ingredients	
Breadfruit flour	1 cup	Sliced almonds (toasted)	¼ cup
Ground dates	½ cup	Sunflower seeds (toasted)	¼ cup
Crasins	½ cup	Drizzled honey	1 tbsp
Oats (rolled)	½ cup	Water (as needed)	2-4 tbsp
Chia seeds	¼ cup	Melted butter	1 tbsp
Honey	1/3 cup		
Salt	½ tsp		

The procedures to make nutrition bars:

1. Preheat oven to 177 °C (350 °F);
2. Mix all ingredients of the recipe, spread evenly in pan;
3. Place mix on a cookie sheet (1/2 inch thick) in a 9x9 baking pan;
4. Drizzle (1 tbsp.) honey on top of mix for coating the top;
5. Bake for 20-25 min or until the color turns to a golden brown;

6. Remove the pan from oven and cool it for 30 min; and
7. Upside the pan, remove and cut the baked mix into a nutrition bar for consumption



Fig. 7. Ingredients for breadfruit bars.



Fig. 8. Breadfruit bar mix before and after baking.



Fig. 9. Breadfruit nutrition bars.

Table 2. Recipes to make breadfruit cake.

Ingredients	Cake
Breadfruit flour	½ cup
All purpose flour	1 cup
Sugar	¾ cup
Egg	2
Butter	½ cup
Vanilla extract	2 teaspoon
Baking powder	1 ¾ teaspoons
Water	¼ - ½ cup
Milk	½ cup

The procedures to make breadfruit cake:

1. Preheat oven to 177 °C (350 °F);
2. Grease and flour a 9x9-inch pan or muffin pan;
3. Cream sugar and butter together in a medium bowl; beat in eggs, one at a time; then stir in the vanilla;
4. Combine flour and baking powder, add to the creamed mixture, and mix well;
5. Stir in the milk and water until the batter is smooth;
6. Pour batter into prepared pan;
7. Bake for 30 min in the preheated oven (20-25 min for cupcake) until the cake springs back to touch; and
8. Remove the pan from the oven for consumption after cooling.



Fig. 10. Cake made with 30% breadfruit flour.

Food safety and quality in making breadfruit flour and products

During growing, harvest and storage, breadfruit can be contaminated with pathogens, such as *Salmonella*, pathogenic *E. coli*, *Listeria monocytogenase*, and aflatoxin from *Aspergillus flavus*. Therefore, in the purchasing and storage of fresh breadfruit, the growth of molds must be prevented by controlling the relative humidity of less than 60%. The residues of aflatoxin from *Aspergillus flavus* in fruit should be monitored by breadfruit suppliers. The dehydration condition in breadfruit processing should kill *Salmonella* and pathogenic *E. coli*. In milling and packaging flour, good sanitation practices should be applied to control the contamination of environmental pathogens, such as *Listeria monocytogenese*.

To process breadfruit flour and make breadfruit bakery products, always practice good personal hygiene, wash hands with warm soapy water and clean and sanitize utensils and food contact surfaces before, during and after processing.

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