Asian Journal of Multidisciplinary Studies
Vol. 7, No. 1, (2024)
ISSN 2651-6691 (Print)
ISSN 2651-6705 (Online)

Sweetened Breadfruit Cookies with Malunggay Sprinkles

Maria Virginia Agustin Fontanos[1] and Dr. Amelita Miranda De Vera[2]
[1,2]Pangasinan State University, Lingayen Campus, Lingayen Pangasinan

Abstract - *This study aimed to develop and evaluate sweetened breadfruit (Artocarpus altilis) cookies with malunggay (Moringa oleifera) sprinkles as a nutritious and innovative food product. Breadfruit, a locally available and underutilized crop, was used as the primary ingredient to enhance the value of indigenous resources, while malunggay leaves were incorporated as sprinkles to boost the product's nutritional profile, particularly its vitamin and mineral content. The research focused on product formulation, sensory evaluation, and acceptability testing in terms of color, aroma, texture, taste, and overall acceptability. A panel of evaluators assessed the finished product using a 9-point hedonic scale. Results revealed that the sweetened breadfruit cookies with malunggay sprinkles were generally acceptable to consumers, with high ratings in taste and texture, and moderate acceptability in color due to the presence of green sprinkles. The study concludes that integrating breadfruit and malunggay into cookies is a viable approach to developing functional and health-oriented snacks. It highlights the potential of maximizing local agricultural resources in creating affordable, nutritious, and innovative food products that promote wellness and sustainability*.

Keywords – *sweetened, breadfruit, moringa oleifera, sprinkles, cookies*

INTRODUCTION

Cookies are one of the earliest food items. Due to dried food, the cookies requirement is unlimited. Cookies are supplied as environmental crashes and crude areas in the affected areas. In the modern era, new cookies are being changed by changing different elements. Bakery products play an important role in the development of human beings. One of the benefits of cookies is to easily get good food rich foods. In the modern world, there is a strong relation between cookies and tea. With global travel becoming widespread at that time, cookies made a natural travel companion, a modernized equivalent of the travel cakes used throughout history. One of the most popular early cookies which traveled especially well and became known on every continent by similar names was the jumble, a relatively hard cookie made largely from nuts, sweetener, and water.

The worlds biscuit market contains low cost diversity, such as glucose biscuits but there is considerable demand for special cookies like cookies. Unlike crackers and biscuits, cookies are very sweet and high in fat content and delicate among baked goods.

Cookies have a much longer shelf life than bread and cake or rather the rest of the processed foods. With the addition of mint powder, it is possible to create notorious rich cookies. 70 percent have chlorophyll and thalassemia patients will have a new life coming from the mint leaves. There are antioxidants and phytonutrients in the mint leaf as well as vitamin A, vitamin D and vitamin K etc. One of them is mint leaf, there are alpha to phenol and pantothenic acid and minerals contain calcium, potassium, Iron magnesium, phosphorus, zinc, copper etc. Mint leaves are used to create any one bakery product. The mint leaves will be used for the development of new products.

Enrichment of foods with supplements like protein and vitamins is of current interest because of nutritional awareness of consumers. The incorporation of mushrooms into existing food items is yet an untouched area of research. Therefore, the present study was undertaken to develop novel variety of 14th century, they were common in all levels of society throughout Europe, from royal cuisine to street vendors. The first documented instance of the figure-shaped gingerbread man was at the court of Elizabeth I of England in the 16th century. She had the gingerbread figures made and presented in the likeness of some of her important guests. With global travel becoming widespread at that time, cookies made a natural travel companion, a modernized equivalent of the travel cakes used throughout history. One of the most popular early cookies, which traveled especially well and became known on every continent by similar names, was the jumble, a relatively hard cookie made largely from nuts, sweetener, and water.

Cookies came to America through the Dutch in New Amsterdam in the late 1620s. The Dutch word "*koekje*" was Anglicized to "cookie" or cookie. The earliest reference to cookies in America is in 1703, when "The Dutch in New York provided...'in 1703...at a funeral 800 cookies.

The modern form of cookies, which is based on creaming butter and sugar together, did not appear commonly until the 18th century. The Industrial Revolution in Britain and the consumers it created saw cookies (biscuits) become products for the masses, and firms such as Huntley & Palmers (formed in 1822), McVitie's (formed in 1830) and Carr's (formed in 1831) were all established. The decorative biscuit tin, invented by Huntley & Palmers in 1831, saw British cookies exported around the world. In 1891, Cadbury filed a patent for a chocolate-coated cookie.

According to Arshad et al., 2007, cookies are a bakery product and a snack food devoured by many people in the world and provide a good source of nutrients. Cookies are popular because of the low vitamins, cost, high stability, long shelf-life and ability to carry a high amount of nutrients (Honda and Jood, 2005) The principle ingredients of cookies are flour, fat, sugar, water, milk, salt, flavoring agents and aerating agents (Suriya et al., 2017) High contents of fat and sugar and low contents of protein, fiber, vitamins and minerals lead to consider many cookie recipes unhealthy snacks.

Fat provides sensory attributes such as texture, mouthfeel, and flavor to the cookies. Particularly the soft-type cookies contain relatively larger contents of fat. According to the Dietary Guidelines, fat should be consumed in moderate amount (Drewnowski et al., 1998) Several studies have been carried out to improve the quality and consumer acceptability of cookies to maximize the fibre, protein, vitamin, and mineral content while reducing the fat content (Ebere et al., 2015; Emelike et al., 2015; Kiin-Kabari and Giami, 2015).

Breadfruit contains an average of average of 0.31% fat, 1.34% protein, 27.8% carbohydrate, 1.5% fibre and 1.23% ash (Wang et al., 2011) while breadfruit flour has been reported to contain about 76.7% carbohydrate, 17.1% protein, 11.1% fat, 3.0% ash and 0.1% crude fibre (Akubor et al., 2000). Breadfruit consists of several minerals such as copper, magnesium, phosphorus, potassium, calcium, cobalt, iron, and manganese in variable levels based on growth location and cultivar (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. Very often in the regions where breadfruit grows abundantly, different types of flour are important to satisfy food requirements. The use of breadfruit to replace usually imported flour such as wheat and rice, may help to improve food security in these areas. The breadfruit is being considered as a substantial staple food with high financial importance (Akanbi et al., 2009)

In the tropics, the plant is used in a variety of food preparations. The pulps of breadfruit are made into various dishes; to produce porridge, it appears to be beaten, seared, bubbled, or pounded, it can also be refined into flour and used in the production of bread and cookies (Amusa et al., 2002). It could be used as a fat replacer as per the high dietary value of breadfruit. 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 with wheat flour in the preparation of cookies and to assess the physical, nutritional, and sensory properties as affected by incorporation of breadfruit in preparation of cookies.

In this study "Sweetened Breadfruit Cookies with Malunggay Sprinkles", good quality, mature breadfruits without any bruises were procured immediately after harvesting. Fruits were washed and wiped to make them free from any dirt. Cured breadfruit was stored at room temperature and humidity until further use. Other major ingredients such as wheat flour, sugar, baking powder, salt, margarine, and vanilla essence were purchased from the local supermarket.

The present utility model entitled Process of Producing Breadfruit cookies, comprising the steps of harvesting the fruit, peeling the skin, cutting the fruit meat, steaming, mashing using a rolling pin, mixing the ingredients for the breadfruit cookies, preheating the oven, spooning batter into cookie sheets, placing the cookie sheets into the preheated oven, baking the cookies, removing the cookie sheet from the oven and cooling, and serving. The inventor of this study is Alburo, Rosalyn P. from Cebu Technological University Argao Campus (Philippines)

The invention discloses moringa oleifera made from freeze-dried moringa oleifera tender leaf powder. The moringa oleifera bread is made from the following raw materials in parts by weight: 80-120 parts of the wheat flour, 20-40 parts of freeze-dried moringa oleifera tender leaf powder, 5-15 parts of whole milk powder,5-10 parts of angelica sinensis. The bread provided by the invention is full of nutrients, unique in flavor, good in taste and popular in consumers; meanwhile; independently developed moringa oleifera powder and traditional Chinese medicine formula are added in the formula, and effects of invigorating stomach and promoting digestion, enriching yin and nourishing kidney as well as calming the nerves and beautifying can be played on eaters. In this invention related to this study there is no prior art citation.

OBJECTIVES OF THE STUDY

This study aimed to produce sweetened breadfruit cookies with malunggay sprinkles. Specifically, it answered the following specific problems;

1. What is the standardized recipe of sweetened breadfruit cookies with malunggay sprinkles?
2. Is there a significant difference on the level of sensory acceptability of different formulations from the sweetened breadfruit cookies with malunggay sprinkles in terms of;

a. aroma
b. color
c. texture, and;
d. taste?

3. What are the microbiological qualities of sweetened breadfruit cookies with malunggay sprinkles?
4. What is the return of expenditure (ROE) of sweetened breadfruit cookies with malunggay sprinkles?

MATERIALS AND METHOD

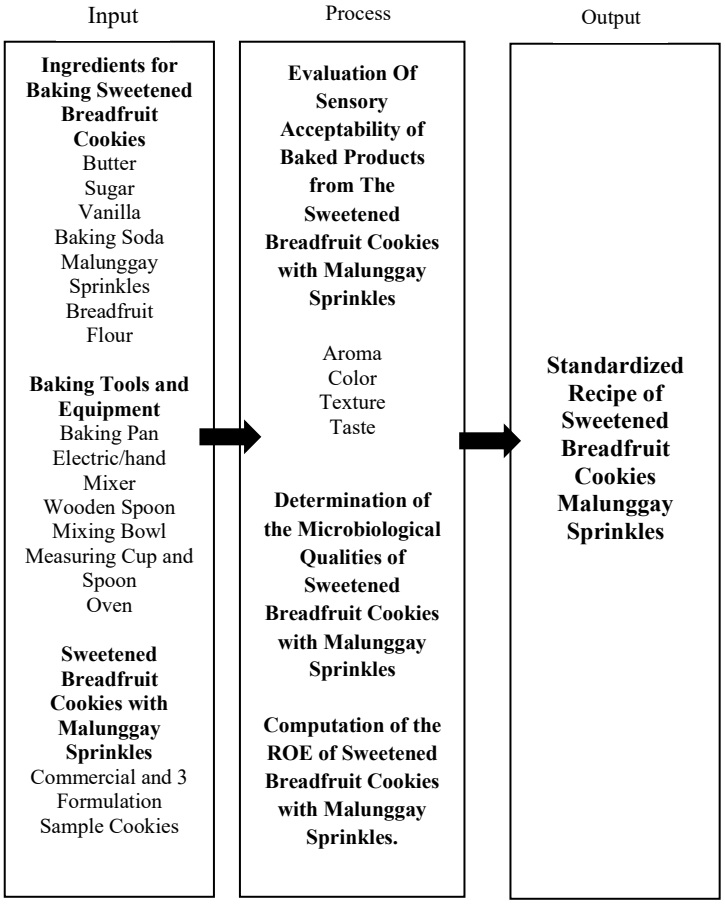
This study aimed to determine the acceptability of sweetened breadfruit cookies with malunggay sprinkles in terms of aroma, color, texture, and taste. It uses Input-Process-Output (IPO) research design as portrayed in the research paradigm.

The input of this study includes the ingredients for making sweetened breadfruit cookies with malunggay sprinkles using the standard and experimental formulations. The controlled factors are the ingredients that will have the same measurements in the four (4) formulations. These are butter, sugar, vanilla, baking soda, and malunggay sprinkles. In addition, the baking tools and equipment that will be used are also standardized in the four (4) formulations. The experimental factors was the percentages between breadfruit and flour specifically 75%breadfruit/25% flour, 50% breadfruit /50% flour, and 25%/ 75%, respectively.

The process of the study includes (1) preparation of the sweetened breadfruit cookies with malunggay sprinkles with different formulations, (2) evaluation of the sensory acceptability of the baked products in terms of aroma, color, texture, and taste, and (3) interpreting the results of the evaluation. Then, the formulation with the highest rating of acceptability was subjected to microbiological test in an accredited food laboratory.

Finally, based on the results of this study, the output will be a standardized recipe of sweetened breadfruit cookies with malunggay sprinkles.

Research Paradigm



RESULTS AND DISCUSSION

Sensory evaluation pertains to the method of judging the characteristics of a food using criteria. In this study, the recipe samples of sweetened breadfruit cookies with malunggay sprinkles was submitted to sensory evaluation in terms of aroma, color, texture, and taste. The data on this sensory acceptability are presented on tables 1 to 5.

Sensory Evaluation in Terms of Aroma

The data on the sensory evaluation in terms of aroma is presented in Table 1. As gleaned in Table 1, the faculty member, students, and bakers gave the highest ratings to Treatment

2 as like very much with the overall mean of 8.40, while Control, Treatment 1, and Treatment 3 has the weighted mean of 7.27, 7.17 and 7.30 respectively with a qualitative description of like moderately.

Table 1. *Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of Aroma*

Treatment	Faculty		Students		Baker		Overall	
	Mean	SD	Mean	SD	Mean	SD	**Mean**	**Desc.**
Control	7.60	1.14	7.25	1.29	7.00	1.00	**7.27**	**LM**
Treatment 1	7.40	1.14	7.10	0.97	7.20	0.45	**7.17**	**LM**
Treatment 2	8.60	0.55	8.40	0.68	8.20	0.84	**8.40**	**LVM**
Treatment 3	7.20	1.10	7.25	1.21	7.60	0.89	**7.30**	**LM**

Legend: 1.00-1.50 Dislike extremely (DE); 1.51-2.50 Dislike very much (DVM); 2.51-3.50 Dislike moderately (DM); 3.51-4.50 Dislike slightly (DS); 4.51-5.50 Never like nor dislike (NLD); 5.51-6.50 Like slightly (LS); 6.51-7.50 Like moderately (LM); 7.51-8.50 Like very much (LVM); 8.51-9.00 Like extremely (LE)

The table 1 shows that the faculty members, students, and bakers like very much the aroma of Treatment 2. The Sweetened Breadfruit Cookies with Malunggay Sprinkles smell like warm bread and slightly sweet when baked (Samita Sarkar, November 17, 2021) as evaluated by the respondents-evaluators.

Sensory Evaluation in Terms of Color

The sensory evaluation on the four (4) Treatments of Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of color is presented on Table 2. The table shows that Treatment 2 got the highest mean of 8.70 with a descriptive rating of Like extremely. Further, Control, Treatment 1 and Treatment 2 got a descriptive rating of like moderately with a mean of 7.33, 7.17, and 7.50 respectively.

Treatment 2 garnered the highest rating; this means that the color of the sweetened breadfruit cookies with malunggay sprinkles is like extremely by the respondents-evaluators to which the color of the sweetened breadfruit cookies with malunggay sprinkles is yellow-brown color when baked. According to D.Ragone the commercialized cookies have a tan or light brown color while Sweetened Breadfruit Cookies with Malunggay Sprinkles are somewhat yellow brown in color.

Table 2. *Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of Color*

Treatment	Faculty		Students		Baker		Overall	
	Mean	SD	Mean	SD	Mean	SD	**Mean**	**Desc.**
Control	7.60	0.55	7.30	1.03	7.20	0.45	**7.33**	**LM**

Treatment 1	7.20	1.10	7.10	1.07	7.40	0.55	**7.17**	**LM**
Treatment 2	8.20	0.84	8.80	0.41	8.80	0.45	**8.70**	**LE**
Treatment 3	8.00	1.22	7.25	1.41	8.00	0.00	**7.50**	**LM**

Legend: 1.00-1.50 Dislike extremely (DE) 1.51-2.50 Dislike very much (DVM) 2.51-3.50 Dislike moderately (DM)
3.51-4.50 Dislike slightly (DS) 4.51-5.50 Never like nor dislike (NLD) 5.51-6.50 Like slightly (LS)
6.51-7.50 Like moderately (LM) 7.51-8.50 Like very much (LVM) 8.51-9.00 Like extremely (LE)

Sensory Evaluation in Terms of Texture

The table shows the sensory evaluation of the respondents-evaluators in terms of texture

Table 3. *Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of Texture*

Treatment	**Faculty**		**Students**		**Baker**		**Overall**	
	Mean	SD	Mean	SD	Mean	SD	**Mean**	**Desc.**
Control	7.00	1.41	6.95	0.94	7.60	0.55	**7.07**	**LM**
Treatment 1	6.40	0.89	7.00	1.38	7.40	0.55	**6.97**	**LM**
Treatment 2	8.00	1.41	8.70	0.57	8.00	0.71	**8.47**	**LVM**
Treatment 3	7.60	1.14	6.80	1.28	7.80	1.10	**7.10**	**LM**

Legend: 1.00-1.50 Dislike extremely (DE) 1.51-2.50 Dislike very much (DVM) 2.51-3.50 Dislike moderately (DM)
3.51-4.50 Dislike slightly (DS) 4.51-5.50 Never like nor dislike (NLD) 5.51-6.50 Like slightly (LS)
6.51-7.50 Like moderately (LM) 7.51-8.50 Like very much (LVM) 8.51-9.00 Like extremely (LE)

With regards to texture, Control, Treatment 1 and Treatment 3 gained a descriptive equivalent of like moderately with a mean of 7.07, 6.97 and 7.10 respectively. Treatment 2 was interpreted as like very much by the respondent-evaluators as shown by its computed weighted mean which are gained a highest mean of 8.47.

The Sweetened Breadfruit Cookies with Malunggay Cookies are equally chewy and gooey, never crispy, or crunchy (Janeshomemade22, April 17, 2023). The texture of the product is not affected by the addition of flour and butter because the sugar or the glucose used for baking is responsible in the moist and chewy texture. Hence, the respondent-evaluators like the product extremely.

Sensory Evaluation in Terms of Taste

The taste of the food is basically referring to the sensation of flavor perceived in the mouth and throat on contact with a substance. Table 4 presents the results of the sensory acceptability of Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of taste.

Table 4. *Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of Taste*

Treatment	Faculty		Students		Baker		Overall	
	Mean	SD	Mean	SD	Mean	SD	**Mean**	**Desc.**
Control	6.40	0.89	7.55	1.10	7.20	0.45	**7.30**	**LM**
Treatment 1	6.40	0.89	7.55	1.05	7.20	0.45	**7.30**	**LM**
Treatment 2	8.60	0.55	8.80	0.41	8.40	0.55	**8.70**	**LE**
Treatment 3	7.00	0.71	6.75	1.02	7.60	0.89	**6.93**	**LM**

Legend: 1.00-1.50 Dislike extremely (DE) | 1.51-2.50 Dislike very much (DVM) | 2.51-3.50 Dislike moderately (DM)
3.51-4.50 Dislike slightly (DS) | 4.51-5.50 Never like nor dislike (NLD) | 5.51-6.50 Like slightly (LS)
6.51-7.50 Like moderately (LM) | 7.51-8.50 Like very much (LVM) | 8.51-9.00 Like extremely (LE)

Table 4 shows that in terms of taste, only Treatment 2 garnered the highest weighted mean of 8.70 with a qualitative descriptive of like extremely. The Control, Treatment 1 and Treatment 3 was given scores within the range of like moderately. The results indicated that Treatment 2, which has 50% breadfruit and 1 cup all-purpose flour was like extremely by the respondent-evaluators. The taste of Sweetened Breadfruit Cookies with Malunggay Sprinkles is expected to be sweet because it contains sugar and butter. (Tessa Arias, 2022)

This implies that Treatment 2 tastes a mild flavor like a nutty potato.

Sensory Evaluation in Terms of Over-all Acceptability

Table 5 presents the overall acceptability of the Sweetened Breadfruit Cookies with Malunggay Sprinkles. The respondent-evaluators have almost the same evaluation on the level of over-all acceptability to the treatments as like extremely by them. But, as gleaned on the table, Treatment 2 has the highest weighted mean of 8.57.

Table 5. *Level of Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of Over-all Acceptability*

Treatment	Faculty		Students		Baker		Overall	
	Mean	SD	Mean	SD	Mean	SD	**Mean**	**Desc.**
Control	7.15	0.55	7.26	1.01	7.25	0.31	**7.24**	**LM**
Treatment 1	6.85	0.49	7.19	0.96	7.30	0.11	**7.15**	**LM**
Treatment 2	8.35	0.74	8.68	0.37	8.35	0.14	**8.57**	**LE**
Treatment 3	7.45	0.67	7.01	0.99	7.75	0.40	**7.21**	**LM**

Legend: 1.00-1.50 Dislike extremely (DE) | 1.51-2.50 Dislike very much (DVM) | 2.51-3.50 Dislike moderately (DM)
3.51-4.50 Dislike slightly (DS) | 4.51-5.50 Never like nor dislike (NLD) | 5.51-6.50 Like slightly (LS)
6.51-7.50 Like moderately (LM) | 7.51-8.50 Like very much (LVM) | 8.51-9.00 Like extremely (LE)

Table 5 implies that Control, Treatment 1 and Treatment 3 was like moderately by the respondent-evaluators while Treatment 2 obtained the highest mean of 8.57 with a descriptive rating of like extremely. It is also noted that the addition of different amounts of breadfruit and all-purpose flour to the standard recipe of sweetened breadfruit cookies with malunggay sprinkles is accepted as shown in the scores given to all treatments.

Differences on the Level of Sensory Acceptability of Sweetened Breadfruit Cookies with Malunggay Sprinkles

Test of significant differences of the characteristics of sweetened breadfruit cookies with malunggay sprinkles use pertains to the statistical analysis of the characteristics of the sweetened breadfruit cookies with malunggay sprinkles using criteria in terms of aroma, color, texture, and taste. The data on these tests of significance difference and multiple mean was presented on tables 6 to 10.

Table 6. *Difference in the Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of Aroma*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.27	1.20	**10.15****	**p<.001**
Treatment 1	7.17	0.91		
Treatment 2	8.40	0.67		
Treatment 3	7.30	1.12		

**Significant at 1% level

Table 6 presents the test of difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of aroma. Preliminary test of assumption revealed a significant difference in variance across group, hence, a robust test on equality of mean using Brown-Forsythe Statistics was utilized. Test revealed that there is significant difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of aroma (Brown Forsythe=10.15, p<.001).

Result of test between subject effect as displayed in Table 6 reveals the sensory acceptability on sweetened breadfruit cookies with malunggay sprinkles in terms of aroma, color, texture and taste response as significant at p<.001 probability level. This means that there was a significant difference detected in the acceptability in terms of aroma among the four (4) formulations. Treatment 2 has the lowest standard deviation but got the highest mean compared to the other treatments with sig value of .001.

Table 7. *Difference in the Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in Terms of Color*

Treatment	Mean	Standard Deviation	Brown-Forsythe	Sig.

			Statistic	
Control	7.33	0.88		
Treatment 1	7.17	0.99	**15.84****	**p<.001**
Treatment 2	8.70	0.53		
Treatment 3	7.50	1.28		

**Significant at 1% level

Result of evaluating the differences between the scores given by the respondent-evaluators in terms of color, Table 7 reveals a significant difference at p<.001.

The statistical analysis aimed to explore how the different formulations affect the color of sweetened breadfruit cookies with malunggay sprinkles. Table 7 reveals that control, Treatment 1, Treatment 2 and Treatment 3 has a mean of 7.33, 7.17, 8.70, 7.50 respectively. With a standard deviation of 0.88, 099, 0.53 and 1.28 respectively. However, test revealed that there is significant difference of p<.001 in terms of color. (Brown Forsythe=15.84, p<.001).

Table 8. *Difference in the Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in Terms of Texture*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.07	0.98		
Treatment 1	6.97	1.22	**12.93****	**p<.001**
Treatment 2	8.47	0.82		
Treatment 3	7.10	1.27		

**Significant at 1% level

To conduct further comparisons and evaluate the differences between the scores given by the respondent-evaluators in terms of texture, Table 8 reveals a significant difference at p<.001.

The analysis conducted aimed to investigate the difference in the sensory acceptability of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of texture. Preliminary test of assumption revealed a significant difference in variance across group, hence, a robust test on equality of mean using Brown-Forsythe Statistics was utilized. Test revealed that there is significant difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of texture (Brown Forsythe=12.93, p<.001).

Table 9. *Difference in the Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in Terms of Taste*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.30	1.06	**21.91****	**p<.001**
Treatment 1	7.30	1.02		
Treatment 2	8.70	0.47		
Treatment 3	6.93	0.98		

**Significant at 1% level

Table 9 presents the test of difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of taste. Preliminary test of assumption revealed a significant difference in variance across group, hence, a robust test on equality of mean using Brown-Forsythe Statistics was utilized. Test revealed that there is significant difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of taste (Brown Forsythe=21.91, p<.001).

Table 10. *Difference in the Overall Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.24	0.85	**23.58****	**p<.001**
Treatment 1	7.15	0.81		
Treatment 2	8.57	0.44		
Treatment 3	7.21	0.90		

**Significant at 1% level

Table 10 presents the test of difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of taste. Preliminary test of assumption revealed a significant difference in variance across group, hence, a robust test on equality of mean using Brown-Forsythe Statistics was utilized. Test revealed that there is significant difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of aroma (Brown Forsythe=23.58, p<.001).

Table 11. *Difference in the Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in terms of Aroma*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.27	1.20	**10.15****	**p<.001**
Treatment 1	7.17	0.91		
Treatment 2	8.40	0.67		
Treatment 3	7.30	1.12		

**Significant at 1% level

Table 11 presents the test of difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of aroma. Preliminary test of assumption revealed a significant difference in variance across group, hence, a robust test on equality of mean using Brown-Forsythe Statistics was utilized. Test revealed that there is significant difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of aroma (Brown Forsythe=10.15, p<.001).

Result of test between subject effect as displayed in Table 11 reveals the sensory acceptability on sweetened breadfruit cookies with malunggay sprinkles in terms of aroma, color, texture and taste response as significant at p<.001 probability level. This means that there was a significant difference detected in the acceptability in terms of aroma among the four (4) formulations. Treatment 2 has the lowest standard deviation but got the highest mean compared to the other treatments with sig value of .001.

Table 12. *Difference in the Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in Terms of Color*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.33	0.88	**15.84****	**p<.001**
Treatment 1	7.17	0.99		
Treatment 2	8.70	0.53		
Treatment 3	7.50	1.28		

**Significant at 1% level

Result of evaluating the differences between the scores given by the respondent-evaluators in terms of color, Table 7 reveals a significant difference at p<.001.

The statistical analysis aimed to explore how the different formulations affect the color of sweetened breadfruit cookies with malunggay sprinkles. Table 7 reveals that Control, Treatment

1, Treatment 2 and Treatment 3 has a mean of 7.33, 7.17, 8.70, 7.50 respectively. With a standard deviation of 0.88, 099, 0.53 and 1.28 respectively. However, test revealed that there is significant difference of p<.001 in terms of color. (Brown Forsythe=15.84, p<.001).

\

Table 13. *Difference in the Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in Terms of Texture*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.07	0.98	**12.93****	**p<.001**
Treatment 1	6.97	1.22		
Treatment 2	8.47	0.82		
Treatment 3	7.10	1.27		

**Significant at 1% level

To conduct further comparisons and evaluate the differences between the scores given by the respondent-evaluators in terms of texture, Table 8 reveals a significant difference at p<.001. The analysis conducted aimed to investigate the difference in the sensory acceptability of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of texture. Preliminary test of assumption revealed a significant difference in variance across group, hence, a robust test on equality of mean using Brown-Forsythe Statistics was utilized. Test revealed that there is significant difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of texture (Brown Forsythe=12.93, p<.001).

Table 14. *Difference in the Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles in Terms of Taste*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.30	1.06	**21.91****	**p<.001**
Treatment 1	7.30	1.02		
Treatment 2	8.70	0.47		
Treatment 3	6.93	0.98		

**Significant at 1% level

Table 14 presents the test of difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of taste. Preliminary test of assumption revealed a significant difference in variance across group, hence, a robust test on equality of mean using Brown-Forsythe Statistics was utilized. Test revealed that there is significant difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of taste (Brown Forsythe=21.91, p<.001).

Table 15. *Difference in the Overall Sensory Acceptability of Baked Products from the Sweetened Breadfruit Cookies with Malunggay Sprinkles*

Treatment	Mean	Standard Deviation	Brown-Forsythe Statistic	Sig.
Control	7.24	0.85	**23.58****	**p<.001**
Treatment 1	7.15	0.81		
Treatment 2	8.57	0.44		
Treatment 3	7.21	0.90		

**Significant at 1% level

Table 15 presents the test of difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of taste. Preliminary test of assumption revealed a significant difference in variance across group, hence, a robust test on equality of mean using Brown-Forsythe Statistics was utilized. Test revealed that there is significant difference in the sensory acceptability across treatment of baked products from the sweetened breadfruit cookies with malunggay sprinkles in terms of aroma (Brown Forsythe=23.58, p<.001).

Microbiological Qualities of Sweetened Breadfruit Cookies with Malunggay Sprinkles

The Sweetened Breadfruit Cookies with Malunggay Sprinkles was submitted for analysis to determine the microbiological qualities of the product. Presented below are the test results of the microbiological qualities in terms of aerobic plate count, mold and yeast count, total coliform (TC), salmonella detection and escherichia coli count.

Different test methods was used to test the parameters for aerobic plate count, mold and yeast count, total coliform (TC) and salmonella detection. The following findings above were provided by the DOST-RSTL La Union about the tests conducted.

Table 16. *Test Result on the Microbiological Qualities of the Sweetened Breadfruit Cookies with Malunggay Sprinkles*

Parameter	Unit	Result	Interpretation
Aerobic Plate Count	250 g	<250 CFU*/g	Passed

Mold and Yeast Count	250 g	<10 CFU/g	Passed
Mold Count	250 g	<10 CFU/g	Passed
Yeast Count	250 g	<10 CFU/g	Passed
Salmonella Detection	250 g	Absent @25g of sample	Passed
Total Coliform Count	250 g	<3.0 MPN/mL	Passed
Escherichia coli Count	250 g	<3.0 MPN/mL	Passed

Source* RSTL-DOST Regional Office No.1 DMMSU-MLU Campus City of San Fernando, La Union

Table 16 describes the microbiological qualities of sweetened breadfruit cookies with malunggay sprinkles. The aerobic plate count of the cookies was found to be 250 CFU*/g (Colony Forming Unit). Aerobic plate count indicates the bacterial population and can sometimes be used to indicate the quality and spoilage level of a product. The mold and yeast count are 10 CFU/g (Colony Forming Unit), and the salmonella detection is absent in the 250g sample of cookies. The total coliform count is found to be less than 3.0 Most Probable Number (MPN)/mL, and the Escherichia coli count is found to be less than 3.0 Most Probable Number (MPN)/mL, which are within the allowable limits set by the Food and Drug Administration Circular No. 2022-012.

Through rigorous examination of key microbial parameters including aerobic plate count, mold and yeast count, salmonella detection, total coliform count, and Escherichia coli count, this study has demonstrated the adherence of Sweetened breadfruit Cookies with Malunggay Sprinkles meet the stringent criteria set forth by regulatory bodies, showcasing low level of microbial contamination across all tested parameters based on the Microbiological Requirements and Assessment of Certain Prepackaged Processed Food Products Repealing FDA Circular No. 2013-010 entitled "Revised Guidelines for the Assessment of Microbiological Quality of Processed Foods".

RETURN OF EXPENDITURES

Initial Production Cost of Sweetened Breadfruit Cookies with Malunggay Sprinkles

The table on the next page shows the initial production cost of the Sweetened breadfruit cookies with malunggay sprinkles.

Table 17. *Initial Production Cost of Sweetened Breadfruit Cookies with Malunggay Sprinkles*

Items	**Measurement**		
	Quantity	Unit	
Breadfruit	1	piece	35.00

All-purpose flour	2	cup	55.00
Unsalted Butter	1	cup	62.00
Dark Brown Sugar	½	cup	33.00
Eggs	1	piece	8.00
Vanilla Extract	1	teaspoon	35.00
Baking Soda	1	teaspoon	25.00
Dry Malunggay Leaves	5	grams	10.00
Packaging			
Labor	1	piece	7.00
Current	1		200.00
Fare	30	mins.	18.00
			40.00
No. Of Yields		34 pcs.	
Total Cost of Sweetened Breadfruit Cookies with Malunggay Sprinkles		510.00	
Cost per piece		15.50	

Treatment 2 which garnered the highest mean score on the level of acceptability. The total cost of the ingredients used was five hundred ten pesos (510 Php). There were thirty-four (34) pieces of cookies of cookies were produced to which the computed cost per piece is fifteen pesos and fifty centavos (15.50 Php)

Production or product costs refer to the incurred by a business from manufacturing a product or providing a service. Production costs can include a variety of expenses, such as labor, raw materials, consumable manufacturing supplies, and general overhead (Investopedia.com, 2020). The production of Sweetened Breadfruit Cookies with Malunggay Sprinkles does not cost much because the raw materials are available in the community and the other ingredients can be purchased in the grocery store or in the market.

Computation of the Return of Expenditure (ROE) of Sweetened Breadfruit Cookies with Malunggay Sprinkles

Table 18. *Return of Expenditure of Sweetened Breadfruit Cookies with Malunggay Sprinkles*

Production Cost (Php)	Total Yield	Mark-Up (Php)	Price per Pack (Php)	Gross Income (Php)	Net Income (Php)	ROE

Php 510.00	15 packs @ 250 grams	Php 15.50	Php 55.00	Php 825.00	Php 315.00	38.18%

CONCLUSION AND RECOMMENDATION

Based on the findings of the study, the researcher has come up with the conclusion that Treatment 2 was liked extremely by the respondents. Treatment 2 got the highest over-all weighted mean in the evaluation of sensory acceptability in terms of aroma, color, texture and taste. Interestingly, sweetened breadfruit cookies with malunggay sprinkles passed the microbiological quality test and it was concluded that Treatment 2 is viable for two to three weeks in the refrigerator and can be stored at room temperature. Hence, the developed sweetened breadfruit cookies with malunggay sprinkles has a good marketing potential and the product is affordable.

Based on the data presented, the researcher recommends the following;

1. The researcher strongly suggests Treatment 2 as a communal food product source.
2. Encourage funding for the product's improved packaging, nutritional analysis, and sensory aspects.
3. Due to its high nutritional value, it might be one of the foods offered in the school feeding program.
4. Encourage marketing viability due to its low price.
5. Breadfruit was widely available in the Philippines and could be used as a source of revenue.

REFERENCES

[1] Agu, H.O., Ayo, J.A., Paul, A.M.. and Folorunsho, F. (2007). Quality Characteristics of Biscuits Made from Wheat and African Breadfruit. Nigerian Food Journal. 25, 19-27. DOI: 10.4314/nifoj.v25i2

[2] Akanbi, T.O., Navami, S. and Adebowale, A.A. (2009). Functional And Pasting Properties of Tropical Breadfruit (Artocarpus Altilis) Starch from Ile- Ife. Osun State, Nigeria. International Food Research Journal. 16, 151-157.

[3] Akubor, P.I, Isolokwu, P.C., Ugbane, O. and Onimawo, I.A. (2000). Proximate Composition And Functional Properties Of African Breadfruit Kernel And Wheat Flour Blends. Food Research International. 33, 707-712. https://doi.org/ 10.1016/S0963-9969 (00)00116-2

[4] Arshad, M.U., Anjum, F.M., and Zahoor, T. (2007). Nutritional Assessment Of Cookies Supplemented With Defatted Wheat Germ. Food Chemistry. 102, 123-128. DOI: 10.1016/j.foodchem Article8.pdf (ggscw.ac.in)

[5] Asian Journal of Agriculture and Food Sciences. 3(4), 361-367Graham, H. D., and Bravo, E. N. DE. (1981). Composition of the Breadfruit.

A.M.P. Jones, ... I.B. Cole, in Comprehensive Biotechnology (Second Edition), 2011 Breadfruit (Artocarpus altilis Fosb) – A Monograph (researchgate.net)

[6] C.M.S. Carrington, ... C.K. Sankat, in Postharvest Biology and Technology of Tropical and Subtropical Fruits: Açai to Citrus, 2011

[7] D. Ragone, in Encyclopedia of Food Sciences and Nutrition (Second Edition), 2003 Diane Ragone, in Exotic Fruits, 2018

[8] Ebere, C.O., Emelike, N.J.T. and Kiin-Kabari, D.B. (2015). Physicochemical And Sensory Properties Of Cookies Prepared From Wheat Flour And Cashew-Apple Residue As A Source Of Fibre. Asia Journal of Agriculture and Food Science. 3(2), 213-218

[9] Emelike, N.J.T., Uwa, F.O., Ebere, C.O. and Kiin-Kabari, D.B. (2015). Effect Of Drying Methods On The Physicochemical And Sensory Properties Of Cookies Fortified With Moringa (Moringa Oleifera) Leaves. Effect Of Dried Moringa (Moringa Oleifera Lam) Leaves On Rheological, Microstructural, Nutritional, Textural And Organoleptic Characteristics Of Cookies - DACHANA - 2010 - Journal of Food Quality - Wiley Online Library

[10] E.M. Yahia, ... G.A. Gonzalez-Aguilar, in Postharvest Biology and Technology of Tropical and Subtropical Fruits: Fundamental Issues, 2011

[11] Folake Lucy Oyetayo, Victor Olusegun Oyetayo, in Nuts and Seeds in Health and Disease Prevention (Second Edition), 2020 Full article: Physicochemical Properties And In-Vitro Digestibility Studies Of Microwave Assisted Chemically Modified Breadfruit (Artocarpus Altilis) Starch (Tandfonline.Com)

[12] Huang, S., Roman, L., Martinez, M. M., & Bohrer, B. M. (2021). The Effect Of Extruded Breadfruit Flour On Structural And Physicochemical Properties Of Beef Emulsion Modeling Systems. Meat Science, 172, 108370. https://doi.org/10.1016/J.MEATSCI.2020.108370 Janeshomemade22, April 17, 2023

[13] Journal of Food Science, 46(2), 535–539. https://doi.org/10.1111/J.13652621.1981.TB04904.X

[14] Kiin-Kabari, D.B. and Giami, S.Y. (2015). Physico-Chemical Properties And In- Vitro Protein Digestibility Of Non-Wheat Cookies Prepared From Plantain Flour And Bambara Groundnut Protein Concentrate. Journal of Food Research. 4(20), 78-86. DOI: 10.5539/jfr.v4n2p78 Literature Review - Breadfruit | PDF (slideshare.net)

[15] Neela Badrie, Jacklyn Broomes, in Bioactive Foods In Promoting Health, 2010

[16] Olusegun A. Olaoye, Beatrice I.O. Ade-Omowaye, in Flour and Breads and their Fortification in Health and Disease Prevention, 2011 (PDF) Incorporating Breadfruit Flour to Prepare High-Quality Cookies with Health Benefits (researchgate.net) (PDF) Sensory Evaluation of Breadfruit (Artocarpus Altilis) Flour (researchgate.net)

[17] Ragone, D. (2006). Artocarpus Altilis (breadfruit). In: Elevitch, C.R. (Ed). Traditional Trees of Pacific Islands, Permanent Agriculture Resources, Holualoa, Hawaii. pp. 85-100.

[18] R. Bhat, G. Paliyath, in Encyclopedia of Food and Health, 2016 Ultimate Chocolate Chip Cookies Recipe - BettyCrocker.com Samita Sarkar, November 17, 2021 Sustainability | Free Full-Text | Interactions between People and Breadfruit in Hawai'i: Consumption, Preparation, and Sourcing Patterns (mdpi.com)

[19] Source 1; Breadfruit: Promoting The Conservation And Use Of Underutilized And Neglected Crops (Diane Ragone, 1997);

[20] Source 2; Artocarpus Atilis (Diane Ragone, April 2006);

[21] Source 3: Breadfruit. Morton, J.1987;

[22] Source 4: Regeneration Guidelines For Breadfruit (Ragone D. 2008);

[23] Source 5: Postharvest Handling Technical Bulletin (New Guyana Marketing Corporation, 2004);

[24] Source 6: Farm and Forestry Production and Marketing Profile for Breadfruit (Ragone 2011);

[25] Source 7: Report of First International Symposium on Breadfruit Research and Development (Taylor. M & Ragone. D, 2007, Nadi, Fiji) Studies On Development Of High Protein Cookies (researchgat e.net)

[26] S.N. Moorthy, in Starch in Food, 2004 Tessa Arias, 2022 The Response Of Breadfruit Nutrition To Local Climate And Soil: A review - ScienceDirect