"Lowland Kangkong (Ipomoea Aquatica)-Flavored Rice Cake Wrapped in Green-Stemmed Alugbati (Basella Alba L.) Edible Wrapper"

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ABSTRACT

This study focuses on the development of a nutritious and environmentally friendly snack by creating a Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in an edible Green-Stemmed Alugbati (Basella alba L.) leaf wrapper. Motivated by the increasing demand for health-conscious and sustainable food products, this research explores the underutilized potential of Kangkong and Alugbati, both rich in vital nutrients such as iron, other minerals, calcium, vitamin A, vitamin C, dietary fiber, and antioxidants. Kangkong, commonly known as water spinach, is valued for its immune-boosting and digestive benefits. At the same time, Alugbati's mucilaginous texture makes it suitable as a biodegradable, edible packaging material that can replace conventional plastic wrappers. This innovative combination aims to provide a nutritious snack option that supports local agriculture and addresses environmental concerns related to plastic waste.

The study employs an experimental design based on the Input-Process-Output framework, involving the preparation and processing of the Lowland Kangkong-flavored rice cake wrapped in Green-Stemmed Alugbati leaves, followed by sensory evaluation to assess Texture, taste, Aroma, color, and overall acceptability among 30 respondents. Additionally, the research examines the economic feasibility through return-on-investment analysis. By integrating local plants into modern snack products and utilizing plant-based edible wrappers, this study contributes to the development of sustainable food innovations. It offers valuable insights for entrepreneurs, vendors, consumers, and future researchers. The findings are expected to promote healthier eating habits, reduce packaging waste, and encourage the development of cost-effective, nutritious snacks in the Philippine context.

Keywords: Lowland Kangkong (Ipomoea aquatica), Green Stemmed Alugbati (Basella alba L.), rice cake, edible wrapper, nutritious snack, sustainable packaging, sensory acceptability, return on investment, food innovation, biodegradable packaging.

INTRODUCTION

Increasing the awareness of health benefits and concerns about environmental waste have led to a constant increase in demand for nutritious, sustainable, and environmentally friendly food products in recent years. The creation of the food products that use natural, local ingredients to minimize the use of potentially dangerous packaging materials is encouraged by the shift in consumer preferences. Lowland kangkong (Ipomoea aquatica) and alugbati (Basella alba L.), two plants which demonstrate a guarantee but are underutilized in the Philippine context, have a beneficial health effects and the potential to help develop sustainable food solutions.

A common leafy vegetable in many Filipino homes, lowland kangkong, also known as water spinach, is rich in dietary fiber, iron, calcium, and vitamin C (Sharma et al., 2013). These nutrients promote healthy digestion, strong bones, and an immune system that is more robust. However, the Lowland Kangkong remains underutilized in the production of modern food items, especially in the rice-based products like rice cakes, and is frequently utilized merely in traditional home-cooked meals.

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Alugbati, sometimes referred to as Malabar spinach, is another plant that is rich in nutrients. Alugbati's benefits for health are credited to its high levels of antioxidants, vitamin A, vitamin C, iron, and dietary fiber, and this is according to studies (De Guzman & Maghirang, 2018). In addition to its nutritional value, Alugbati has become known for its mucilaginous texture, that provides strength and flexibility which makes it appropriate for other applications like edible food wrappers (Das et al., 2015). This attribute offers a potential for food innovation that examines environmental issues, especially when it pertains to substituting biodegradable, plant-based materials for single-use plastic wrappers.

The combined use of Lowland Kangkong and Alugbati in modern-day snack products remains largely unexplored, despite of their well-established advantages. Studies aimed at Kangkong as an ingredient in rice cakes and Alugbati as an edible packaging material are lacking in the Philippines' current research on plant-based functional foods, which mostly focuses on moringa, sweet potato leaves, and other traditional vegetables (Santos & Valdez, 2020). Filling this gap would promote sustainable packaging methods in along with integrating a new, and health-conscious snack.

With the aim to provide a healthy and sustainable substitute for typical snacks, this study intends to developed a rice cake with the flavor of Lowland Kangkong (Ipomoea aquatica) wrapped in an edible Green-Stemmed Alugbati (Basella alba L.) wrapper. By exploring this product idea, the study anticipates to encourage a wider use of regional plants in the development of food products and reduce waste by using the edible packaging derived from plants.

Research Objectives

Generally, this study aimed to develop a Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in Green-Stemmed Alugbati (Basella alba L.) edible wrapper.

The purpose of this study was to achieve the following specific objectives:

To develop a nutritious Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in Green-Stemmed Alugbati (Basella alba L.) edible wrapper.

To determine the sensory acceptability of the Lowland Kangkong (Ipomoea aquatica)- flavored rice cake wrapped in Green-Stemmed Alugbati (Basella alba L.) edible wrapper in terms of its:

Texture,

Taste,

Aroma,

Color, and

Overall acceptability.

To assess whether the significant differences exist among the formulations

To determine the return on investment in the product

Conceptual Framework

The experimental study on the Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in a Green-Stemmed Alugbati (Basella alba L.) edible wrapper was based on the Input-Process-Output (IPO) paradigm.

The input includes ingredients, tools, and equipment that used in the preparation of the Lowland Kangkong-flavored rice cake wrapped in the Green-Stemmed Alugbati edible wrapper.

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The process involves preparation and processing of the product, followed by a ranking test, a preference test, and frequency percentage analysis to evaluate sensory attributes of the product.

The output is the newly developed and innovative Lowland Kangkong-flavored rice cake wrapped in a Green-Stemmed Alugbati edible wrapper.

INPUT		PROCESS		OUTPUT
Ingredients Tools Equipment	→	Preparation and processing of the Lowland Kangkong- flavored rice cake wrapped in Alugbati edible wrapper Ranking Test, Preference test Frequency Percentage.	→	Newly innovated Lowland Kangkong-flavored rice cake wrapped in Green-Stemmed Alugbati edible wrapper

Figure 1. Conceptual Paradigm

Significance of the Study

The ultimate significance of the study is to provide target consumers with an all-edible, nutritious food option for their consumption that can be purchased at a low price. This study would also promote the use of healthier ingredients and sustainable materials, thereby mitigating the excessive use of paper and plastic wrappers. In addition, this study also serves to provide further information and data to benefit the following:

Entrepreneurs. This study would provide them with ideas on how to enhance the nutritional value of their products. Additionally, this would guide them in creating a healthier delicacy that benefits not only the consumer's stomach but also their pocket.

Vendors. This study would provide vendors with insight into how they could offer consumers a healthy and nutritious snack. This might also help them in acquiring more customers with their cost-efficient, nutritious product.

Consumers. This study may present them with new products that not only satisfy their hunger but also provide them with nutritional values beneficial for their growth and health, which their body rightfully needs. This will also provide them with insights into the importance of responsible consumerism, not only to be satisfied with the goods presented to them, but also to evaluate the nutritional benefits a product offers. Additionally, as consumers, this study would help them mitigate and even prevent food waste.

Future Researchers. This study may be a valuable contribution to the existing research on Lowland Kangkong (Ipomoea aquatica)-flavored rice cakes wrapped in Green-Stemmed Alugbati (Basella alba L.) edible wrappers. It can also serve as a valuable reference for future researchers, providing relevant information and guidance for studies related to the development of similar nutritious and environmentally friendly food products.

Scope and limitation

This research focuses on creating a rice cake infused with Lowland Kangkong (Ipomoea aquatica) flavor and encased in an edible leaf of Alugbati (Basella alba L.). The study aims to assess the sensory acceptability of the Lowland Kangkong-flavored rice cake wrapped in a Green-Stemmed Alugbati edible wrapper by evaluating its Texture, taste, Aroma, color, and overall acceptability. Furthermore, the investigation will examine the product's return on investment and packaging design. The data will be collected through survey questionnaires distributed to 30 participants, comprising both faculty and students from the Sultan Kudarat State University – Isulan Campus.

Operational Definition of Terms

The following technologies are defined operationally according to their use in the study.

Green-Stemmed Alugbati (Basella alba L.): In this study, Alugbati refers to the leafy vegetable used as an edible wrapper for the rice cake. It serves as a nutritious, flexible, and biodegradable alternative to conventional packaging, supporting the study's goal of promoting sustainability and reducing plastic waste.

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Aroma: Aroma, as used in this research, refers to the scent emitted by the Lowland Kangkong-flavored rice cake wrapped in Alugbati leaves. It is one of the sensory attributes that respondents evaluate to assess the product's overall acceptability.

Color: Color refers to the visual appearance of both the rice cake and the alugbati wrapper. In this study, it is assessed as a sensory quality that may influence consumer preference and acceptability.

Edible: Within the context of this study, edible refers to the fact that both the rice cake and its Alugbati wrapper are safe and suitable for human consumption, highlighting the product's entirely edible composition and its potential to reduce food packaging waste.

Edible Wrapper: This term refers explicitly to the Alugbati leaf used to encase the rice cake. Its purpose in the study is to serve as a sustainable, plant-based packaging material that is edible and can be consumed together with the product.

Lowland Kangkong (Ipomoea aquatica): Kangkong, also known as water spinach, is the primary flavoring and nutritional ingredient in the rice cake. Its inclusion in the study aims to enhance the health benefits of the snack and promote the use of locally available, underutilized vegetables.

Nutritious Snack: In this research context, a nutritious snack refers to the Lowland Kangkong-flavored rice cake wrapped in Alugbati, developed to deliver vitamins, minerals, and fiber, and to offer a healthier alternative to conventional snacks.

Packaging: Packaging here pertains to the use of Alugbati leaves as the material that wraps and protects the rice cake, highlighting the study's focus on sustainable and biodegradable food packaging.

Rice Cake: The rice cake in this study is a steamed snack made from rice flour and flavored with Lowland Kangkong. It serves as the base product to which the innovative edible wrapper is applied.

Sensory Acceptability: This term refers to the overall assessment of the rice cake's qualities —texture, taste, Aroma, color, and general appeal—by respondents, which is central to determining the product's potential success in the market.

Taste: The taste experienced when eating the rice cake is influenced by the combination of Lowland Kangkong, Rice, and Alugbati. It is a key criterion in the sensory assessment.

Texture: Texture refers to the physical feel and consistency of the rice cake and its wrapper, as perceived by touch and when chewed. It is one of the primary sensory attributes assessed in the study.

Wrapper: The term "wrapper" in this study is specifically referring to the Alugbati leaf that is used to wrap the rice cake, serving as both the snack's packaging and its edible part.

REVIEW OF RELATED LITERATURE

Lowland Kangkong (Ipomoea aquatica)

A semi-aquatic leafy vegetable that is prevalent throughout Southeast Asia, especially in the Philippines, kangkong is also referred to as by the name water spinach. Kangkong is an essential crop for both home and commercial farming given its subtle flavor and tender texture, as well as the fact that it is affordable and simple to grow in tropical climates.

Iron, calcium, phosphorus, vitamin C, dietary fiber, and other essential vitamins and minerals are all high in Kangkong. These nutrients are essential for supporting the digestive health, bolstering bones, and encouraging the absorption of iron (Sharma et al., 2013). Furthermore, the antioxidants present in kangkong aid in protecting cells from harm caused on by free radicals (Raja et al., 2013).

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Kangkong is generally produced locally as an ingredient in stews and stir-fried recipes, or as a component of the dishes like "adobong kangkong." Studies on its use in useful snack foods, like rice cakes or baked goods, are still limited despite its high nutritional content and easy availability. Morales et al. (2021) suggest that adding native leafy greens, like kangkong, to the food items could improve the nutritional value of common snacks and encourage the consumption of affordable, naturally produced vegetables.

The possibility of treatment of Kangkong has also been demonstrated by the international research. According to a 2017 study by Tripathi and Mishra, kangkong has an anti-inflammatory and anti-diabetic qualities, which increases its value as a functional food ingredient. It is a good choice for use in modern food products targeted at consumers who are health-conscious because of these health-promoting qualities.

Despite of these advantages, Kangkong's use in processed foods is still comparatively new, especially in the Philippine market. This research gap offers a chance to explore kangkong as an essential component of rice cakes, both to improve their nutritional value and to encourage the use of the regional vegetables as modern snack substitutes.

Green-Stemmed Alugbati (Basella alba L.

The malabar spinach, or alugbati (Basella alba L.), is a tropical leafy vegetable that grows quickly and is widely grown in the Philippines. In recognition of its adaptability in the Filipino cooking and rich nutritional profile, it is widely esteemed locally. According to De Guzman and Maghirang (2018), Alugbati's high rich in iron, calcium, and antioxidant content supports its use in traditional rural medicinal practices as well as in food. Their study demonstrates its potential as a functional food ingredient and its use as a natural treatment for ailments like inflammation and constipation.

Santos and Valdez (2020) executed another local study that explored the use of Alugbati extract in baked products, such as bread and pastries. According to their findings, the inclusion of Alugbati improved the product's nutritional profile and extended its shelf life due to the antioxidant qualities of the plant. This implies that the alugbati may be a beneficial aspect of contemporary processed foods, providing both health advantages and usage outside of traditional cooking.

Numerous medicinal and nutritional studies have been conducted on the Basella alba globally. According to a study carried out in Malawi by Msonthi and Magombo (1983), Basella alba has a high mineral content and dietary fiber, which backs its use as a dietary supplement in rural African diets. The plant's contribution to the micronutrient intake was noted by the researchers, particularly in areas with little accessibility to fortified foods.

Similarly, the Basella alba's phytochemical components were examined by Kumar et al. (2012), who proved that the plant could serve as a natural source of anti-inflammatory and antioxidant compounds. According to their research, phenolic compounds that exist in alugbati leaves aid in protecting against the oxidative stress, a leading cause of chronic diseases like diabetes and heart disease.

A study by Das et al. (2015) that studied the antimicrobial and wound-healing qualities of Basella alba leaf extracts provides another worldwide viewpoint. Their research demonstrated that the plant's status in traditional medicine as a dietary staple and a treatment for skin disorders and external wounds.

Nutritious Value and Health Benefits of Alugbati

Because of its nutritional content, the alugbati is a useful ingredient in both regular diets and functional food formulations. Because of its high dietary fiber content, it helps maintain a digestive health by encouraging regular bowel movements and avoiding constipation (Sharma et al., 2013). Vitamins A and C are prevalent in the vegetable. Additionally, Alugbati provides iron, which is essential for the healthy red blood cells, and calcium, which is necessary for the development of strong bones (De Guzman & Maghirang, 2018). Flavonoids and saponins, two of its antioxidant compounds, aid in protecting the body from the oxidative stress and could reduce the risk of chronic illnesses like cancer and cardiovascular disease (Kumar et al., 2012). Alugbati is acknowledged as a functional vegetable with potential uses in innovative food products because of its broad range of nutrients and health-promoting qualities.

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Rice cakes

Many cultures consume rice cakes, and each has its own special preparation methods and traits (Kelly et al., 2017). Puto is a popular rice cake in the Philippines that is usually eaten for breakfast, dessert, or as a snack. Rice is submerged overnight, pounded, and mixed with sugar and coconut milk in a traditional way. The batter rises as a result of the mixture's prolonged fermentation, increasing its acidity. Before serving, the batter is steamed for approximately half an hour following the fermentation.

Ideal Texture of rice cake

According to Taylor et al. (2016), traditional rice cakes are made from fermented rice grains, water, and sugar. These rice cakes are typically sticky and dense, often shaped into small, bite-sized pieces. The rice cake, a leavened steamed product, is ideally spongy in Texture and is prepared using a mixture of 80% fermented parboiled rice and 20% black grams.

Shelf life of Rice cake

According to Ji et al. (2007), it is typically served as a dessert and is well-known for its soft, sticky Texture. These goods are often cooled and steamed before being packaged in plastic bags. It becomes hard and stale very rapidly, and its shelf life is only two days.

Edible wrapper

Kincaid et al. (2017) said that the Indonesian-based business Evoware developed a novel edible wrapper composed of seaweed, as reported by Fast Company. The product has practically no flavor, is healthy when consumed, and spontaneously biodegrades when discarded. Evoware's wrapping may be eaten solid or dissolved with hot water.

Customers would be drawn to the eco-friendly packaging for two primary reasons: sustainability and ease of use. One could consume the wrapper with their coffee instead of looking for scissors to open a Starbucks via packet. Additionally, consumers who place a high value on a product's ecological footprint would view this as a means of reducing the number of plastics that end up in landfills. An increasing proportion of consumers place importance on waste minimization. Many consumers are willing to pay more for goods they perceive as high-end, eco-friendly, and mission-driven. A brand's reputation can also be enhanced by sustainable packaging, which lends it a much-desired aura of social responsibility.

METHODOLOGY

The materials and procedures used to conduct the study are presented in this chapter. It also covers the instrumentation, the data collection process, and the respondents.

MATERIALS

Table 1. Materials Used in the Study

Equipment / utensils	Ingredients
Steamer	Lowland Kangkong leaves
Blender	Alugbati leaves
Measuring cups	Rice flour
Measuring cups	Rice water rinse
Mixing bowl	White sugar
Wire whisk	Cooked rice
Strainer	Instant yeast
Puto molders	Coconut milk
Pastry Brush	Eden cheese

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Knife	Vanilla extract
Tong	Egg white
Cheesecloth	Evaporated milk
Gas stove	
Rubber spatula	

Experimental design and treatment

A completely randomized design (CRD) with four treatments duplicated three times would be used for this investigation. The following were the treatments:

F1- 500g cooked rice + 1,000g rice flour + 118g rice water rinse + 472g Coconut milk + 236g evaporated milk + 224g egg white + 250g white sugar + 18g vanilla extract + 5.6g instant yeast + 165g cheese.

F2- 3.25g lowland-kangkong leaf + 1 alugbati leaf + 500g cooked rice + 1,000g rice flour + 118g rice water rinse + 472g coconut milk + 236g evaporated milk + 224g egg white + 250g white sugar +18g vanilla extract + 5.6g instant yeast + 165g Cheese.

F3- 6.25g lowland-kangkong leaf + 1 alugbati leaf + 500g cooked rice + 1,000g rice flour + 118g rice water rinse + 472g coconut milk + 236g evaporated milk + 224g egg white + 250g white sugar + 18g vanilla extract +5.6g instant yeast + 165g cheese.

F4- 125g lowland-kangkong leaf + 1 alugbati leaf + 500g cooked rice + 1,000g rice flour + 118g rice water rinse + 472g coconut milk + 236g evaporated milk + 224g egg white + 250g white sugar + 18g vanilla extract + 5.6g instant yeast + 165g cheese.

INGREDIENTS	FORMULATION 1	FORMULATION 2	FORMULATION 3	FORMULATION 4
Lowland Kangkong leaves		3.25g	6.25g	125g
Alugbati leaves		1 leaf	1 leaf	1 leaf
Cooked rice	500 g	500 g	500 g	500 g
Rice flour	1,000 g	1,000 g	1,000 g	1,000 g
Rice water rinse	118 g	118 g	118 g	118 g
Coconut milk	472 g	472 g	472 g	472 g
Evaporated milk	236 g	236 g	236 g	236 g
Egg white	224 g	224 g	224 g	224 g
White sugar	250 g	250 g	250 g	250 g
Vanilla extract	18 g	18 g	18 g	18 g
Instant yeast	5.6 g	5.6 g	5.6 g	5.6 g
cheese	165 g	165 g	165 g	165 g

Preparation and processing of Alugbati (Basella alba L.) edible wrapper

Select and wash the young alugbati leaves. Preheat water in a cooking pot to blanch the alugbati leaves for about 1-2 minutes, then rinse them. Let it cool. Grease the puto molds using a pastry brush. Then put the blanched alugbati in the puto molds and set aside.

Preparation and processing of Lowland-Kangkong flavored rice cake

Lowland kangkong leaves were washed and selected, then blended with cooked rice and rice water rinse until smooth. Rice flour was sifted, and the ingredients were measured according to treatments. Then add the rice flour, white sugar, coconut milk, egg white, and vanilla extract to a mixing bowl. Mix until smooth, then add the instant yeast. Mix and ferment for about 1-3 hours. After fermenting for hours, fill each mold with the kangkong rice cake mixture to a medium level, then tap to remove any air bubbles. Preheat the steamer, arrange the puto molds, and steam on medium-high heat for about 10-15 minutes, covering the lid with cheesecloth to prevent

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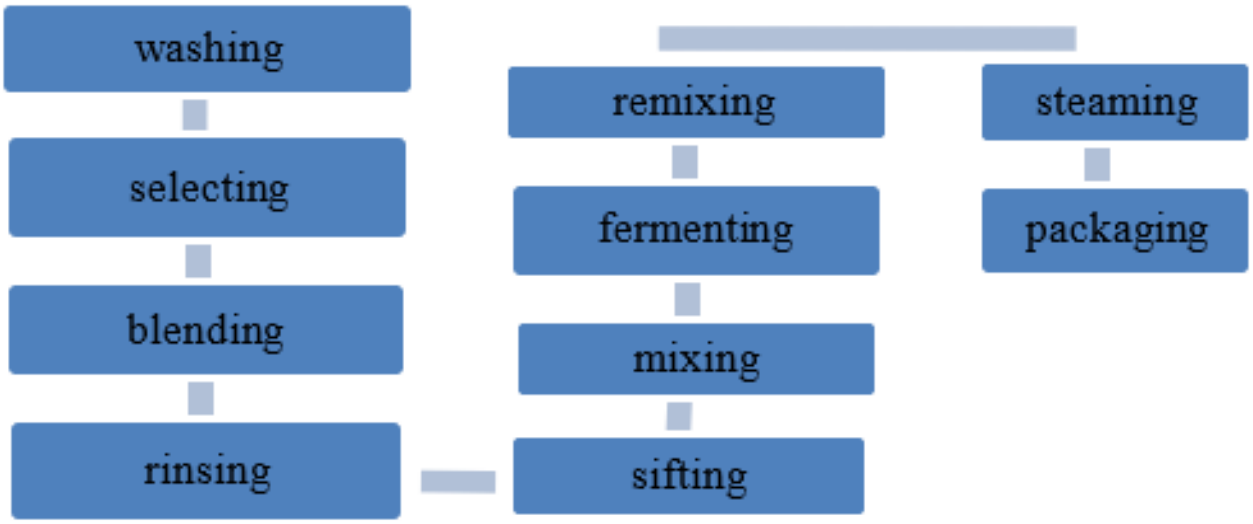
drips. When it is almost cooked, add a small slice of cheese as a topping. Cover it, wait for just 5 minutes, and check it using a toothpick when it is cooked; then remove it from the steamer using tongs and let it cool for a minute.

Flow process of lowland kangkong (Ipomoea aquatica)-flavored rice cake wrapped in alugbati (Basella alba L.) edible wrapper.



Respondents of the study

Thirty (30) respondents, composed of faculty and students of the Sultan Kudarat State University-Isulan Campus, were invited to evaluate the said product.

Data Gathering Procedure

The 9 hedonic rating scale and just-about-right scale were distributed by the researcher to the respondents, who evaluated the products under study. After which, it was collected, tabulated, and analyzed.

Table 2. The Rating Scale and Descriptive Rating (hedonic)

RATING	Texture	taste	Aroma	Color	Overall acceptability	RATING SCALES
	Like extremely	Like extremely	Like extremely	Like extremely	Like extremely	9
	Like very much	Like very much	Like very much	Like very much	Like very much	8
	Like moderately	Like moderately	Like moderately	Like moderately	Like moderately	7
	Like slightly	Like slightly	Like slightly	Like slightly	Like slightly	6
DESCRIPTIVE RATING	Neither like nor dislike	Neither like nor dislike	Neither like nor dislike	Neither like nor dislike	Neither like nor dislike	5
	Dislike slightly	Dislike slightly	Dislike slightly	Dislike slightly	Dislike slightly	4
	Dislike moderately	Dislike moderately	Dislike moderately	Dislike moderately	Dislike moderately	3
	Dislike very much	Dislike very much	Dislike very much	Dislike very much	Dislike very much	2
	Dislike extremely	Dislike extremely	Dislike extremely	Dislike extremely	Dislike extremely	1

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Table 3. The rating scale and descriptive rating (just-about-right)

RATING	SWEETNESS	FLUFFINESS	RATING SCALE
Descriptive rating	Much too strong	Much too fluffy	5
	a little too strong	A little too fluffy	4
	Just about right	Just about right	3
	A little too weak	A little too unfluffy	2
	Much too weak	much too unfluffy	1

Data Gathering Instrument

During the evaluation of the product, an evaluation sheet was distributed to the evaluator to assess the Lowland Kangkong rice cake wrapped in a Green-Stemmed Alugbati-based edible wrapper. The completed sheet was collected immediately for data analysis.

Instrumentation

The instruments used for data gathering were the Ranking Test and the 9-Point Hedonic Scale, which were used to gauge participants' responses to the various treatments in the experimental study.

Standard Formulation

To determine the standard formulation of ingredients for processing Lowland Kangkong-flavored rice cakes wrapped in Green-Stemmed Alugbati edible wrappers, different treatments consisting of varying ingredient proportions were formulated.

Statistical Analysis

Friedman's test was employed to analyze the data gathered from the participants' rating sheets to determine the level of acceptability of the Lowland Kangkong-flavored rice cake wrapped in a Green-Stemmed Alugbati-based edible wrapper, based on taste, Aroma, color, Texture, and overall preference.

Cost and Return Analysis

The output cost and input quantity were taken into consideration in order to compute the product's cost and return analysis (CRA). In order to determine the ROI, the formula of:

Cash in Flow - Cash Out Flow = Net Income

Return of Investment (ROI) = Net Income x 100

Cash-Out-Flow

RESULTS AND DISCUSSIONS

This chapter presented the findings and analysis and interpretation of results from the study.

Sensory evaluation on the lowland kangkong-flavored rice cake wrapped in green-stemmed alugbati edible wrapper.

Table 4. Mean rating of the Lowland Kangkong-flavored Rice Cake Wrapped in Green-Stemmed Alugbati Edible Wrapper of different formulation in terms of texture.

FORMULATION	N	Mean
1	30	78.57[a]
2	30	39.34[b]
3	30	80.05[a]
4	30	39.65[b]

[abcd] Means, there is a significant difference.

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The statistical analysis of the texture revealed notable differences across the various formulations. Formulation Three (3) achieved the highest average score of 81.05, followed by formulation one (1) with an average of 78.57 and formulation four (4) with 39.65. Formulation two (2) received the lowest average rating of 39.34. These findings suggest that participants favored Formulation Three (3) for its Texture, describing the Lowland Kangkong-flavored rice cake wrapped in a Green-Stemmed Alugbati edible wrapper as "like very much."

According to Taylor et al. (2016), traditional rice cakes are made from fermented rice grains, water, and sugar. These cakes typically have a sticky and dense texture and are usually produced in small, bite-sized pieces. Rice cake is a leavened, steamed product that ideally has a spongy texture, made from a blend of 80% fermented parboiled rice and 20% black grams.

Ji et al. (2013) describes rice cakes as having a soft and sticky texture, commonly served as a dessert. After steaming and cooling, these cakes are traditionally wrapped in polyethylene bags. They have a shelf life of about two days, after which they quickly lose their softness and become stale and hard.

Table 5. Mean rating of Lowland Kangkong-flavored rice cake wrapped in Green-Stemmed Alugbati edible wrapper of different formulation in terms of taste.

FORMULATION	N	Mean
1	30	68.54^{b}
2	30	34.36^{c}
3	30	75.60^{a}
4	30	39.53^{c}

^{abcd} Means, there is a significant difference.

The formulation one (1) was rated with an average score of 68.54, and formulation four (4) was rated with an average score of 39.53. At 34.36, formulation two (2) had the lowest mean score. These findings indicate that the respondents preferred formulation three (3), which received the highest mean rating. This signifies that the rice cake with the flavor of Lowland Kangkong (Ipomoea aquatica) wrapped in an edible wrapper made of Green-Stemmed Alugbati (Basella alba L.) was rated as tasting "like very much."

Oladeji and colleagues studied rice-based snack products in Eldoret Town, Kenya. They found that rice cake dishes flavored with local vegetables and wrapped in natural edible materials were highly regarded by the customers. Their study, which used a 5-point hedonic scale to evaluate taste and overall acceptability, revealed that the consumers liked unique flavor combinations and eco-friendly packaging.

The use of edible wrappers in the conventional snacks has been studied by Singh and Singh (2019). They observed that by improving the sense of texture and freshness, they positively affected the entire sensory experience. This lends validity to the idea that Formulation Three's edible wrapper may have received the higher ratings as a result of its increased sensory appeal.

Table 6. Mean rating of Lowland Kangkong flavored rice cake wrapped in Green-Stemmed Alugbati edible wrapper of different formulation in terms of aroma.

FORMULATION	N	Mean
1	30	69.68^{a}
2	30	36.41^{b}
3	30	70.10^{a}
4	30	39.43^{b}

^{abcd}Means, there is a significant difference.

In terms of aroma, significant differences were observed among the treatments. Formulation 3 received the highest mean rating of 70.10. Then, formulation one (1) had a mean rating of 69.68. Formulation four (4), with a mean rating of 39.43 and the lowest mean rating of 36.41, was observed in formulation two (2).

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The result implies that Formulation Three (3), having the highest mean rating, was most favored by the respondents, who described the Lowland Kangkong-flavored rice cake wrapped in a Green-Stemmed Alugbati edible wrapper as being moderately aromatic.

Raj, Tapasya, Neetu Singh, and Alka Nanda (2024) conducted a sensory evaluation of fortified rice cakes incorporating various flours and dry fruit powder. Their study found that sensory attributes, including Aroma, significantly influenced overall acceptability, with specific formulations receiving higher aroma ratings that contributed to consumer preference, supporting the importance of formulation on aroma perception.

Table 7. Mean rating of Lowland Kangkong-flavored rice cake wrapped in Green-Stemmed Alugbati edible wrapper of different formulation in terms of color.

FORMULATION	N	Mean
1	30	77.88[a]
2	30	42.59[b]
3	30	78.574[a]
4	30	45.19[b]

[abcd]Means, there is a significant difference.

It can also be noticed in the table that formulation three (3) had the highest mean rating of 78.574 for the color, which is significantly different from the control of 3 formulations, followed by formulation one (1) with a mean rating of 77.88. Formulation four (4) had a mean rating of 45.19, and the lowest was observed in formulation two (2) with a mean rating of 42.59, as evaluated. The result implies that formulation three (3), with the highest mean rating, was most favored by the respondents, who described the Lowland Kangkong-flavored rice cake wrapped in a Green-Stemmed Alugbati edible wrapper as very much like in terms of color.

According to Del Rosario (2013), "puto" refers to a Filipino steamed rice cake that is typically white, round, and varies in size. It is commonly served with freshly grated coconut. Puto is often enjoyed as a merienda, a light snack typically eaten in the afternoon, but it can also be consumed for breakfast alongside coffee or hot chocolate. A popular way to enjoy puto is to pair it with "dinuguan" (pork blood stew) as a hearty afternoon snack. Incorporating local ingredients such as ube (purple yam) or pandan can alter the flavor and color of traditional puto, though these variations require additional preparation and adaptation of the recipe. A more straightforward method to flavor puto is by using flavored essences that also tint the cake—pandan essence imparts a light green hue, while ube essence gives a pale purple color. Additionally, food coloring can be used to enhance appearance without changing the original taste.

Table 8. Mean rating of Lowland Kangkong-flavored rice cake wrapped in Green-Stemmed Alugbati edible wrapper of different formulation in terms of overall acceptability.

FORMULATION	N		Mean
1	30		79.06[a]
2	30		35.50[b]
3	30		81.98[a]
4	30		39.87[b]

[abcd] Means, there is a significant difference.

The study's results revealed significant differences among the treatments. Formulation three (3) received the highest mean score of 81.98 for overall acceptability, followed by Formulation one (1) with a mean rating of 79.06. Formulation four (4) scored 39.87, while Formulation two (2) had the lowest mean rating of 35.50. This indicates that Formulation three (3), with its top mean score of 81.98, was rated as "Like Extremely" in terms of the overall acceptability of the product.

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According to the nine-point hedonic scale, all formulations were deemed acceptable, as their scores ranged between "Like Very Much" and "Like Extremely." Notably, significant differences were observed in the sensory qualities—Aroma, color, taste, Texture, and overall acceptability—between the control and the treatments with varying levels of Lowland Kangkong. The findings also show that respondents generally preferred the formulation containing the highest amount of lowland kangkong compared to the other three treatments, two of which included different proportions of lowland kangkong and one control sample without any kangkong. This suggests that incorporating varying quantities of lowland kangkong positively influenced the overall acceptability of the rice cake flavored with lowland kangkong and wrapped in green-stemmed alugbati, thereby enhancing the product's quality.

Just-About-Right Evaluation

Table 9. Mean sensory attributes for Lowland Kangkong-flavored rice cake wrapped in Green-Stemmed Alugbati edible wrapper.

Formulations				
Sensory attributes	F1	F2	F3	F4
Sweetness	Just About Right	A little too weak	Just About Right	Much too weak
Fluffiness	Just About Right	A little too unfluffy	Just About Right	Much too unfluffy

The table presents the mean scores based on the sweetness and fluffiness of the lowland kangkong-flavored rice cakes wrapped in green-stemmed alugbati edible wrappers. Based on the result, the sweetness and fluffiness of the Lowland Kangkong-flavored rice cake wrapped in a Green-Stemmed Alugbati edible wrapper were just about right.

According to Taylor et al. (2016), traditional rice cakes are created with fermented rice grains, water, and sugar. These rice cakes are sticky and dense in Texture, and are generally produced in small, bite-size pieces. Rice cake is a leavened steamed rice cake that is ideally also a spongy cake made from fermented parboiled rice, blended butter (80%), and black gram (20%).

Table 10. Summary table on the Lowland Kangkong-flavored rice cake wrapped in Green-Stemmed Alugbati edible wrapper.

Sensory Evaluation	Weighted Average	Description
Aroma	7	Like Moderately
Color	8	Like very much
Taste	8	Like very much
Texture	8	Like very much
Overall Acceptability	9	Like extremely
Sweetness	3	Just About Right
Fluffiness	3	Just About Right

The sensory evaluation summary indicates that the lowland kangkong-flavored rice cake, wrapped in an edible green-stemmed alugbati leaf, was rated as "Like moderately" for Aroma and "Like very much" for color, taste, and Texture. Overall acceptability received a rating of "Like extremely," while sweetness and fluffiness were judged as "Just About Right."

These results suggest that the innovative combination of kangkong-flavored filling with an alugbati leaf wrapper presents a promising alternative to traditional rice cakes. The favorable scores for Aroma, color, taste, Texture, and overall appeal imply that consumers may appreciate this product as a tasty and healthful snack option. The well-balanced sweetness and fluffiness further highlight its potential commercial success as a unique and nutritious food offering (Tan & Santos, 2021)

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Table 11. Significant Difference among Formulations

	Friedman		
	χ^2	**df**	**p**
	54.3	3	< .001
Pairwise Comparisons (Durbin-Conover)			
		Statistic	**p**
F1	- F2	7.29	< .001
F1	- F3	3.21	0.002
F1	- F4	4.70	< .001
F2	- F3	10.50	< .001
F2	- F4	2.59	0.011
F3	- F4	7.91	< .001

Table 11 presents a chi-square statistic of 54.3 with 3 degrees of freedom and a p-value of less than 0.001, indicating a highly significant difference among the groups or conditions tested. This result implies that at least one group's median ranking is significantly different from those of the others, leading to the rejection of the null hypothesis, which assumes that all groups have equal medians. Thus, the treatment or condition has a meaningful statistical impact on the measured variable. However, while the Friedman test identifies the existence of differences, it does not specify which groups differ, making further post-hoc analysis necessary.

Subsequent pairwise comparisons, conducted using the Durbin-Conover method, showed significant differences between most groups, except for the comparison between Formulation 2 (F2) and Formulation 4 (F4), which, although still significant, had a higher p-value of 0.011. These results demonstrate that the treatments yielded distinct effects, reinforcing the conclusion that significant differences are present.

According to Kuehl (2000), the Friedman test is beneficial for analyzing ordinal data that do not follow a normal distribution, or for small sample sizes—situations frequently encountered in fields such as behavioral science, clinical studies, and ecology. Because it uses ranked data instead of raw scores, the Friedman test is less sensitive to outliers and deviations from normality, enabling researchers to detect actual treatment effects without the need for data transformation or strict parametric assumptions.

Table 12. Cost Snd Return Analysis

The table displays the cost and return analysis for the Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in Green-Stemmed Alugbati (Basella alba L.) edible wrapper.

Cash Outflow

Particulars	**Quantity**	**Cost/Pesos/Unit**			**Receipt cost**
		AP	**% yield**	**EP**	
Lowland Kangkong	62.5 g	30/ kg		0.03	1.87
Alugbati	200 g	40/200 g		0.2	40
Cooked rice	500 g	45/ kg		0.045	22.5
Rice flour	1,000 g	55/ kg		0.055	55
Water	118 ml	15/350 ml		0.042	5.05
Coconut milk	472 ml	47/400 ml		0.1175	55.46
Evaporated milk	236 ml	236/370 ml		0.6378	150.52
Eggs	224 g	8/56 g		0.1428	32
White sugar	250 g	60/ kg		0.06	15
Vanilla Extract	18 ml	45/150 ml		0.3	5.4
Instant yeast	5.6 g	161/11 kg		0.16111	0.902216
Eden Cheese	165 g	53/165 g		0.3212	52.99
Clamshell/label					240

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Transportaion/charcoal Electricity					100
Labor					250
Production Cost					**P1,026.69**
Markup (20%)					**205.33**
Selling Price					**30 pesos**

AP = as purchased

% yield = edible portion weight/AP weight

Receipt Cost = EP × Quantity

Mark up = Total Receipt cost × Markup %

Gloss Rate F3 = 40 containers at P30.00 = P1,200

Net income

P1,200 – P1,026.69 = P173.31

Return on Investment

$\frac{P173.31}{P1,026.69} \times 100 = 16.88\ \%$

Table 12 shows that the listed formulation can produce 40 containers, each containing six pieces of Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in an edible wrapper made from Green-Stemmed Alugbati (Basella alba L.).

The recommended selling price is set at Php 30.00 per box, incorporating a 20% profit margin. Results indicate that Formulation 3 yielded a return on investment (ROI) of 16.88%, exceeding the 15% threshold and suggesting its potential as a profitable venture. Nonetheless, ROI has its drawbacks, notably its failure to consider the time value of money. To gain a more thorough financial assessment, it is recommended to use additional measures such as Net Present Value (NPV) or Internal Rate of Return (IRR).

SUMMARY

The study of the Lowland Kangkong (Ipomoea aquatica) -flavored rice cake wrapped in Green Stemmed Alugbati (Basella alba L.) edible wrapper was conducted at Sultan Kudarat State University- Isulan Campus, Kalawag II, Isulan, Sultan Kudarat.

This research aimed to assess the consumer acceptance of rice cakes flavored with Lowland Kangkong (Ipomoea aquatica) and wrapped in edible Green-Stemmed Alugbati (Basella alba L.) leaves. The study focused on evaluating key sensory characteristics, including aroma, color, taste, Texture, and overall appeal. Furthermore, it examined whether significant differences existed among the different formulations and conducted a return-on-investment analysis.

The study consisted of four Formulations, replicated three times, and was statistically analyzed. Data gathered in this study were statistically analyzed using Friedman's test. The instruments used for data gathering will be the Ranking Test and the 9-Point Hedonic Scale, which will gauge participants' responses to the various treatments in the experimental study.

The return on investment revealed that Formulation three (3) got the ROI of 16.88% percent.

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FINDINGS

The study's findings can be summarized as follows:

In terms of Aroma, notable differences were observed across the treatments. Formulation 3 achieved the highest mean score of 70.10, with formulation one closely behind at 69.68. Formulation 4 received a score of 39.43, while formulation 2 had the lowest average rating of 36.41.

Result implies that Formulation three (3), having the highest mean rating, was most favored by the respondents, who described the Lowland Kangkong (Ipomoea aquatica) -flavored rice cake wrapped in Green Stemmed Alugbati (Basella alba L.) edible wrapper as Like Moderately in terms of Aroma.

It can also be observed in the table that Formulation three (3) had the highest mean rating of 78.574 for the color, which is significantly different from the control of the three formulations. Followed by Formulation one (1) with a mean rating of (77.88), Formulation four (4) with a mean rating of (45.19), and the least was observed in Formulation two (2) with a mean rating of (42.59) as evaluated. The result implies that Formulation three (3), having the highest mean rating, was most favored by the respondents, who described Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in Green-Stemmed Alugbati (Basella alba L.) edible wrapper as "Like very much" in terms of color.

According to Del Rosario (2013), "Puto" refers to a traditional Filipino steamed rice cake that is typically white, round, and varies in size. It is commonly enjoyed with freshly grated coconut. Puto is often consumed as a light snack, known locally as merienda, especially in the afternoon, but it can also be served for breakfast alongside coffee or hot chocolate. A popular pairing is with "Dinuguan" (pork blood stew), making for a hearty afternoon treat. Incorporating local ingredients such as ube (purple yam) or pandan can subtly alter the flavor and color of puto, though this requires additional preparation and recipe adjustments. A more straightforward method to flavor puto is by using flavored essences that also tint the cake—pandan essence produces a light green hue, while ube essence imparts a soft purple color. Food coloring can also be added without changing the original taste.

The study found that Formulation 3 received the highest mean score of 75.60, followed by Formulation 1 with a mean score of 68.54. Formulation 4 scored 39.53, and Formulation 2 had the lowest rating at 34.36. These results indicate that Formulation 3 was the most preferred by respondents, suggesting that the Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in Green-Stemmed Alugbati (Basella alba L.) leaf was rated as "Like very much" in terms of taste.

The statistical analysis of Texture showed significant variations among the different formulations. Formulation 3 received the highest average score of 81.05, followed by Formulation 1 with a mean rating of 78.57. Formulation 4 scored 39.65, while Formulation 2 had the lowest rating at 39.34. These results indicate that respondents preferred Formulation 3 in terms of Texture, suggesting that the Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in Green-Stemmed Alugbati (Basella alba L.) leaf was rated as "Like Very Much" for its Texture.

According to Taylor et al. (2016), traditional rice cakes are created with fermented rice grains, water, and sugar. These rice cakes are sticky and dense in Texture, and are generally produced in small bite-size pieces. Rice cake is a leavened steamed rice cake that is ideally also a spongy cake made from fermented parboiled rice, blended with butter (80%) and black grams (20%).

According to Ji et al. (2013), it is known for its soft and sticky Texture and is commonly served as a dessert. After steaming and cooling, these goods are traditionally wrapped in polyethylene bags. It has a two-day shelf life and quickly loses its softness, becoming stale and hard.

Based on the study's results, significant differences were observed among the treatments. Formulation three (3) obtained the highest mean rating of 81.98 for the overall acceptability. Formulation one (1) had a mean rating of 79.06. Formulation four (4) had a mean rating of 39.87. The least was observed in Formulation two (2) with

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a mean rating of 35.50 as evaluated. This implies that Formulation three (3), having the highest mean rating of 81.98, was found to be "Like Extremely" as evaluated in Overall acceptability.

According to the nine-point hedonic scale, all formulas were considered acceptable since each score fell between "Like Very Much" and "Like Extremely". It can also be observed that there is a significant difference between the mean scores of sensory attributes (Aroma, Color, Taste, Texture, and Overall Acceptability) for the control with varying measurements of lowland kangkong. Results reveal that most respondents have a higher overall acceptability level for the formulation with the highest cups of lowland kangkong compared to three treatments: two of which utilized lowland kangkong at various proportions, and the other treatment served as the control, containing no lowland kangkong at all. This indicates that the addition of varying amounts of Lowland Kangkong (Ipomoea aquatica) positively affects the overall acceptability of the lowland kangkong-flavored rice cake wrapped in a Green-Stemmed Alugbati (Basella alba L.) edible wrapper, and would likely lead to an improvement in the product's quality.

The mean score based on the Sweetness and Fluffiness of Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in Green-Stemmed Alugbati (Basella alba L.) edible wrapper formulations yielded a result that was just about right.

The cost and return analysis revealed that formulation three (3) got the return on investment of 16.88 percent.

CONCLUSION

The researcher concludes that formulation three (3) with a combination of - 6.25g lowland kangkong leaf +1 alugbati leaf + 500g cooked rice +1,000g rice flour + 118g rice water rinse +427g coconut milk + 236g evaporated milk + 224g egg white + 250g white sugar + 18g vanilla extract +5.6g instant yeast + 10g cheese is the best formulation for processing of lowland kangkong (ipomoea aquatica) -flavored rice cake wrapped in green stemmed alugbati (basella alba l.) edible wrapper.

Based on the summary of sensory evaluation conducted, lowland kangkong (Ipomoea aquatica) -flavored rice cake wrapped in green stemmed alugbati (Basella alba L.) edible wrapper was "Like moderately" in terms of its Aroma and "Like very much" in terms of Color, Taste, and Texture. Like significantly in overall acceptability, "Just About Right" in terms of its sweetness and Fluffiness.

RECOMMENDATION

When preparing Lowland Kangkong (Ipomoea aquatica)-flavored rice cake wrapped in edible Green-Stemmed Alugbati (Basella alba L.) leaves, it is essential to simultaneously consider its Aroma, color, taste, Texture, and nutritional value.

This study encourages the use of healthier ingredients and eco-friendly packaging alternatives to reduce reliance on conventional paper and plastic wrappers.

The researchers strongly advise selecting fresh, high-quality ingredients and accurately measuring each component to ensure consistent and successful outcomes in any recipe.

It is recommended to establish a standardized recipe during product development to maintain uniformity in both quantity and quality.

When setting the product's price, adhering to consistent quality and quantity standards is crucial to achieve uniform results. Additionally, balancing the interests of both consumers and producers by maintaining fair market prices for ingredients and materials is important.

Microbial, Nutritional, and shelf-life analysis tests are recommended before selling the product to ensure consumer safety.

Encourage gathering feedback from a diverse range of people with different backgrounds to achieve stronger study results.

Environmental impact evaluation and assessment are also encouraged to support the sustainability of the product's ingredients.

Finally, selecting appropriate packaging should prioritize product safety. Packaging must not only be visually appealing but also protect the product from contamination and ensure a secure seal.

REFERENCES

1. Akinyele, I. O., & Akinlosotu, A. (1991). Effect of blanching and drying methods on the nutritional and sensory quality of Basella alba leaves. Plant Foods for Human Nutrition, 41(2), 151–154. https://doi.org/10.1007/BF02193935
2. Das, S., Mandal, M., Chakraborty, T., Bhattacharjee, S., & Das, N. (2015). Evaluation of antimicrobial and wound healing activity of Basella alba leaves. Journal of Ethnopharmacology, 175, 116–123. https://doi.org/10.1016/j.jep.2015.09.010
3. De Guzman, M. E., & Maghirang, R. G. (2018). Nutritional and therapeutic values of Basella alba in the Philippine diet. Philippine Journal of Agricultural and Biosystems Engineering, 16(2), 45–52.
4. Evoware. (2020). Seaweed-based packaging solutions for a sustainable future. https://www.evoware.id/
5. Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R., & Law, K. L. (2015). Plastic waste inputs from land into the ocean. Science, 347(6223), 768–771. https://doi.org/10.1126/science.1260352
6. Kumar, S., Kumar, D., Deshmukh, R. R., & Singh, N. (2012). Phytochemical screening and antioxidant activity of Basella alba leaves. Asian Pacific Journal of Tropical Medicine, 5(3), 182–186. https://doi.org/10.1016/S1995-7645(12)60025-4
7. Morales, J. P., Dizon, E. I., & Manuel, M. S. (2021). Potential of indigenous leafy vegetables in enhancing the nutritional quality of traditional Filipino snack foods. Philippine Journal of Nutrition and Dietetics, 58(1), 34–41.
8. Msonthi, J. D., & Magombo, C. (1983). Nutrient composition of edible wild plants in Malawi: The case of Basella alba. Journal of Food Composition and Analysis, 1(3), 223–227.
9. Raja, R., Babu, P., & Ganesan, S. (2013). Antioxidant activity and phytochemical analysis of Ipomoea aquatica leaf extracts. International Journal of Current Pharmaceutical Research, 5(2), 63–65.
10. Santos, K. J., & Valdez, M. A. (2020). Development of functional bakery products enriched with Alugbati (Basella alba L.) leaf extract. Philippine Journal of Science and Technology, 13(1), 11–18.
11. Sharma, S., Mishra, V., & Verma, A. (2013). Nutritional and medicinal values of Basella alba leaves: An overview. International Journal of Pharmacy and Pharmaceutical Sciences, 5(2), 32–35.
12. Tripathi, D., & Mishra, R. (2017). Pharmacological and therapeutic potential of Ipomoea aquatica — A review. Journal of Pharmacognosy and Phytochemistry, 6(5), 470–474.
13. Tan, M. T., & Santos, J. B. (2021). Evaluation of consumer preferences for alternative rice-based snack products. Journal of Food Science and Technology, 58(5), 1974–1981. https://doi.org/10.1007/s11483-020-02256-7
14. Kuehl, R. O. (2000). Design of Experiments: Statistical Principles of Research Design and Analysis (2nd ed.). Brooks/Cole. This textbook emphasizes the value of nonparametric tests like the Friedman test for analyzing related samples when normality assumptions are not met, especially with ordinal or skewed data and small sample sizes.