

DEVELOPMENT, SENSORY ACCEPTABILITY, AND NUTRIENT ANALYSIS OF PAKAK SEED (*Artocarpus camansi*) FOOD PRODUCTS

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ABSTRACT

The viability of Pakak seeds (*Artocarpus camansi*) as food products suggests their potential to meet diverse dietary preferences and nutritional needs in the market. This study was conducted to develop and determine the acceptability of Pakak seed-based food products, namely Pakak Seed Croquettes, Pakak Seed Spread, and Tart with Pakak Seeds. Additionally, it looked into the nutritional value and shelf-life of the developed products. The study used a survey method to determine the perceptions of the 120 respondents belonging to varied groups of children, teenagers, adults, and experts. The products were evaluated in terms of appearance/color, aroma, taste, and texture. The 9-point Hedonic Likert scale was used in the study. Results showed that the developed food products contain essential nutrients, aligning with the edibility of mature Pakak fruits. Across all demographic groups, positive perceptions were observed, with teenagers displaying a notably higher liking (*like extremely*) for the products. Particularly, the Pakak Seed Spread and Tart received widespread acceptance. At room temperature between 25°C and 30°C, the shelf life of Pakak seed croquettes was 3-4 days, Pakak seed spread was 3 days, and Pakak seed tart was 10 days.

Keywords: *Pakak seed products, croquettes, spread, tart, nutritional value, shelf-life*

INTRODUCTION

The global food industry faces challenges due to the potential problems looming over staple crops. To mitigate these issues, there's a growing interest in exploring underutilized crops like breadnuts (*Artocarpus camansi*), known as "pakak" in the Philippines, which have been traditionally overlooked and underdeveloped. Breadnuts offer nutritional benefits, with their seeds being rich in protein, carbohydrates, and minerals, making them a promising resource for addressing nutritional deficiencies, particularly in developing countries (Mayes, et. al., 2012; Ragone, 2006; Adeleke & Abiodun, 2010).

Despite their nutritional value and abundance, breadnuts have been underutilized in commercial food production, primarily due to limited research on their processing methods and applications. Current studies mainly focus on conventional uses like roasting or boiling, neglecting potential novel strategies for product development that could cater to modern consumer preferences (Jones et. al., 2013).

Moreover, Williams & Bardie (2005) explained that the short shelf life of breadnut fruits poses a challenge, leading to spoilage and waste during the growing season. However, research suggests that processing breadnuts into flour or other products could enhance their storage stability and broaden their utilization in various food formulations (Oshodi, et. al., 1999; Alcon, Barrion, & Nguyen-Orca, 2021).

Understanding the sensory properties, shelf life, and consumer acceptance of breadnut-based foods is crucial for their commercial viability and wider adoption (Rodriguez-Bermudez, et. al., 2020). Moreover, promoting the cultivation and consumption of breadnuts can contribute to agricultural sustainability, support local farmers, and preserve traditional knowledge and practices in indigenous food systems (Perez, et. al., 2020; Gomez, et. al., 2015).

Therefore, this research aimed to bridge the gap in knowledge regarding the full potential of breadnuts as a food resource. By exploring various processing methods and applications, investigating sensory properties, and assessing consumer acceptance, this study sought to enhance the commercial viability and global acceptance of breadnut-based food products. Ultimately, this research endeavors to promote food security, sustainable farming practices, and culinary innovation, while benefiting local communities and economies (Reyes & Santos, 2019; Zamora, et. al., 2017).

Research Questions

The purpose of this research was to develop food products from *pakak* seed (*Artocarpus camansi*) and determine their acceptability.

The following questions were addressed by this research:

1. What are the processes involved in developing the *pakak* seed (*Artocarpus camansi*) as a food product, namely (a) *Pakak* Seed croquettes (b) *Pakak* seed spread, and (c) Tart with *Pakak* Seeds?
2. What is the nutritive value of *pakak* seed food products?
3. What is the level of acceptability of *pakak* seed products in terms of (a) appearance/color (b) aroma (c) taste, and (d) texture?
4. What is the general level of acceptability of the developed *pakak* food products as evaluated by (a) children (b) teenagers (c) adults, and (d) experts?
5. Is there a significant difference in the general acceptability of *pakak* seed food products?
6. What is the shelf-life of the *pakak* seed food products at room temperature?

METHODOLOGY

In this study, the survey research method was employed to determine the level of acceptability of *pakak* seed products in terms of appearance/color, aroma, taste, and texture. The general acceptability of the *pakak* seed products was evaluated through sensory evaluation by children, teenagers, adults, and experts. Furthermore, the nutritional values of the developed *pakak* seed products were determined through a laboratory test conducted by the Department of Science and Technology (DOST) Region 02. The researcher conducted direct observation to determine the shelf life of the *pakak* seed products.

Materials

Preparation tools and equipment that were used in the conduct of the study are shown in Table 1 below.

Table 1. Tools, utensils, and equipment used in the conduct of the study

PREPARATION TOOLS	MEASURING TOOLS	CUTTING TOOLS	MIXING TOOLS	PACKAGING MATERIALS	EQUIPMENT
Sterilized Knife	Measuring Cup	Sterilized Knife	Rubber scraper	Round bottle jar	Portable Food Dehydrator
Spatula	Measuring spoon		Wooden spoon	Medium rectangular plastic container	Blender
Collander/ Strainer	Digital Weighing Scale		Mixing bowl	Ziplock plastic Packaging	Oven
Chopping Boards			Mortar & pestle	Yema Wrapper	Gas range

Disposable Gloves					
Utility tray					

Ingredients

The recipes used in this study were based on the standard recipes for Potato Croquettes in the Cookery NC II Module, Peanut Butter in the Food Processing NC II Module, and Caramel Butter Tarts in the Bread and Pastry Production NC II Module. The following tables show the ingredients to be used in the production of pakak seed food products.

Table 2. Ingredients and measurements in the preparation of Pakak Seed Croquettes

Ingredients	Measurement
Pakak Seed (powdered)	300 g
Cheese (grated)	1/3 cups
Klim	50 g
Brown Sugar	50 g
Salt	2 g
Egg (beaten)	10 g
Vanilla	5 g
Water	15 g
Oil for frying	2 cups

Table 3. Ingredients and measurements in the preparation of Pakak Seed Spread

Ingredients	Measurement
Pakak Seed (boiled)	2 cups
Evaporated milk	1 cup
Water	2 cups
Brown Sugar	$\frac{3}{4}$ cups
Unsalted butter	$\frac{3}{4}$ cups

Table 4. Ingredients and measurements in the preparation of Tart with Pakak Seed

Ingredients	Measurement
For the Crust	
Pakak seed (powdered)	185 g
Butter	80 g
Powdered Sugar	50 g
For the Filling	
Butter	3 tbsp
Brown Sugar	6 tbsp
Beaten egg	3 tbsp
Pakak seed	¼ cups
Pakak flesh	¼ cups
Glazed fruit	¼ cups
Raisin	¼ cups

Developmental Procedure

Procedures for developing food products made from pakak (seed croquettes, pakak seed spread, and tarts with pakak seed) are presented and described below.

1. Preparation of Pakak Seed Croquettes

The process of making pakak seed croquettes began by accurately measuring all the required ingredients. These ingredients were then combined in a mixing bowl, where the dry ingredients were thoroughly mixed. A well was created in the center of the dry mixture, and the liquid ingredients were added. The ratio of dry to liquid ingredients was adjusted until a mixture that held together well but was not too dry was achieved.

Using hands, the mixture was then molded into bite-sized croquettes, ensuring that each one weighed around 2-3 grams and was compact enough to hold its shape. The croquettes were then either fried in oil or baked in an oven preheated to 180 degrees Celsius until they turned golden brown on all sides, ensuring even cooking throughout.

Once cooked to perfection, the croquettes were removed from the heat, and any excess oil was blotted away using paper towels. After allowing the croquettes to cool down to room temperature, they were transferred to a plastic container for storage. The container was tightly sealed to prevent air and moisture from entering, and it was labeled with the contents and date of preparation for easy identification.

2. Preparation of Pakak Seed Spread

To make pakak seed spread, the process began by boiling the seeds until they were tender. Once boiled, the seeds were peeled to remove the outer layer. Then, using a blender, the boiled pakak seeds were ground with water until a fine and smooth consistency was achieved.

Next, the mixture was cooked until it thickened to the desired spreadable consistency. Additional ingredients such as sugar and butter were then added to the mixture, and everything was blended again until smooth and well combined.

To preserve the spread, it was transferred into sterilized jars. Each jar was tightly sealed to ensure freshness and prevent spoilage. Finally, the jars were labeled for easy identification.

3. Preparation of Tart with Pakak Seed

The process of making tart pakak seed began with measuring all the necessary ingredients for both the crust and the filling. Once the ingredients were measured, the crust was prepared by mixing them until a smooth dough was formed. The dough was then rolled out evenly to fit the tart pan.

To prevent sticking, the tart pan was greased and dusted with flour before placing the rolled-out dough into it. The crust was pre-baked until it was lightly golden brown, ensuring a crisp and sturdy base for the tart.

While the crust was pre-baking, the filling ingredients were prepared. Once the crust was ready, it was filled with the prepared pakak seed filling mixture. The tart was then baked until the filling was set and the crust turned a light golden brown color.

After baking, the tart was allowed to cool completely before being prepared for packaging. It was carefully removed from the tart pan and placed on a serving dish or a suitable container for storage. Labels were then applied, indicating the contents and date of preparation.

Finally, the tart was stored in a cool, dry place to maintain its freshness and quality until ready to be served or consumed. This process ensured that the tart pakak seed was made with care and attention to detail, resulting in a delicious and satisfying dessert for all to enjoy.

Data Gathering Procedure

Permission to conduct the study through sensory evaluation was requested from the respondents, consisting of children, teenagers, adults, and experts. After permission was granted, the administration of the sensory evaluation form followed. Directions concerning the accomplishment of the questionnaires were discussed by the researcher

with the evaluators personally. Copies of the checklist forms were retrieved after being completed by the respondents.

The Department of Science and Technology (DOST) Region 02 through its Regional Standards and Testing Laboratory assessed the developed pakak seed food products to determine their nutritional value. In addition, to determine the shelf life of the food products, the observation method was used to identify changes in the appearance, aroma, taste, and texture of pakak seed croquettes, pakak seed spread, and pakak seed tarts.

Sensory Evaluation

The finished products were subjected to sensory evaluation. One hundred twenty (120) respondents from varied age groups were selected and properly oriented on evaluating the products using the 9-point Hedonic Scale. The samples were arranged and assessed.

Then, the evaluators are asked to taste the samples placed in a 9-point Hedonic Scale. Data on each sample's appearance, aroma, taste, texture, and general acceptability were collected and decoded for statistical analysis.

The 9-point Hedonic Scale was used as an instrument for data gathering because of its suitability in measuring the acceptability of the product. On the acceptability of the different samples of food products from pakak seed in terms of appearance, aroma, taste, texture, and general acceptability, the range and its corresponding qualitative description are as follows:

Liking Score	Numerical Value	Hedonic Rating
9	8.12 - 9.00	Like Extremely
8	7.23 - 8.11	Like Very Much
7	6.34 - 7.22	Like Moderately
6	5.45 - 6.33	Like Slightly
5	4.56 – 5.44	Neither Like nor Dislike
4	3.67 – 4.55	Dislike Slightly
3	2.78 – 3.66	Dislike Moderately
2	1.89 – 2.77	Dislike Very Much
1	1.00 – 1.88	Dislike Extremely

RESULTS AND DISCUSSION

Product Development

The pakak food products underwent different stages of development starting from washing, sorting, boiling, drying, pulverizing, mixing, cooking, baking, packaging, and labeling. Through these stages of development, careful observation and analysis were done to come up with pakak food products.

Preparation of Pakak Seed Croquettes, Pakak Seed Spread, and Tart with Pakak Seed

The development process commenced with the preparation of pakak seed croquettes, pakak seed spread, and tart with pakak seed. Initially, the pakak seeds were washed thoroughly to eliminate the sticky latex residue from the fruit and any impurities. Following this, the mature seeds were boiled until fully cooked, then drained and left to cool. Subsequently, the outer layer of skin was removed from the pakak seeds, and they were ground into a fine powder using a blender.



Figure 1. The researcher carefully mixes all the required ingredients for Pakak Seed Croquettes.



Figure 2. Chilling combined butter, powdered sugar, and *pakak* seed powder for 10 to 15 minutes is a step in making Tart with Pakak Seed



Figure 3. The Three Developed Products from Pakak Seeds (Pakak Seed Croquettes, Pakak Seed Spread, and Tart with Pakak Seed)

Report of Analysis on the Nutritive Value of Pakak Seeds Food Products

Figure 4 below is a report of analysis by the Department of Science and Technology (DOST) Regional Standards and Testing Laboratory on the nutritive value of three Pakak seeds food products: Pakak Seed Spread, Pakak Seed Croquettes, and Pakak Seeds Tart.

As evident in the report, the Pakak Seed Spread is relatively high in crude fat which is 27.60 g/100 g, indicating a potentially rich source of dietary fats. However, it contains moderate levels of crude protein (5.51 g/100 g) and very low moisture content which is equal to 1.81 g/100 g. In addition, the Pakak Seed Croquettes have slightly lower crude fat content (25.29 g/100 g) compared to the spread, but they are higher in crude protein which amounts to 9.68 g/100 g. The moisture content which is 18.01 g/100 g is considerably higher, likely due to the cooking or preparation process. Moreover, the Pakak Seeds Tart has the lowest crude fat amounting to 15.40 g/100 g, and crude protein which amounts to 4.30 g/100 g content among the three products. However, it still provides some fat and protein. The moisture content is moderate which amounts to 15.69 g/100 g, similar to the croquettes.

Overall, each Pakak seeds food product offers a different balance of nutrients. The Pakak Seed Croquettes are relatively higher in protein, while the Pakak Seed Spread is richer in fat. The tart provides a moderate amount of both fat and protein. These differences in nutrient composition can cater to varying dietary preferences and nutritional needs.

Significantly, the three pakak seed food products: pakak seed croquettes, pakak seed spread, and tart with pakak seed have nutritive content present such as fats and

protein in every food product developed. This implies that the three food products are safe to eat, particularly to the shelf life of each food product. All parts of the mature and ripe fruits are edible (National Tropical Botanical Garden, 2015). Therefore, the developed pakak food products are appropriate and safe for food consumption. In support of the analysis, the seeds can be used to produce flour, resulting in a product rich in protein, similar to or higher than that found in wheat.

The use of pakak seed flour and all-purpose flour mixtures in food products like cookies will encourage the widespread use of underutilized pakak seed. The cookies with breadnut seed flour in any level of substitution were highly acceptable to the panelists since there was no cookie sample rejected based on the 9-point hedonic scale. However, the most acceptable formulation based on the general acceptability score was the cookie with 50% all-purpose flour and 50% breadnut seed flour (Go, Velos, Minyamin, Bagsit, and Pableo, 2003). Food products produced using pakak seeds offer a range of culinary options due to the seeds' versatile characteristics.



Republic of the Philippines
DEPARTMENT OF SCIENCE AND TECHNOLOGY
 Regional Office No.02
 Regional Standards and Testing Laboratory

Test Report No.: 2024-0200

REPORT OF ANALYSIS

Laboratory Reference No. : R2-012024-CHE-0200	Sampling Date : January 30, 2024/07:39 AM
Sample Submitted : Food Sample	Date Submitted : February 09, 2024
Submitted by : Sherilyn D. Silva	Date Reported :

Address : ISU Ilagan
 : Alinguigan 2nd, City of Ilagan, Isabela

Crude Protein
 Procedure Description: A suitable amount of sample was digested at 400°C with sulfuric acid using copper sulfate – potassium sulfate as catalyst. The digested sample was diluted with water. Forty percent sodium hydroxide was added to liberate ammonia and subsequently steam distilled using Kjeltac Distilling apparatus. The liberated ammonia was collected in Boric acid receiver solution then titrated with standard acid.

Moisture
 Procedure Description: Accurately weighed sample was placed in aluminum dish and dried at 100 °C in an oven for two hours. The dish with residue was weighed to determine weight loss as moisture

REMARKS:
 The result/s given in this report was those obtained at the time of test and refers only to the particular sample submitted. This report shall not be reproduced except in full without the written approval of the DOST Regional Office 02.

Certified Correct by:

Samantha H. Baliza
SAMANTHA H. BALIZA, RCh
 OIC-Technical Manager, Chemical Testing Lab
 Lic #0015361

Not valid without seal

Postal Address: Regional Government Center, Carig Sur, Tuguegarao City
 Hotline No.: 0929-621-6871 Page 2 of 2

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FIGURE 4. Report of Analysis by DOST on the Nutritive Value of Pakak Seeds Food Product

The Level of Acceptability of Pakak Seed Products

Table 5 shows the level of acceptability of pakak seed products in terms of appearance/color, aroma, taste, and texture.

Table 5. The level of acceptability of Pakak seed products in terms of appearance/color, aroma, taste, and texture

Respondents	Characteristics	Pakak Seed Croquettes		Pakak Seed Spread		Tart with Pakak Seeds	
		Mean	Description	Mean	Description	Mean	Description
Children	Appearance/Color	7.50	Like Very Much	7.72	Like Very Much	7.97	Like Very Much
	Aroma	7.49	Like Very Much	7.68	Like Very Much	7.83	Like Very Much
	Taste	7.21	Like Moderately	8.01	Like Very Much	8.17	Like Extremely
	Texture	7.40	Like Very Much	7.87	Like Very Much	8.02	Like Very Much
Teenagers	Appearance/Color	8.46	Like Extremely	8.71	Like Extremely	8.69	Like Extremely
	Aroma	8.58	Like Extremely	8.49	Like Extremely	8.62	Like Extremely
	Taste	8.64	Like Extremely	8.76	Like Extremely	8.73	Like Extremely
	Texture	8.51	Like Extremely	8.54	Like Extremely	8.61	Like Extremely
Adults	Appearance/Color	7.93	Like Very Much	8.46	Like Extremely	8.30	Like Extremely
	Aroma	7.87	Like Extremely	8.51	Like Extremely	8.52	Like Extremely
	Taste	7.90	Like Extremely	8.72	Like Extremely	8.40	Like Extremely
	Texture	7.79	Like Extremely	8.66	Like Extremely	8.56	Like Extremely
Food Experts	Appearance/Color	8.47	Like Extremely	8.46	Like Extremely	8.69	Like Extremely
	Aroma	8.46	Like Extremely	8.40	Like Extremely	8.68	Like Extremely
	Taste	8.37	Like Extremely	8.73	Like Extremely	8.80	Like Extremely
	Texture	8.33	Like Extremely	8.46	Like Extremely	8.72	Like Extremely
Overall Mean		8.05	Like Very Much	8.39	Like Extremely	8.46	Like Extremely

The provided data offers valuable insights into the consumer perception of three Pakak Seed-based dishes—Pakak Seed Croquettes, Pakak Seed Spread, and Tart with Pakak Seeds—across various groups of respondents.

Children generally displayed a positive response to all three developed food products, particularly favoring the appearance/color, and aroma. However, their liking for the taste of Pakak Seed Croquettes was moderate compared to their strong preference for the taste of the spread and tart. Texture received favorable ratings across the board, with the highest liking observed for the tart.

Teenagers exhibited exceptionally high ratings across all characteristics of the dishes. They showed a strong liking for the appearance, aroma, taste, and texture of all three dishes, indicating a robust appeal to this demographic group.

Similarly, adults displayed a positive perception of the dishes, with strong preferences for appearance, aroma, taste, and texture. Although their ratings were slightly lower compared to teenagers, adults still showed significant liking for all three dishes.

Food experts consistently rated all characteristics of the dishes extremely high, suggesting a sophisticated palate and appreciation for the culinary aspects of the Pakak Seed-based dishes. Their ratings align closely with those of teenagers, indicating a shared enthusiasm for these innovative culinary creations.

The overall mean ratings for all developed food products were generally high, indicating a positive perception across all groups (children, teenagers, and adults, food experts). The Pakak Seed Spread and Tart with Pakak Seeds received particularly high ratings of 8.39 and 8.46 respectively, interpreted as *"like extremely"*, suggesting broad appeal and potential market success.

The data highlights the broad appeal and positive reception of Pakak Seed-based products across different demographic groups and expertise levels. While children, teenagers, and adults all showed varying levels of liking, the overall trend indicates a favorable perception of these products. Food experts' high ratings further validate the culinary excellence of these food creations.

The findings suggest opportunities for product development and marketing strategies tailored to different demographic groups. The Pakak Seed Spread and Tart with Pakak Seeds, in particular, hold promise for commercial success, given their widespread appeal. Further research could explore consumer preferences in more detail and inform targeted approaches to maximize the potential of Pakak Seed-based food products in the market

General Level of Acceptability of the Developed Pakak Food Products Across Age Groups

The following table presents the general level of acceptability of the developed pakak food products across age groups.

Table 6. The general level of acceptability of the developed Pakak Food Products across age groups

Respondents	Pakak Seeds Croquettes		Pakak Seeds Spread		Tart with Pakak Seeds	
	Mean	Description	Mean	Description	Mean	Description
Children	7.39	Like Very Much	7.82	Like Extremely	8.00	Like Extremely
Teenagers	8.55	Like Extremely	8.63	Like Extremely	8.66	Like Extremely
Adults	7.87	Like Very Much	8.59	Like Extremely	8.44	Like Extremely
Food Experts	8.41	Like Extremely	8.51	Like Extremely	8.72	Like Extremely
Overall Mean	8.06	Like Very Much	8.39	Like Extremely	8.46	Like Extremely

The table shows the general level of acceptability of the developed Pakak food products across different age groups.

Pakak Seeds Croquettes received positive ratings across all groups, with teenagers showing the highest average liking with a mean of 8.55 described as “like extremely”. However, it's noteworthy that children rated it slightly lower (7.39) compared to other age groups.

The Pakak Seeds Spread garnered high ratings across all groups, with teenagers (8.63) and adults (8.59) expressing particularly strong preference (like extremely). Food experts also rated it highly (8.51), indicating its appeal extends beyond general consumer groups.

Tart with Pakak Seeds emerged as the most favored product, with consistently high ratings across all segments (overall mean of 8.46 described as “like extremely”). Food experts rated it the highest (8.72), suggesting its culinary sophistication and appeal.

The data indicates a generally positive perception of Pakak Seeds products across all groups of respondents, with slight variations in preference among different age groups and expertise levels. Teenagers consistently showed a higher liking for all three products, possibly due to their adventurous palate and openness to new flavors.

The Pakak Seeds Spread and Tart with Pakak Seeds emerged as clear favorites, receiving high ratings from all groups, including food experts. This suggests that these products have broader appeal and could potentially find success in the market as innovative and flavorful options.

While Pakak Seeds Croquettes received slightly lower ratings compared to the spread and tart, they still garnered positive feedback, especially from teenagers and food experts. This indicates that while not as universally favored as the other products, there

is still a market for Pakak Seeds Croquettes, particularly among certain consumer segments.

Comparison in the General Acceptability of Pakak Seeds Food Products

Table 7 presents the comparison in the general acceptability of pakak seed food products.

Table 7. Comparison in the General Acceptability of Pakak Seed Food Products

Pakak Seeds Products	F-Value	p-Value	Decision	Remarks
Pakak Seeds Croquettes	18.8359	0.0000	Reject H_0	Significant
Pakak Seeds Spread	22.8870	0.0000	Reject H_0	Significant
Tart with Pakak Seeds	17.5796	0.0000	Reject H_0	Significant

The table shows the comparison in the general level of acceptability of three Pakak seed food products: Pakak Seed Croquettes, Pakak Seed Spread, and Tart with Pakak Seeds.

As indicated, significant differences in the general level of acceptability among the three products were established. The F-value of 18.8359 and the p-value of 0.0000 indicate that there is a significant difference in the general acceptability of Pakak Seed Croquettes compared to the other products. Since the null hypothesis (H_0) is rejected, it implies that there are significant differences in the acceptability levels between Pakak Seed Croquettes and at least one of the other products.

Similarly, the F-value of 22.8870 and the p-value of 0.0000 show a significant difference in the general acceptability of Pakak Seed Spread compared to the other products. The rejection of H_0 suggests that there are significant differences in acceptability levels between Pakak Seed Spread and at least one of the other products. The F-value of 17.5796 and the p-value of 0.0000 indicate significant differences in the general acceptability of Tart with Pakak Seeds compared to the other products. As with the other products, the rejection of H_0 suggests significant differences in acceptability levels between Tart with Pakak Seeds and at least one of the other products.

In summary, the analysis reveals that there are significant differences in the general acceptability levels among all three Pakak seed food products. This implies that consumers perceive these products differently in terms of overall liking or acceptability, with each product potentially appealing to different preferences or tastes. Further investigation could explore the specific factors contributing to these differences in acceptability.

Shelf-life of the Produced Pakak Seed Croquettes, Pakak Seed Spread, and Tart with Pakak Seed in Room Temperature and Refrigerator

After production, the *pakak* food products were stored at room temperature between 25°C and 30°C. Furthermore, the following table displays the observation:

a. Shelf-Life of pakak seed croquettes at room temperature

Table 8. Shelf-Life of pakak seed croquettes, pakak seed spread, and tart with pakak seed

Days of Observation	Observation Results
First day	The <i>pakak</i> seed croquettes tasted cheesy and nutty, were crunchy and tender, and had a nice appearance and color. They also smelled good.
Second day	The same observation was made on the first day: the appearance, color, flavor, and texture were all good.
Third day	The same observation was made on the second day: the texture, flavor, aroma, and appearance of the pakak seed croquettes were all good.
Fourth day	The pakak seed croquettes had a moldy appearance and color, the same smell, a stale, oily taste, and a greasy texture.
Fifth day	The pakak seed croquettes had an oily appearance and green molds on them. They had an oily and moldy aroma, as well as a bad taste and texture.

b. Shelf-Life of pakak seed spread at room temperature

Table 9. Shelf-Life of pakak seed spread at room temperature

Day of Observation	Observation Results
First day	The pakak seed spread was well-looking and colored, tasted creamy, sweet, and nutty, and had a soft texture. It also smelled nutty.
Second day	The pakak seed spread had a nice look and color, a nutty aroma, a creamy, sweet, and nutty flavor, and a soft texture. These observations were made on the first day as well.
Third day	The second day revealed the same observations: the pakak seed spread was soft to the touch, had a nice color and appearance, and smelled nutty. It also tasted creamy, sweet, and nutty.
Fourth day	The pakak seed spread's texture is sticky and crumbly, its aroma and taste both exhibit signs of spoiling, and its appearance is oily.

Fifth day	The pakak seed spread had an initially watery and oily look, a sour essence scent, a stale and oily taste, and a sticky texture. The spread was more susceptible to spoilage due to the high temperature.
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c. Shelf-Life of tart with pakak seed at room temperature

Table 10. Shelf-Life of tart with pakak seed at room temperature

Days of Observation	Observation Results
First day	The pakak seed tart was nicely colored, smelled nutty, tasted sweet and nutty, and had a texture that was chewy, soft, and tender.
Second day	The tart with pakak seed had the same observations as the first day: it was attractive in color and appearance, smelled nutty, tasted sweet and nutty, and had a texture that was chewy, soft, and tender.
Third day	The second day's observations were the same: the pakak seed tart had a nice color and appearance, a nutty aroma, a sweet and nutty flavor, and a soft, tender, chewy texture.
Fourth day	Similar observations were made on the third day: the pakak seed tart had a nice color and appearance, a nutty aroma, a sweet and nutty flavor, and a soft, tender, and chewy texture.
Fifth day	The tart containing pakak seeds had a nice look and color, a nutty aroma, a sweet and nutty flavor, and a soft, tender, and chewy texture. These observations were made on the fourth day.
Sixth day	The pakak seed tart was nicely colored, smelled nutty, tasted sweet and nutty, and had a texture that was chewy, soft, and tender.
Seventh day	The tart with pakak seeds had the same observations on the sixth day: it was attractive in color, smelled nutty, tasted sweet and nutty, and had a texture that was chewy, soft, and tender.
Eighth day	The tart containing pakak seeds had a nice look and color, a nutty aroma, a sweet and nutty flavor, and a soft, tender, and chewy texture. These observations were made on the seventh day.
Ninth day	The tart with pakak seed had the same observations on the eighth day: it was attractive in color, smelled nutty, tasted sweet and nutty, and had a texture that was chewy, soft, and chewy.
Tenth day	The tart with pakak seeds was soft, tender, and chewy on the tenth day, and it tasted sweet and nutty. It also had a nice color and appearance.

Conclusions

This study concludes that the development of Pakak food products involved meticulous stages aimed at ensuring quality and safety. Through washing, sorting, boiling, drying, pulverizing, mixing, cooking, baking, packaging, and labeling, careful observation and analysis were conducted, resulting in the creation of Pakak Seed Croquettes, Pakak Seed Spread, and Tart with Pakak Seeds. These products offer varying nutrients, with croquettes being higher in protein, spread richer in fat, and tart providing moderate amounts of both. Importantly, all three products contain essential nutrients, indicating their safety for consumption and aligning with the edibility of all parts of mature and ripe Pakak fruits. Moreover, Pakak seeds' potential to produce protein-rich flour further supports their suitability for consumption.

The research findings also demonstrate a positive perception of Pakak seed products across all respondent groups, including children, teenagers, adults, and food experts. While teenagers consistently displayed a higher liking for all products, the Pakak Seed Spread and Tart with Pakak Seeds received particularly high ratings, revealing their broad appeal and potential for market success. This favorable perception suggests that these products could effectively cater to diverse dietary preferences and nutritional needs. The provided shelf-life information is also essential for ensuring product quality and safety during storage and distribution.

Finally, the study highlights the viability and positive reception of Pakak seed-based food products, suggesting their potential to meet consumer demand for nutritious and flavorful options.

Recommendations

Based on the findings and conclusions of the study, several recommendations can be made to further enhance the development, marketing, and distribution of Pakak food products:

1. Product development is strongly encouraged. Continuous innovation and refinement of the formulations of Pakak food products to cater to evolving consumer preferences and dietary needs should be done. This could involve experimenting with different flavors, textures, and nutritional profiles to broaden the product range and appeal to a wider audience.
2. Consumer education should be conducted particularly about the nutritional benefits and versatility of Pakak food products through targeted marketing campaigns and informational materials. The unique nutrient compositions of Pakak seed croquettes spreads, and tarts should be highlighted to help consumers make informed choices based on their dietary requirements.

3. Further optimization or improvement of the sensory attributes of Pakak food products, including appearance, aroma, taste, and texture, be done to maximize consumer satisfaction and acceptability. The conduct of sensory evaluations and consumer feedback sessions to identify areas for improvement and refine product formulations accordingly is highly encouraged.
 4. Marketing strategies and product offerings to different consumer segments based on their preferences and needs should be tailored. For example, adolescents and food experts are to be targeted with messaging that emphasizes the nutritional value and appeal of Pakak food products, while also considering more general messaging for broader consumer segments. Hence, coordination with government agencies like the Department of Science and Technology (DOST) and the Department of Trade and Industry (DTI) is needed.
 5. Implementation of effective storage and distribution practices to optimize the shelf life of Pakak food products and minimize waste is encouraged. This could involve investing in packaging technologies that extend shelf life, optimizing storage conditions, and establishing efficient distribution channels to ensure products reach consumers in optimal condition. Collaboration with the Department of Trade and Industry (DTI) is recommended.
 6. Allocation of resources for ongoing research and development initiatives to further explore the potential applications of Pakak seeds in food product development is encouraged. This could involve collaboration with food scientists, nutritionists, and culinary experts to innovate new Pakak-based food products that meet emerging consumer trends and preferences. Tapping the school's R&D Unit, the DOST, and the DTI is needed.
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Compliance with Ethical Standards

This research followed ethical standards and adhered to principles of integrity, respect, and responsibility towards the participants. Before conducting the study, the researcher obtained informed consent from the participants. She ensured that they understood the purpose of the study, its procedures, and potential risks. Confidentiality and anonymity were well kept up throughout data collection, analysis, and dissemination, safeguarding participants' privacy. Additionally, the researcher made sure that there was no conflict of interest in conducting the study, avoided plagiarism issues, and no bias was

made in the interpretation of the results of the study. Finally, she ensured that the findings were used only for the research.

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