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Development and Acceptability of Kanduli (Arius Manillensis) Siomai: A Research-Based Culinary Innovation

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Abstract: This study aimed to develop Kanduli (Arius manillensis) Siomai as a research-based product, measure its acceptability, and integrate expert evaluators' feedback to improve its quality. A total of ten purposively selected expert evaluators from various food establishments in the Province of Rizal participated in the study. Utilizing a descriptive research method and developmental research design, the researchers documented the developmental process and incorporated expert feedback to refine the product. The findings revealed that the Kanduli Siomai underwent several trial-and-error stages before achieving its final, standardized version. Expert evaluations highlighted key areas for improvement, including ingredient selection and cooking techniques. Adjustments were made based on these suggestions, particularly to enhance the product's taste, texture, and overall appeal. The level of acceptability of the Kanduli Siomai was rated as "Much Acceptable" in terms of appearance, smell, taste, and texture. However, comments indicated that the taste did not strongly reflect the distinct flavor of Kanduli fish, which was instead perceived as having a pork-like taste. Suggestions for improving the product included steaming the fish with bay leaf and ginger to reduce its intense smell and improve tenderness. Opinions on the use of ginger varied, with some experts recommending more while others suggested less. Overall, this study highlights the importance of expert feedback in developing innovative food products. The process emphasized the value of iterative refinement to ensure the product meets both quality standards and consumer preferences.

Keywords: Kanduli (Arius manillensis); Siomai Development; Product Acceptability; Rizal Province; Freshwater Catfish; Abundant in Areas; Alternative Meat; Philippine Innovation.

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1. Introduction

Kanduli, a freshwater catfish abundant in areas near Laguna Lake, is known for its flavorful meat and numerous health benefits, including its rich omega-3 fatty acids and lean protein source. Traditionally prepared in dishes like adobo with coconut milk and kasubha, Kanduli offers versatility in creating innovative recipes with market potential in Philippine cuisine. Siomai, a

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popular Chinese dumpling widely embraced in Filipino culinary culture, is traditionally steamed or fried and served with condiments like garlic, chili oil, calamansi, and soy sauce. Inspired by its popularity, this study explores using Kanduli as an alternative meat for siomai, addressing the fish's oversupply while introducing a nutrient-packed, flavorful product. Aligned with the Philippine Innovation Act [14], which emphasizes innovation to support economic growth and empower local industries, this study highlights the potential of Kanduli Siomai to promote sustainable use of local ingredients, develop innovative food products, and enhance community well-being. The researchers aimed to create an acceptable research-based product by integrating expert feedback and utilizing local raw ingredients. This study seeks to engage consumers with a unique, healthy culinary experience while contributing to the evolution of Philippine cuisine and fostering community development.

1.1. Research Objectives

This study aimed to achieve the following objectives:

- To determine the development process of Kanduli (Arius manillensis) Siomai.
- To evaluate the level of acceptability of Kanduli (Arius manillensis) Siomai based on expert assessments in terms of:
    - Appearance
    - Smell
    - Taste
    - Texture
- To identify and implement improvements to Kanduli (Arius manillensis) Siomai based on the comments and suggestions of expert evaluators.

1.2. Research Gap

Despite the abundance of Kanduli (Arius manillensis) in Laguna Lake and its recognized health benefits, there has been limited exploration of its utilization in innovative food products, particularly as a meat alternative in siomai. While siomai is widely popular in the Philippines and commonly prepared with pork or shrimp, there is minimal research on using nutrient-rich and locally sourced fish like Kanduli to create a healthier and sustainable variation. Additionally, there is a lack of studies addressing the acceptability of such innovative products based on sensory attributes like appearance, smell, taste, and texture, as evaluated by experts. This study aims to bridge this gap by introducing and assessing Kanduli Siomai, contributing to the diversification of Philippine cuisine, and promoting the use of local ingredients in line with the goals of the Philippine Innovation Act [14].

2. Literature Review

Zickafoose et al. [17] emphasized that food innovations boost the market profit of the agri-food sector, enhance agricultural sustainability, and produce nutrient-dense foods. These innovations contribute to sustainable food production, food security, and healthier diets. Bouafou et al. [3] identified street food as a response to rapid urbanization, providing affordable and accessible food options while supporting local economies.

Rabadán et al. [15] discussed how reformulating traditional food items with healthier and sustainable ingredients addresses consumer demand for nutritious diets. Such efforts reduce environmental impacts and cater to health-conscious consumers. Similarly, Abitria [1] highlighted the fish processing sector's potential to create value-added products from by-products, promoting sustainability and addressing market demands driven by population growth.

Lagniton [7] reported that over 4.5 billion people globally derive at least 15% of their daily protein intake from fish, underscoring its importance in developed and developing nations. Fish production has a smaller carbon footprint than other animal production systems, making it a sustainable protein source. The Department of Agriculture's Bureau of Fisheries and Aquatic Resources encouraged fish consumption during high meat prices, highlighting fish as a healthier and more affordable alternative.

Several studies demonstrated the success of fish-based food innovations. Okereke [13] developed tilapia and catfish spring rolls using basic, affordable equipment, creating livelihood opportunities for small-scale entrepreneurs. Larina [8] explored using fish by-products in pasta production, resulting in nutrient-rich functional foods. Zebib et al. [6] evaluated wheat bread fortified with fish flour, addressing malnutrition through high-nutrient-density foods.

Siomai has been a popular snack in the Philippines due to its affordability, convenience, and adaptability. Cardaño et al. [4] traced its origins to Chinese cuisine, while Flores et al. [5] introduced pork siomai enriched with malunggay, emphasizing its health benefits. Borinaga et al. [2] and Maloloyon-Mones [9] developed squid and bamboo shoot siomai, respectively,

showcasing the versatility of siomai in incorporating various nutritious ingredients. Maté [10] highlighted fish vegetable siomai as a low-calorie, high-protein food enriched with vitamins and antioxidants.

3. Research Methodology

The study utilized descriptive and developmental methods of research. As Nikolopoulou [12] stated, the descriptive research method seeks to characterize or record the traits, actions, viewpoints, attitudes, or perceptions of a population or group being studied. It outlines a study or topic and clarifies the properties of the variables being studied and their responses. Descriptive research aims to determine whether Kanduli (Arius manillensis) Siomai was acceptable based on the responses of the expert evaluators.

Merano [11] mentioned that developmental research design is a specific approach to addressing basic questions and educating particular audiences. It seeks to provide an empirically based explanation of how a sequence functions, which is deemed a significant contribution to the knowledge of educators, curriculum designers, and educational researchers. Developmental research analyzes what changes and remains the same while examining how the study evolves and changes over time using various variables. This study employed developmental research to solicit and consider feedback, comments, and suggestions from expert validators for developing and improving Kanduli (Arius manillensis) Siomai.

The study's primary purpose was to discuss the development process, measure the acceptability level, and discuss the expert respondents' inputs to improve Kanduli (Arius manillensis) Siomai; thus, descriptive and developmental research methodologies were utilized. Descriptive research was used to determine whether Kanduli (Arius manillensis) Siomai was acceptable based on the responses of the expert evaluators. Developmental research was also used as the researchers solicited and considered feedback, comments, and suggestions from the expert validators for developing and improving the product [16].

4. Analysis and Discussions

Siomai in Filipino cuisine is not just a simple snack because of its affordability; it is also considered a symbol that the Chinese leave a huge impact on our cuisine. The fondness that we have for siomai is significant because it holds a bridge between two cultures. Eventually, different types of siomai took off in Filipino Cuisine as they reflected different cultural influences. Siomai was mostly made with pork, shrimp, or beef. Still, as time passed, people were looking for healthier options for siomai, so the researchers adapted this dish by utilizing locally caught fish. The researchers incorporate local ingredients and flavors to be introduced in the market. Kanduli was suitable for the main element of the siomai because of its mild flavor that was not overpowering in the whole dish. The firm white flesh gives siomai the right texture, high protein, and many health benefits that one cannot acquire in pork.

Kanduli was used in Filipino dishes despite its odor. The researchers used kanduli in siomai to inform the masses that unique local ingredients like kanduli can make siomai flavorful and nutritious. The key component of the product was Kanduli meat. Compared to traditional pork and shrimp siomai, it has an element that benefits the older consumer. Kanduli has less cholesterol, contains omega 3, and has many benefits that one can get. The researchers underwent different trials and errors to achieve the standardized recipe before it was introduced to experts. At first, the researchers tried to steam/boil the kanduli with ginger before proceeding with the siomai recipe. But as it goes through another steam, it gets crumbly, and its texture is like wet paper. Afterward, the researchers tried to marinate it with calamansi, and it worked. The problem was to find an alternative to turnip because the supply might be the issue. So, the panel suggested that the researchers substitute breadcrumbs, which worked fine. And the last trial was the one the researchers used in their entire validation and evaluation.

The preparation was simple, but it needed a lot of patience as the Kanduli was slimy. To get rid of that slimy texture of the skin, the researchers soaked it with water and vinegar mixture for about 5 minutes. As it absorbed the mixture, the slime came off easily and was ready for deboning. The ingredients used in preparing Kanduli (Arius manillensis) Siomai were Kanduli meat, carrots, onion, breadcrumbs, egg, oyster sauce, sesame oil, salt, pepper, and paprika. It accompanies the tangy sauce and contains soy sauce, sugar, water, calamansi, and sesame oil. The researchers peeled the skin, put a small amount of vinegar to lessen its slippery texture, and rinsed it.

The researchers marinated the meat with vinegar, ginger, and salt to remove its fish odor before proceeding with the siomai recipe. The researchers sliced the meat into small cubes to keep it tender as it cooks. In contrast to pork, Kanduli is very delicate as it gets cooked; its meat becomes crumbly if cooked too much. The Kanduli was the same as the usual siomai, but it was cooked for 10 to 12 minutes. It was highly recommended that these techniques be used to achieve the tenderness and juiciness of the siomai.

Table 1: Level of Acceptability of Kanduli (Arius manillensis) Siomai as Evaluated by the Experts to Appearance

Appearance **The Kanduli *(*Arius manillensis*)* Siomai …**	**Weighted Mean**	**Verbal Interpretation**	**Rank**
Features a thin translucent wrapper that displays the vibrant filling inside.	4.50	Very Much Acceptable	3
Highlighted the delightful garnishes of spring onion and fried garlic.	4.50	Very Much Acceptable	3
Proportionally formed, making it attractive.	4.80	Very Much Acceptable	1
Vibrantly gives a delicate appearance.	4.10	Much Acceptable	5
Overall, the appearance is appetizing.	4.50	Very Much Acceptable	3
Overall Mean	**4.48**	**Much Acceptable**	

The findings reveal in Table 1 that item number 3, "is proportionally formed, making it attractive," yielded the highest mean score of 4.80 and was verbally interpreted as Very Much Acceptable. On the other hand, item number 4 ranks last, "vibrantly gives a delicate appearance," resulting in a mean value of 4.10 with a verbal interpretation of Much Acceptable. The computed weighted overall mean score was 4.48 and verbally interpreted as Much Acceptable for all aspects on the level of acceptability to appearance. This means the product was generally implemented as the expert evaluators find researchers' products attractive, particularly because of their proportioned form.

The findings imply that the evaluators' attention was focused mostly on the product's packaging and that alone affected the product's appearance as it distracted the experts. Despite being widely seen as Very Much Acceptable, this immensely impacts the evaluation. However, the product's appearance and consistent size also leave an impression on the experts, indicating that it is promising to be introduced as a new, improved siomai. The findings agree with the study of Maloloyon-Mones [9], which states that siomai has a cheaper cost and can be sold in any market. However, delicate appearance must be highly prioritized.

Table 2: Level of Acceptability of Kanduli (Arius manillensis) Siomai as Evaluated by the Experts to Smell

Smell **The Kanduli (Arius manillensis) Siomai …**	**Weighted Mean**	**Verbal Interpretation**	**Rank**
Fill the senses with a good and balanced aromatic impression.	4.70	Very Much Acceptable	1
Has a pleasantly mild fish smell that adds an appetizing flavor.	4.20	Much Acceptable	5
Has a fragrant quality that gives a pleasing and unique smell.	4.30	Much Acceptable	4
Has an improved fragrance from the garnish, giving the kanduli siomai a mouthwatering aroma.	4.50	Very Much Acceptable	3
Offers a pleasant nutty flavor of sesame oil.	4.60	Very Much Acceptable	2
Overall Mean	**4.46**	**Much Acceptable**	

As shown from Table 2, it indicates that the overall weighted mean is 4.46 with a verbal interpretation of Much Acceptable. Item number 1, "fill the senses with a good and balanced aromatic impression," ranked 1st with a weighted mean of 4.70 and was interpreted as Very Much Acceptable. However, item number 2, "has a pleasantly mild fish smell that adds an appetizing flavor," got the lowest weighted mean of 4.20, verbally interpreted as Much Acceptable. Based on the result, a good and balanced aroma could be applied for the acceptability of kanduli siomai. It suggests incorporating a well-balanced smell from garnish and sesame oil, and the fish can give a mouthwatering and delightful aroma.

The findings imply that the fact that it is a Kanduli fish mostly affects the opinion of the experts. They already imagine that the product has a fishy smell. Perhaps the product lacks aroma based on the experts' preference, so it causes a huge blow to the overall evaluation. However, according to some of the experts' evaluations, the product received positive feedback, and it could be sold in the market and introduced as a continuity of a new innovative product from seafood, which was more affordable. It was congruent with the study of Rabadán et al. [15]; even with classic items, new alternatives have been established in response to the present need for sustainable and nutritious diets. Manufacturers can provide healthier options for an increasing number of customers who want to maintain a balanced diet by reformulating their products. The Kanduli (*Arius manillensis*) Siomai was a new variety of siomai that can be called a healthy version of pork siomai. It offers healthier food at a reasonable price.

Table 3: Level of Acceptability of Kanduli (Arius manillensis) Siomai as Evaluated by the Experts to Taste

Taste **The Kanduli (Arius manillensis) Siomai…**	**Weighted Mean**	**Verbal Interpretation**	**Rank**

Enhances a rich and fragrant blend of kanduli meat and vegetables, making it delightful.	4.50	Very Much Acceptable	3
Complements the overall flavor from the freshness of spring onion, a fragrant compound of fried garlic, and a tangy sauce.	4.60	Very Much Acceptable	1.5
Features flavors and a combination of savory and aromatic notes.	4.60	Very Much Acceptable	1.5
Pleasantly mild, imparting a delicate fish flavor that adds a nuanced touch to the siomai.	4.40	Much Acceptable	4.5
Features a strong nutty flavor that enhances the siomai, contributing to its enjoyment.	4.40	Much Acceptable	4.5
Overall Mean	**4.50**	**Very Much Acceptable**	

Table 3 shows that, in terms of taste, item two and item 3 "complements the overall flavor from the freshness of spring onion, a fragrant compound of fried garlic, and a tangy sauce" and "features flavors and a combination of savory and aromatic notes", both sharing the same mean value of 4.60. These were interpreted as Very Much Acceptable and jointly secured the 1.5 rank. Meanwhile, there was a tie for the last rank as well: item 4 "is pleasantly mild, imparting a delicate fish flavor that adds a nuanced touch to the siomai," and item 5 "features a strong nutty flavor that enhances the siomai, contributing to its enjoyment". Each option holds the same mean value of 4.40 and indicates a verbal interpretation of Very Much Acceptable. The overall mean value of taste was 4.50, interpreted as "Very Much Acceptable".

The data suggests that combining the freshness of spring onion, fried garlic, and the nutty taste of sauce can greatly impact the overall taste of the siomai. The product was generally implemented because of the flavorful taste of siomai that leaves an impression on evaluators and its aromatic notes from spices. This insinuates that some experts dislike the fishy aftertaste of the siomai, and they also pointed out that it lacks sesame oil. Although this criticism slightly hurt the review as a whole, it is useful in identifying the product's shortcomings. Despite this, the evaluation received positive feedback, and the researchers assume that it was enough reason to vouch for locally sourced fish to be introduced into the industry. This conforms with the Department of Agriculture's Bureau of Fisheries and Aquatic Resources study. It states that fish is a source of protein, and they urge people to consume more fish as there is a significant amount of supply. By the researchers' product, this could be the way to undertake the situation.

Table 4: Level of Acceptability of Kanduli (Arius manillensis) Siomai as Evaluated by the Experts to Texture

Texture **The Kanduli (Arius manillensis) Siomai …**	**Weighted Mean**	**Verbal Interpretation**	**Rank**
Shows tender yet slightly firm.	4.10	Much Acceptable	5
Features fresh spring onion and fried garlic that add a crunchy texture.	4.50	Very Much Acceptable	2
Showcases a thin and soft wrapper that is easy to bite.	4.40	Much Acceptable	4
Caters to a well-moist mixture.	4.50	Very Much Acceptable	2
The overall texture is the same as that of pork siomai.	4.50	Very Much Acceptable	2
Overall Mean	**4.40**	**Much Acceptable**	

As revealed in Table 4, three items resulted in second in rank. Item number 2 "features fresh spring onion and fried garlic that adds crunchy texture"; item number 4 "caters to a well-moist mixture"; and item number 5" overall texture was the same as the pork siomai." These options hold an identical mean value of 4.50 and were interpreted as Very Much Acceptable. On the other hand, the last rank has a weighted mean of 4.10 with a verbal interpretation of Much Acceptable, item number 1, which "shows tender yet slightly firm". The overall mean value of taste is 4.40, with a verbal interpretation of Much Acceptable. Based on the result in terms of texture, the siomai, if taken as a whole with freshly chopped spring onion, crunchy fried garlic, and a well-moist mixture, then the overall consistency was just right compared to the usual siomai. Although the siomai tenderness was quite questionable, it was still acceptable by some respondents.

The findings imply that, unlike typical siomai, the product's firmness and softness did not stand out. According to one of the experts, giving it a few minutes could help it get the softness it needs. Also, the wrapper for siomai needs to be thinner as it was not easy for some evaluators to bite. This affects the whole evaluation, which leads to Much Acceptable only. However, the overall affirmative answer from the experts builds up the chance to develop a new innovative product utilizing kanduli fish. This could help small businesses with just a small amount of money. The findings agree with the study of Okereke [13], who uses economical and locally available fish as the main ingredient for a newly introduced product that provides livelihood to entrepreneurs.

Table 5: Composite on the Level of Acceptability of Kanduli (Arius manillensis) Siomai as Evaluated by the Experts to Different Aspects

Aspect	Overall Mean	Verbal Interpretation	Rank
Appearance	4.48	Much Acceptable	2
Smell	4.46	Much Acceptable	3
Taste	4.50	Very Much Acceptable	1
Texture	4.40	Much Acceptable	4
Composite Mean	**4.46**	**Much Acceptable**	

The findings reveal that on the level of acceptability of Kanduli (Arius manillensis) Siomai, taste ranked 1 with an overall mean of 4.50 and was interpreted as Very Much Acceptable (Table 5). Next in line was an appearance with the verbal interpretation of Much Acceptable and an overall mean of 4.48. Rank 3 was the smell, with a total mean of 4.46 and interpreted as Much Acceptable. Lastly, texture, with an overall mean of 4.40, was interpreted as acceptable. The composite means on the level of acceptability of Kanduli (Arius manillensis) Siomai, as evaluated by the experts to different variables, was 4.46 and verbally interpreted as Much Acceptable. This means that the taste of Kanduli (Arius manillensis) siomai was the leading in terms of the acceptability of the product. However, as perceived by the experts, texture ranked last, though it was an acceptable feature as revealed by its computed weighted mean.

This insinuates that the texture needs improvement as it is not firm enough. Fish might be delicate enough, so achieving its firmness and texture was hard. The researchers used the evaluation as a chance to change what was lacking and improve what needed to be improved. And aim to get a high level of acceptability to support healthy eating habits and answer to malnutrition. This conforms with the study of Zebib et al. [6], who used fish to have flour blends to support those who were developing malnutrition. They aimed to get the right and high evaluation for the research to pass.

Table 6: Improvements made on Kanduli (Arius manillensis) Siomai based on the Comments and Suggestions of the Expert Evaluators

Aspects	Comments and Suggestions	Improvements Made
Smell	Instead of ginger, try using calamansi and bay leaf in the steamer to lessen the fish odor.	This reduces the fish smell even more and doesn't overshadow siomai.
Taste	Add a little bit of ginger, enhancing the flavor of siomai more. Add more pepper and lessen the ginger as it confuses the taste. There's a fishy aftertaste, especially if the sauce has no calamansi.	The researchers used vinegar to illuminate the fishy aftertaste. And lessen the use of ginger.
Texture	Add a couple of minutes and check its tenderness. The texture is different compared to pork siomai.	In order to match pork in texture, the researchers decided to shorten the cooking time.

Table 6 presents the improvements made on Kanduli (Arius manillensis) Siomai based on the Comments and Suggestions evaluated by the experts on the different aspects. The expert evaluators raised a few points regarding smell, taste, and texture. Some said that to have a tender consistency of siomai, it has to be steamed for a few more minutes. Their comments were based on what they prefer when they eat siomai, and their opinion was divided. The initial goal of this study was to determine the acceptability of Kanduli (Arius manillensis) Siomai, and the expert evaluators' feedback helps the researchers enhance their product. In this way, the product's potential was seen in the market and can be introduced in the food industry. The experts suggest putting ginger and bay leaf in the steamer to lessen the strong smell of Kanduli (Arius manillensis) Siomai and make it more appetizing. And give it more time to steam to achieve tender and juicy siomai. Kanduli (Arius manillensis) is a delicate meat, and this suggestion saves more time as researchers worry about its smell and texture. The expert evaluators' comments and suggestions contributed a lot to the improvement of the product. Researchers believe that the experts' remarks can greatly affect the trust of the future consumer as the product was already proven and tested by the experts.

5. Research Future Opportunities

- **Product Enhancement and Variation:** Further studies could explore variations of Kanduli siomai, such as incorporating other locally sourced fish or plant-based ingredients to improve nutritional value, taste, and texture. Testing different steaming methods or alternative seasonings could also help refine the product's acceptability.

- **Market and Consumer Acceptance:** Future research could focus on consumer acceptance in different regions, analyzing preferences for taste, texture, and aroma. Surveys or focus groups could assess how well the product performs in the market, considering price points and its potential as a healthy alternative to traditional siomai.
- **Nutritional and Health Benefits:** Given the increasing demand for healthier food options, studies could investigate the nutritional content of Kanduli siomai compared to other siomai varieties. This could include analysis of protein levels, fat content, and its suitability for diets aimed at combating malnutrition.
- **Shelf Life and Packaging:** Research into the shelf life of Kanduli siomai and the development of appropriate packaging solutions could ensure the product's viability for wider distribution. This could involve exploring preservation techniques that maintain freshness and taste.
- **Business and Entrepreneurial Impact:** Future studies could examine the economic feasibility of using Kanduli fish in siomai production, focusing on its potential to support small-scale businesses and local fisheries. Research could explore the socio-economic benefits for local communities involved in its production and distribution.

6. Conclusion

This study successfully developed Kanduli (Arius manillensis) Siomai through multiple trials and adjustments, incorporating expert feedback to create a standardized recipe. The product's acceptability, as evaluated by experts, was generally "Much Acceptable" in terms of appearance, smell, and texture, with taste receiving the highest level of approval. The final product demonstrated a promising balance of flavors and an appealing texture comparable to traditional siomai. Improvements based on expert suggestions, such as steaming with bay leaf and calamansi to address the fish's scent and adjustments to texture for tenderness, further enhanced the product. The product's potential marketability is evident, with positive feedback indicating its feasibility as a unique and innovative offering in the food industry. Overall, Kanduli Siomai holds strong potential for introduction into the market, contributing to the development of healthy, locally sourced seafood products and allowing small businesses to tap into a growing demand for nutritious alternatives.

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