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Breadfruit Flour as An Alternative Ingredient for Cookies

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Abstract: The present study aimed to investigate the feasibility of using breadfruit flour as an alternative in cookie making. The study was designed and implemented with an experimental research approach including a shelf-life observation and recipe testing with the percentage used of breadfruit flour for cookie making. A series 30 days observation method was used to determine the quality of the final product show there is no presence of foreign objects that affect the integrity and maintained its characteristics throughout the observation period. 10 expert panel was involved in sensory evaluation who accessed 5 different cookie recipes formulation blends of wheat flour: breadfruit flour (S1: 100% wheat flour 0% breadfruit flour; S2: 75% wheat flour 25% breadfruit flour; S3: 50% wheat flour 50% breadfruit flour; S4: 25% wheat flour 75% breadfruit flour; S5: 0% wheat flour 100% breadfruit flour). The cookies made from different formulation blends were analyzed for physical and sensory qualities using a 5-point Likert scale. The result shows that are no significant difference among 50% breadfruit flour added compared to the controlled product however there are significant differences in the other percentage of breadfruit added. 50% breadfruit flour added has a high acceptance level in terms of all sensory parameters and satisfaction. Thus, the use of wheat-breadfruit flour added in preparing cookies would be a value addition while it promotes the diversification of utilization of breadfruit so that the product could be further developed for commercialization.

Key words: *Product Innovation; Breadfruit Flour; Cookies; Sensory Properties*

1.0 INTRODUCTION

Many people around the world eat cookies as a snack food, which is both a bakery item and a good source of nutrients (Arshad et al., 2007). Cookies are well-liked because they are inexpensive to produce, highly stable, have a long shelf life, and are able to carry a lot of nutrients (Honda and Jood, 2005). According to Suriya et al. (2017), the main components of cookies are flour, fat, sugar, water, milk, salt, flavouring agents, and aerating agents. Many cookie recipes are viewed as unhealthy snacks due to their high fat and sugar content and low protein, fibre, vitamin, and mineral content. Several studies have been conducted (Ebere et al., 2015; Emelike et al., 2015; Kiin-Kabari and Giami, 2015) to find ways to increase the amount of fibre, protein, vitamins, and minerals in cookies while reducing the amount of fat. A cashew apple residue was used as a source of fibre in a cookie recipe, per a study (Ebere et al., 2015). According to studies (Emelike et al., 2015; Kiin-Kabari and Giami, 2015), plant protein sources can be added to cookies using ingredients like Bambara groundnut protein concentrate and Moringa leaf powder. A variety of fat substitutes have been the focus of the development of low-fat snacks. Vegetarians may object to the fact that animal-origin fat substitutes are frequently used in cookie baking today. Additionally, creating cookies with low fat content will increase consumer acceptance and demand for them.

According to Wang et al. (2011), breadfruit typically contains 0.31% fat, 1.34% protein, 27.8% carbohydrate, 1.5% fibre, and 1.23% ash. According to Akubor et al. (2000), breadfruit

flour contains roughly 76.7% carbohydrates, 17.1% protein, 11.1% fat, 3.0% ash, and 0.1% crude fibre. According to its growth location and cultivar, breadfruit contains varying amounts of copper, magnesium, phosphorous, potassium, calcium, cobalt, iron, and manganese (Ragone, 2006). The fruit does not contain gluten proteins that are harmful to patients with celiac disease and can also be a potential ingredient for use of gluten-free products. In order to meet food demand, different types of flour are frequently imported into areas where breadfruit is a plentiful crop. According to Akanbi et al. (2009), breadfruit is regarded as a substantial staple food with significant economic value.

Despite the importance of breadfruit, its production and use are limited due to lack of knowledge (Omobuwajo, 2003). Thus, there is a need to investigate how to process breadfruit into flour with a dependable capacity which can be utilized to substitute wheat flour in preparing bakery products. Thus, this study was carried out to incorporate breadfruit flour as an alternative in preparation of cookies and to assess the physical and sensory properties as affected by incorporation of breadfruit flour in preparation of cookies.

2.0 LITERATURE REVIEW

Breadfruit is a highly nutritious food, and has provided sustenance to people from many parts of the world for centuries. Although breadfruit has a starchy taste and a texture similar to that of a potato when cooked, it is actually a fruit. Nutritional analysis of the fruit has revealed that it is a good source of carbohydrates, and is low in fat and protein (Graham and Bravo, 1981). A typical 100-gram serving of the raw fruit contains 74 calories, 0.3 grams of fat, 15.3 grams of carbohydrates, 2.4 grams of dietary fiber, and 1.1 grams of protein (Sachau et al., 1985). In addition to its high carbohydrate content, breadfruit is also a good source of several vitamins and minerals. It is an excellent source of Vitamin C and contain significant amounts of Vitamin A, Vitamin B1 (Thiamine), Vitamin B2 (Riboflavin), Vitamin B3 (Niacin), and Vitamin B6 (Graham and Bravo, 1981). One hundred grams of breadfruit also contains 8.4 milligrams of iron, 46 milligrams of magnesium, 15 milligrams of phosphorus, and 322.1 milligrams of potassium (Sachau et al., 1985).

Breadfruit are fruit that can be process in several types of dishes. The process may include boiled, dried, deep-fry, steam and many others. The breadfruit pulps are made into various dishes; it can be pounded, fried, boiled or mashed to make porridge; it can also be processed into flour and used in bread and biscuit making (Amusa et al., 2002). A number of studies have focused on the potential of Breadfruit as a food substitution for other carbohydrates in several countries. In India for example, breadfruit is highly beneficial and it serves many purposes. Its consumption as a main food item has increased significantly in the recent years (Kanaujia et al., 2020). Also, traditional products some of which are processed and stored without or with minimal energy input, are gaining popularity.

Breadfruit is a potential source for various bakery products, such as biscuits, sweetmeats, buns, cakes, beer, bread, doughnuts, and pancakes (Beatley and Leon-Bertozzi, 2019). A challenge noticed with breadfruit flour when compared with other more traditional flours was that the starch in breadfruit flour (Huang et al., 2021). This is due to the grainy texture of the breadfruit which makes it suitable for processing into snacks and bakery items.

Breadfruit flour is suitable for making biscuits, porridges, breads and other bakery products with the addition of other ingredients.

3.0 MATERIAL AND METHOD

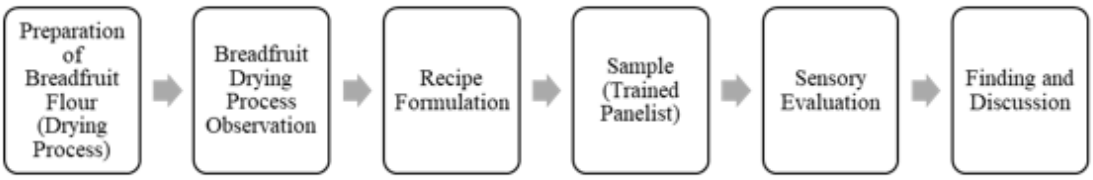


Chart 1: Preparation Steps

3.1 Materials

Materials Good quality, mature breadfruits without any bruises were procured immediately after harvesting from a home garden of a villager. Fruits were washed, wiped to make them free from foreign materials. Cured breadfruits were stored at room temperature and humidity until further use. Other major ingredients such as wheat flour, brown sugar, almond nib, chocolate chip, butter and vanilla essence were purchased from the local supermarket.

3.2 Preparation of breadfruit for drying process

Dehydration is a process used to preserve food by removing moisture content. Dehydrated foods have been used for centuries to preserve food for trading, gifts, and travel. Breadfruit is an agricultural crop grown in tropical and subtropical regions. It functions as a starchy staple necessary for sustenance in many cultures. Breadfruit flour is made by mashing dried, peeled, or cooked breadfruit, either in a mortar and pestle or using a food processor or grinder in combination with sieving to obtain a fine powder. Dehydration of breadfruit flour is an important process for food preservation as it helps to minimize spoilage and retains most of the nutrient content of the original ingredient.

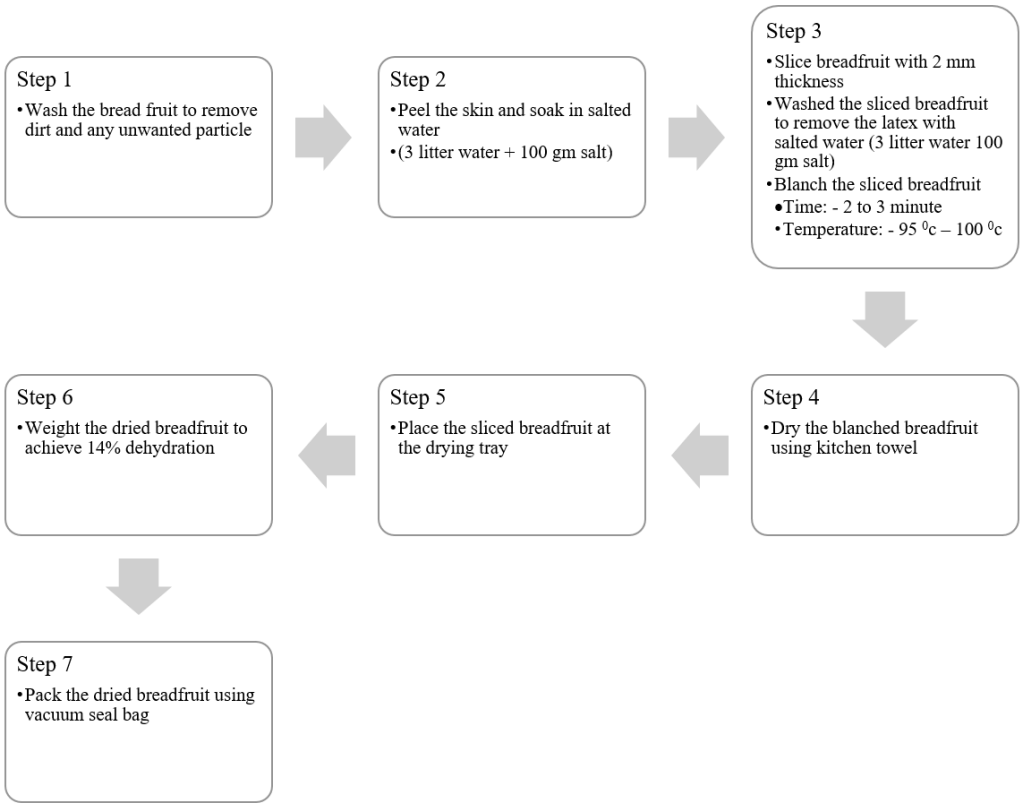


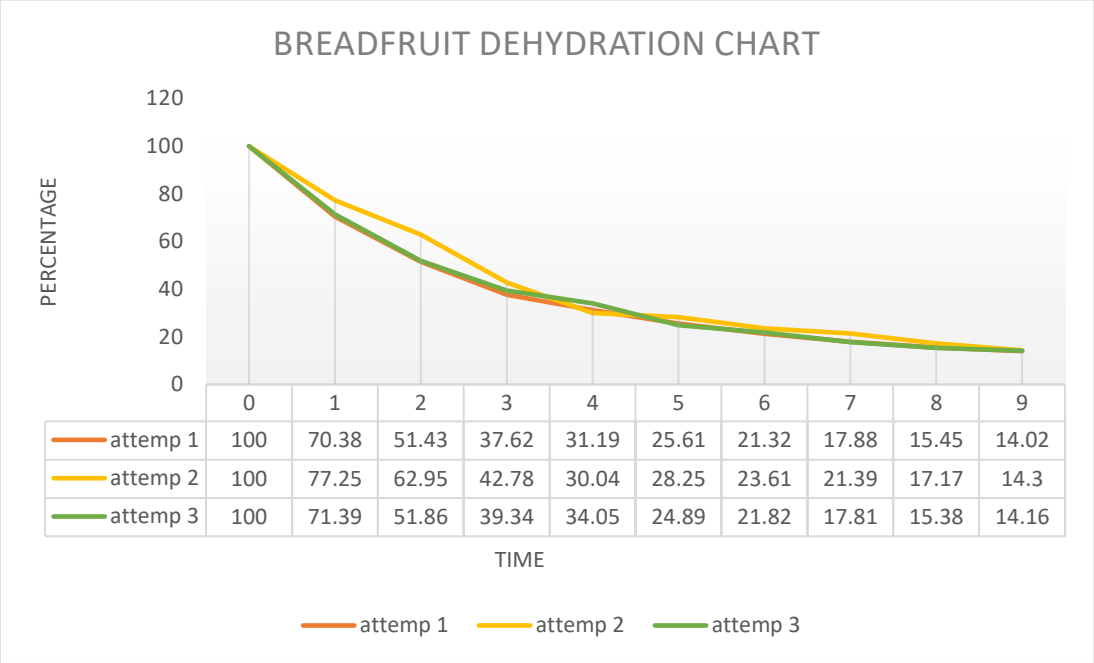
Chart 2: -The process flow for dehydration of breadfruit flour

The process flow for dehydration of breadfruit flour can be divided into four different stages:

a. Pre-treatment: Pre-treatment process involves washing the breadfruit with running water to remove any chemical residues, dirt, and other contaminants. Peeling and slicing of the breadfruit is done to remove the outer skin and reduce the size for drying. Sliced breadfruit pieces are then boiled in salt water for about 10 minutes at 95-99°C to deactivate enzymes.
b. Drying: Breadfruit slices were dried in either a solar or mechanical dryer at the temperature of about 65-70°C. The drying process should take 16-20 hours to obtain moisture content of about 12-13 %. The drying process was stopped when the desired moisture content was achieved. Drying promotes the retardation of the enzymatic activity and microbial growth.
c. Milling: The dried slices of breadfruit were milled into flour with the help of mechanical mill or food processor. The resulting flour is sieved to obtain a finer texture.
d. Packaging, Labelling and Storage: The milled flour is then packaged in airtight and moisture-proof containers. It is important to store the flour in a cool and dry place. The flour is to be labelled with the manufacturing, expiry dates and other necessary information.

Dehydration of breadfruit flour is an important technology for food preservation as it helps minimize spoilage and maintains most of the nutrient value of the original ingredient. Proper pre-treatment, drying and milling is important to produce high-quality flour with desired texture, color, flavour and nutrient value.

3.3 Breadfruit Dehydration Observation (Breadfruit Flour)



	0	1	2	3	4	5	6	7	8	9
attemp 1	100	70.38	51.43	37.62	31.19	25.61	21.32	17.88	15.45	14.02
attemp 2	100	77.25	62.95	42.78	30.04	28.25	23.61	21.39	17.17	14.3
attemp 3	100	71.39	51.86	39.34	34.05	24.89	21.82	17.81	15.38	14.16

Chart 3: - Dehydration Graf Process - Breadfruit

The dehydration process of breadfruit, graph shows that the drying process takes almost the same time to reach the 14% dehydration level. The test was performed 3 times, and all 3 processes showed significant achievement. The chart shows that the process of breadfruit dehydration takes about 9 hours to achieve the 14% level. The chart shows a very fast drop during the first 3 hours, where from the 5 hours to 7 hours mark a very slow drop of percentage occur in the process. However, the change can be achieved well when the three products reach a stage of drying that is almost similar in the 9th hour. This shows a significant achievement in the production of the product.

3.4 Development of cookies from Breadfruit flour

Table 1: - Standard Recipes Formulation

No	Item	Quantity (GM)
1	Wheat Flour	120 gm
2	Chocolate chip	60 gm
3	Brown Sugar	25 gm
4	Almond Nib	30 gm
5	Butter (unsalted)	100 gm
6	Vanilla essence	¼ tsp

Cookies were developed using the method described by Aderinola and Allikura (2015) with some modifications. The cookie dough was prepared according to the following formula; 120g of flour (different proportion of breadfruit flour and wheat flour), sugar (25 g), butter (100 g), chocolate chip (60 g), almon nib (30 g), vanilla essence (1/4 tsp) and various proportion of water to make required consistency. Butter and brown sugars were creamed in a mixer. Dough that contained flour, chocolate chip, almond nib and vanilla were added to the cream to obtain a homogeneous mixture. A firm dough was prepared, rolled to 5mm thickness in a baking tray and 5cm diameter circles were cut with a cookie cutter. The cookies were placed on a greased tray and baked in a pre-heated oven at 200 °C for 10 minutes. Table 2 shows the different combination of breadfruit and wheat flour used for the production of cookies.

Table 2: - Different combination of breadfruit flour and wheat flour

Sample	Breadfruit Flour (%)	Wheat Flour (%)
S1	0	100
S2	25	75
S3	50	50
S4	75	25
S5	100	0

3.5 Shelf-life observation for chocolate chips cookies using breadfruit flour

An observation process is carried out to assess the level of durability of the product. This method is used to see any changes to the product. This observation method is carried out in a controlled environment where the product will be stored in an airtight plastic container. The product will be left at room temperature between 28^0C -32^0C, for a period of 30 days.

Table 3: - Different combination of breadfruit flour and wheat flour

Sample	Breadfruit Flour (%)	Wheat Flour (%)	Result
S1	0	100	No signs of foreign object
S2	25	75	No signs of foreign object
S3	50	50	No signs of foreign object
S4	75	25	No signs of foreign object
S5	100	0	No signs of foreign object

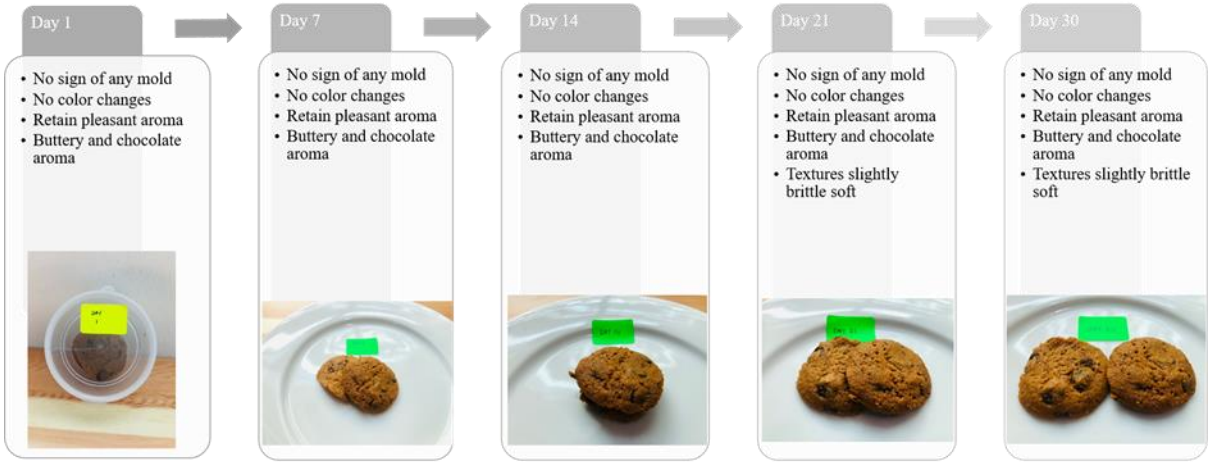


Chart 5: - Chocolate chips cookies shelf life observation

3.5 Sensory Analysis

Sensory evaluation consisted of judging the quality of prepared cookies by a panel of 10 trained panelists. The evaluation deals with analyzing the overall sensory quality of cookies as perceived by the sense of sight, taste, and touch. A hedonic scale rating test was used to measure the degree of pleasurable and un-pleasurable experience of cookies on a scale of 1 point from “strongly disagree” to “strongly agree”. The panelists were given an evaluation form which listed various sensory parameters and score options with number rankings. When all the evaluation forms were complete, the data were averaged and tabulated. The cookies were rated for their sensory attributes like color, appearance, texture, mouth feel, taste, and overall acceptability.

4.0 DATA ANALYSIS AND DISCUSSION

The experiment was carried out in a complete randomized design with 5 recipes formulation. The significant of the formulation effect on the measuremed parameter were analysied by using SPSS for means analysis on the color, apperance, texture, mouth feel, taste and overall acceptance.

Table 3: - Means Score

Sample	Color	Apperance	Texture	Mouth feel	Taste	Acceptance
S1	4.9000	4.8000	4.9000	4.9000	4.9000	5.0000
S2	4.8000	4.8000	4.5000	4.4000	4.9000	5.0000
S3	4.8000	3.8000	4.5000	4.5000	4.8000	4.1000
S4	3.6000	3.8000	3.6000	3.0000	3.0000	3.6000
S5	2.6000	3.6000	3.6000	3.0000	3.0000	2.6000

N: 10

S1: 100% wheat flour; S2: 75% wheat flour 25% breadfruit flour; S3: 50% wheat flour 50% breadfruit flour; S4: 25% wheat flour 75% breadfruit flour; S5: 0% wheat flour 100% breadfruit flour.

Mean values of sensory evaluation of different recepies formulation are shown in Table 3. These values were in accordance with Agu et al. (2007). Colour is one of the primary sensory attributes of food. Attractive colour improves the demand of food. Sometimes colour of cookies may vary from light brown to dark brown. The dark colour may be due to the Maillard reaction between reducing sugar and protein (Dhingra and Jood, 2000). Finding of this study show that there are no significant difference between control treatment (S1) interm of color compare to the breadfruit flour added S3 however there are significent difference in color for S4 and S5. Appearance plays a major role in determines the food quality. Apperance measures on how a food physical look. Finding show that, there were significant differences between control treatment (S1) with 50% breadfruit flour (S3), 25% breadfruit flour (S4) and 100% breadfruit flour however there are no significant difference in apperance to the product with 25% of breadfruit flour added.

Texture also determines the food quality. Texture measures how a food feels in the mouth. Finding of this study, there were no significant differences between control treatment (S1) with 25% breadfruit flour (S2) and 50% breadfruit flour (S3) added cookies. Mouth feel also plays an important role as a sensory parameter in determining the acceptability of new food products in the market. This study show that there were no significant differences among treatments. 50% breadfruit flour added cookies had the highest mean value compared with other breadfruit flour added cookies. Overall acceptability will determine the overall quality of the food product. Taste is the primary factor which determines the acceptability and market value of any product. Breadfruit flour added cookie had more caramel taste than others. This might be due to the caramelization of free sugar in breadfruit flour during baking. S3 had the highest mean value of taste compared with other breadfruit flour added cookies. There were no significant differences between 100% wheat flour added cookies (S1) and 50% breadfruit flour added cookie (S3) in taste. This study show that S3 with 50% breadfruit flour added cookies had the highest mean value for overall acceptability among other breadfruit flour added cookies, which was not significantly

different from cookies prepared with 100% wheat flour. 100% breadfruit flour added cookies had the least overall acceptance.

5.0 DISCUSSION AND CONCLUSIONS

The current study was conducted in an effort to create value-added cookies using breadfruit flour that can be used as an alternative product substitution for wheat flour. Incorporating breadfruit flour in the recipe improved the acceptance based on the physical and sensory qualities, 50% breadfruit flour and 50% wheat flour (S3) were significantly acceptable to 100% wheat flour cookies. Utilizing breadfruit in food products will significantly increase its usage and prevent wastage of this priceless fruit.

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