Product Development and Acceptability of Squash–Oats Flouras a Siomai Wrapper

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ABSTRACT

This research paper explores the development of a squash-oats flour siomai wrapper as a healthier alternative to traditional flour-based wrappers, catering to the growing demand for nutritious food options. Squash was selected for its rich nutritional benefits, while oats offer essential carbohydrates, vitamins, and dietary fiber. The study aimed to identify the most effective combination of squash and oats flour and to establish suitable procedures for making the wrapper. Sensory acceptability was evaluated based on texture, aroma, taste, color, and overall satisfaction. To achieve this, various ratios of squash and oats were tested: 75% oats to 25% squash, 50% oats to 50% squash, and 25% oats to 75% squash.

For sensory evaluation, 50 Hospitality Management students from Saint Mary's University were selected through quota sampling. Each participant rated the wrapper samples, all of which were found to be "Very Much Acceptable." Remarkably, the wrapper made with 75% oats and 25% squash received the highest scores, highlighting its appealing taste and texture. These findings suggest that using a squash-oats combination can create a nutritious and enjoyable alternative to conventional siomai wrappers. In light of the increasing focus on health and well-being, this innovative product could contribute to healthier eating habits while maintaining the flavors that consumers love. The research emphasizes the potential for incorporating alternative ingredients into popular dishes, promoting a balanced diet without sacrificing taste

Keywords: nutritional value, acceptability, sensory evaluation

INTRODUCTION

The increasing focus on innovative and nutritious food products reflects the industry's continuous pursuit of healthier options for consumers (Rangavajla, 2025). In Nueva Vizcaya, a major producer of vegetables, an oversupply of squash arises during harvest seasons due to simultaneous cropping, leading many farmers to struggle with unsold produce and decreasing prices (Arnaldo, 2023). This waste prompts the need for innovative solutions to utilize excess squash effectively.

This study seeks to address this issue by developing a siomai wrapper made from squash and oats, which aligns with Sustainable Development Goals 12 (Responsible Consumption and Production) and 3 (Good Health and Well-being). The squash, rich in vitamins and fiber, is paired with oats to create a healthier alternative to traditional siomai wrappers while providing insights into market trends for squash products.

However, the research gap exists in the exploration of innovative value-added products from surplus vegetables in local markets. The proposed siomai wrapper not only addresses squash oversupply but also offers a gluten-free option catering to health-conscious consumers. It is created to have a soft texture and subtle sweetness, appealing to those looking for nutritious alternatives. This study aims to fill the gap by providing farmers and vendors with practical strategies for enhancing product offerings and marketability of surplus vegetables.

Conceptual and Analytical Framework: To establish a framework for the study, key terms are defined: Texture, aroma, taste, color, and overall acceptability are vital for evaluating food products. Texture includes properties like solidity and chewiness that affect preferences (EricT_CulinaryLore, 2024). Aroma is the specific smell of food, influenced by various factors (Calín-Sánchez & Carbonell-Barrachina, 2021). Taste is how the brain interprets signals from taste buds, identifying five main flavors: sweet, sour, salty, bitter, and umami (Naveeda, 2025). Color affects perceptions of flavor and enjoyment (Philips, 2023), while overall acceptability reflects consumer enjoyment (Samaron, 2025).

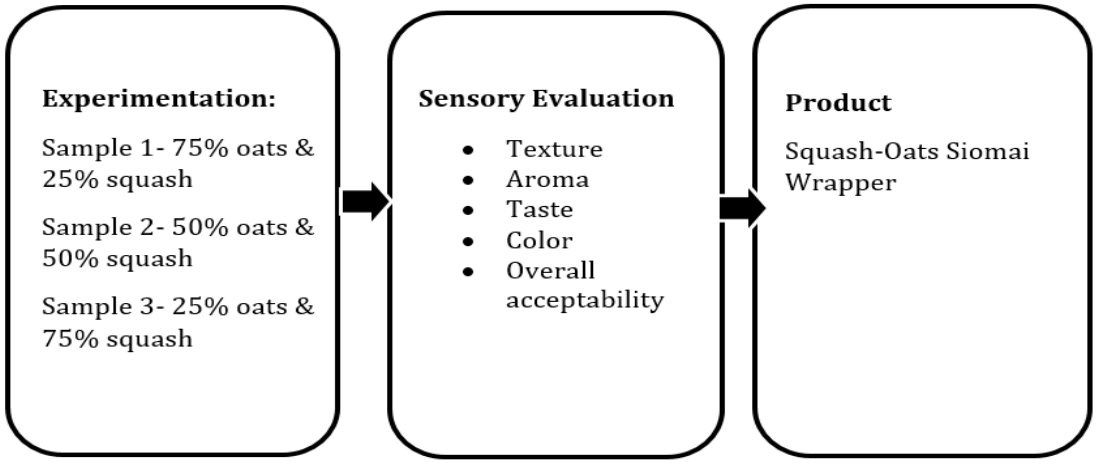

Figure 1: Research paradigm

Figure 1 showcases the development process of using squash-oats flour as a unique siomai wrapper. This innovative project involved testing three different proportions to arrive at an optimal recipe through systematic trial and error. Following the initial formulation, a sensory evaluation was conducted to assess key attributes such as texture, aroma, taste, color, and overall acceptability among participants. The final recipe incorporated pulverized oats and dehydrated squash as both flavoring and binding agents, which were combined with salt, egg, and water to create a pliable dough. This dough was then rolled out, cut into squares, and filled with seasoned pork, resulting in a delicious and nutritious siomai wrapper.

METHODOLOGY

This study used experimental and quantitative-descriptive method. A survey questionnaire evaluated the acceptability of the siomai wrapper based on texture, aroma, taste, color, and overall appeal. The experimental design tested different ratios of oats to squash to find the best ingredients and procedures. Descriptive feedback was also collected through open-ended responses. Quota sampling targeted 141 students from the Hospitality Management Department at Saint Mary's University, distributed as follows: 45 first-year, 40 second-year, 27 third-year, and 29 fourth-year students. A sample of 50 students was selected from the first, second, and fourth years, excluding third-year students, to participate in the study.

RESULTS AND DISCUSSIONS

Section 1. Ingredients and procedures in developing squash-oats flour as a siomai wrapper

In testing the acceptability of siomai wrapper, the following samples were considered:

Table 1. Results and Recommendations for the Three Sample

SAMPLES	PROCEDURE for 3 Samples	RESULTS	RECOMMENDATIONS
SAMPLE 1 (75% oats and 25% squash)	**Procedure for making Squash- Oats Siomai Wrapper** (a) Clean and sanitize your	**Trial & Error 1** ● Grainy (Usage of Rolled Oats)	● Use Instant Oats ● Use egg as binder

Ingredients: - 225g oats powder - 75g squash powder - ¼ tsp salt - 105ml water - 1 small egg - 4tbsp cornstarch for dusting	workstation, equipment, and utensils such as pasta machine, utility bowl, sifter, measuring cups and spoons, spoon and fork, rolling pin, and kitchen knife. Measure and prepare all ingredients. Organize ingredients properly according to the recipe; (b) Sift squash and oats flour into a large bowl, add salt and mix until incorporated. Create a well in the center and add the egg, gradually pour water while mixing using a wooden spoon until a dough forms. Divide the dough into four equal pieces; (c) Dust the surface with cornstarch. Take one-fourth of the dough and roll it slightly thin using a rolling pin. Feed the rolled dough through a pasta machine to flatten it evenly. Cut into 2.5 by 2.5 inches' square shapes; (d) Dust the wrapper with cornstarch and stack it. Refrigerate to keep them fresh; and (e) Maintain cleanliness and avoid contamination throughout the process. Repeat the process for each three-sample ratio (75% oats: 25% squash, 50% oats: 50% squash, and 25% oats: 75% squash).	● Crumbly and breaking dough (doesn't have binder)	
		Trial & Error 2 ● Dry dough	● Adjust the ratio of water.
SAMPLE 2 (50% oats and 50% squash) **Ingredients**: - 150g oats powder - 150g squash powder - ¼ tsp salt - 105ml water - 1 small-size egg - 4tbsp cornstarch for dusting		**Trial & Error 1** ● Grainy (Usage of Rolled Oats) ● Crumbly and breaking dough (doesn't have binder)	● Use Instant Oats ● Use egg as binder
		Trial & Error 2 ● Dry dough ● Wrapper is tearing apart	● Adjust the ratio of water.
SAMPLE 3 (25% oats and 75% squash) **Ingredients**: - 75g oats powder - 225g squash powder - ¼ tsp salt - 105ml water - 1 small-size egg - 4tbsp cornstarch		**Trial & Error 1** ● Grainy (Usage of Rolled Oats) ● Crumbly and breaking dough (doesn't have binder)	● Use Instant Oats ● Use egg as binder
		Trial & Error 2 ● Dry dough	● Adjust the ratio of water.

The table above presents the ingredients for the squash-oat siomai wrappers across three samples. Sample 1, consisting of 75% oats and 25% squash, was found to be crumbly, subtle, light yellow, nutty, and firm, earning high acceptance from both respondents and experts. Sample 2, with equal parts squash and oats, featured a

soft, funky aroma, vibrant color, balanced taste, and a soft, fragile texture. Sample 3, at 25% squash and 75% oats, exhibited a tender yet overwhelming aroma, deep yellow hue, and a rich flavor reminiscent of squash fritters.

Following a refinement of the ingredients and procedures, experts evaluated the samples and identified Sample 1 as the best alternative to the traditional siomai wrapper, rated very acceptable across most sensory factors. It was recommended to make this wrapper thinner for better resemblance to the classic version. While respondents favored Sample 1 for its taste, texture, and overall appeal, aroma remained a point of concern, with suggestions to incorporate aromatics like herbs or spices.

In conclusion, both experts and respondents preferred Sample 1 as the most acceptable squash-oats siomai wrapper. The only divergence was on aroma: respondents sought to diminish the squash smell, while the expert advocated for a subtle hint to highlight the main ingredient. Both sets of feedback proved valuable for enhancing the squash-oats siomai wrapper.

Procedure for making the Squash and Oats Flour (for all samples)

Below are descriptions of procedures for making oat and squash flour:

(a) Clean and sanitize the workstation, equipment, and utensils such as dehydrator, grinder, utility bowl, sifter, measuring cups and spoons, spoon, and spatula;

(b) Peel the squash, remove the seeds and wash it. Steam the squash until tender;

(c) Mash the steamed squash for dehydration, set the dehydrating temperature to 75 degrees for 10-12 hours; and

(d) Cut the dehydrated squash into small pieces, and grind the cut squash until fine and can be sifted. After repeated grinding and sifting if should become a fine squash flour. And for the oats, do the same procedure with the grinding and sifting. In order to avoid food contamination always clean the area before leaving.

Table 2. Ingredients and Procedure for Siomai Pork Fillings

Ingredients	**Procedure for Making Filling**
1 ½kg ground pork	(a) Gather all the necessary ingredients and tools. Weigh the ingredients accurately. (b) In a large mixing bowl, combine the weighed ingredients. Mix thoroughly until well incorporated to ensure even distribution of flavors; (c) Transfer the mixed filling into a container with a lid. Refrigerate it for approximately 30 minutes. The marinating time allows the flavors to meld and prevents sogginess when wrapping the siomai.
2 medium size carrot, minced	
1 whole bulb garlic, minced	
1 large red onion, minced	
3tbsp oyster sauce	
4tbsp soy sauce	
2tbsp sesame oil	
1tsp salt and black pepper	
2tbsp white sugar	
2 small-size eggs	
1 cup cornstarch	

The table presented above provides a detailed overview of the standard filling used for the siomai. It precisely outlines the ingredients and their respective quantities, offering a comprehensive understanding of the ingredients and procedure of the siomai filling.

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Assembling the Siomai:

a) Set up a clean surface. Gather your ingredients (wrappers and filling) and equipment (spoon, fork, and weighing scale); and

b) Take an individual wrapper. Weigh 10g of the filling. Spread the filling in the center of the wrapper. Using the handle of a spoon, push each corner toward the center to lock and form a square shape.

Section 2. The acceptability of squash and oats siomai wrapper in terms of texture, aroma, taste, color and overall acceptability

Table 3. The level of acceptability of the three samples of squash-oats wrapper

Criteria		f	Mean	SD	QD
Texture	Sample 1- 75% Oats : 25% Squash	50	3.48	0.50	Very Much Acceptable
	Sample 2- 50% Oats : 50% Squash	50	3.41	0.64	Very Much Acceptable
	Sample 3- 25% Oats : 75% Squash	50	3.52	0.66	Very Much Acceptable
	Total	150	3.47	0.60	Very Much Acceptable
Aroma	Sample 1- 75% Oats : 25% Squash	50	3.24	0.69	Acceptable
	Sample 2- 50% Oats : 50% Squash	50	3.16	0.67	Acceptable
	Sample 3- 25% Oats : 75% Squash	50	3.20	0.63	Acceptable
	Total	150	3.20	0.66	Acceptable
Taste	Sample 1- 75% Oats : 25% Squash	50	3.35	0.57	Very Much Acceptable
	Sample 2- 50% Oats : 50% Squash	50	3.50	0.55	Very Much Acceptable
	Sample 3- 25% Oats : 75% Squash	50	3.48	0.59	Very Much Acceptable
	Total	150	3.44	0.57	Very Much Acceptable
Color	Sample 1- 75% Oats : 25% Squash	50	3.42	0.74	Very Much Acceptable
	Sample 2- 50% Oats : 50% Squash	50	3.39	0.73	Very Much Acceptable
	Sample 3- 25% Oats : 75% Squash	50	3.34	0.73	Very Much Acceptable
	Total	150	3.38	0.73	Very Much Acceptable
Overall	Sample 1- 75% Oats : 25% Squash	50	3.48	0.51	Very Much Acceptable
	Sample 2- 50% Oats : 50% Squash	50	3.45	0.52	Very Much Acceptable
	Sample 3- 25% Oats : 75% Squash	50	3.30	0.73	Very Much Acceptable
	Total	150	3.41	0.60	Very Much Acceptable

On Texture

The table compares three samples with varying ratios of oats to squash, all rated as acceptable with an overall mean of 3.47. Sample 3, with 25% oats and 75% squash, had the highest mean rating of 3.52, followed by Sample 1 (75% oats and 25% squash) at 3.48, and Sample 2 (50% oats and 50% squash) at 3.41. This indicates that the texture of the siomai wrappers was well-received, especially for the higher squash content. Adelaïde et al. (2021) highlighted the potential of squash powder as a functional ingredient, while Mahmoud & Mehder (2022) noted the nutritional benefits of oats. The squash provided a rich, buttery smoothness, and the oats added a tender consistency, resulting in a preferred mouthfeel. According to EricT_CulinaryLore (2024), food texture significantly influences the overall sensory experience.

When the respondents were asked to recommend how the texture could be improved, the following verbatim responses were culled:

Mas maganda kung i-fried ng onti para ma-improve ang texture (Improving the texture by lightly frying the siomai).

Respondents recommended frying to enhance texture. Chen (2023) noted that the Maillard reaction gives fried foods a unique flavor and appeal. Dangal et al. (2024) highlighted that deep-frying improves taste and creates desirable crispiness in certain dishes.

On Aroma

Participants assessed the aroma of the squash-oats siomai wrapper as acceptable, with an overall mean of 3.20, noting a faint hint of aroma. Sample 1 (75% oats, 25% squash) received the highest mean of 3.24, followed by Sample 3 (25% oats, 75% squash) at 3.20, while Sample 2 (50% oats and squash) had the lowest rating among 50 respondents. Olfaction plays a key role in eating behavior by stimulating appetite (Boesveldt & Parma, 2021), and the aroma is vital for flavor perception (Rocha, Costa, & Martins, 2022). Squash emits a sweet, slightly nutty aroma, while oats have a warm, cereal-like scent (Stanko, 2023; Good, 2024). Oats' flavor is influenced by production and cooking processes (Porter, 2025).

When the respondents were asked to recommend how the aroma could be improved, the following verbatim responses were called:

Mas okay kapag mag add ng aromatics para ma-enhance yung amoy (It is better if aromatic was added to enhance the aroma) Okay naman, more improvement lngsa appetizing aroma (More improvement in making it appetizing aroma*)*

Rocha, Costa, and Martins (2022) emphasize the significance of food fragrance in consumer choices and its link to food safety and quality. Similarly, Mercadal et al. (2022) note that aroma alerts diners to a dish's presence and can attract them even before seeing the food. To enhance a dish's aroma, it's essential to use aromatic ingredients strategically, incorporating herbs, spices, or seasonings for a more appealing fragrance

On Taste

The developed squash-oats siomai wrapper was influenced by several factors, particularly taste. All samples were well received, with Sample 2 (50% oats, 50% squash) scoring the highest at 3.50. Sample 3 (25% oats, 75% squash) followed with 3.48, while Sample 1 (75% oats, 25% squash) had the lowest at 3.35. The preferred flavor balance in Sample 2, combining the nuttiness of oats and the sweetness of squash, contributed to its popularity. Balancing savory and sweet flavors requires careful practice and gradual adjustments (SGC Food Service, 2022).

When the respondents were asked to recommend how the taste could be improved, the following verbatim responses were culled:

Masarappero mas okay kapag maglagay pa po ng spices (Product's taste is good but maybe add more spices)*Dagdagan ng salt para mas malasa (*add more salt to enhance the flavor)

Taste is a fundamental sense that allows individuals to evaluate food flavors, including sweet, sour, salty, bitter, and umami (IQWiG, 2023). Enhancing taste involves balancing flavors and ingredients, with spices playing a key role in adding depth, preserving food, and improving safety by reducing spoilage risks (Otunola, 2021). Increasing salt and squash can create a richer flavor profile, as salt not only enhances taste but also balances sweetness and bitterness (Sandman, 2022)..

On Color

The sensory evaluation of color showed that Sample 1 (75% Oats: 25% squash) had the highest mean score of 3.42, followed by Sample 2 (50% Oats: 50% squash) at 3.39, and Sample 3 (25% Oats: 75% squash) with the lowest at 3.34. The overall mean score was 3.38, indicating that the samples were very much acceptable. The samples exhibited different shades of yellow: Sample 1 was light yellow, Sample 2 was bright yellow, and

Sample 3 was deep yellow. According to Chaudhary and Singh (2021), color is crucial in food quality, enhancing visual appeal and influencing consumer choices, while Francis (2023) notes its impact on taste perception.

When the respondents were asked to recommend how the color can be improved, the following verbatim responses were culled:

Make it more attractive, maganda tignan yung light na kulay kaysa sa dalawang dark (The light color looks better than the two dark ones)

Food color is well-known to affect the consumer's perception of the flavor of the food. It affects the aesthetics, safety, sensory characteristics, and acceptability of food. Color is a major contributor to the initial acceptance or rejection of food (Lynch, 2025). When food is observed before being tasted, the eyes send signals to the brain before the taste buds do, aiding in the understanding of its flavor and taste (Nanjundappa & Jayasimha, 2023).

On Overall Acceptability

The squash-oats siomai wrapper showed high acceptability among respondents. Sample 1, with 75% oats and 25% squash, received the highest mean score of 3.48, followed closely by Sample 2 at 50% oats and 50% squash with a mean of 3.45. Sample 3, consisting of 25% oats and 75% squash, had the lowest mean score of 3.30. As noted by Samaron (2025), sensory properties are crucial for food acceptance. By gathering consumer feedback and improving taste, aroma, and flavor balance, researchers can enhance the product's acceptability. Continuous refinement based on feedback can lead to greater consumer preference. When the respondents were asked to recommend how the overall acceptability can be improved, the following verbatim responses were called:

Masarap sya overall, need lng iimprove yung texture (it taste good overall but it needs more improvement when it come to texture)Masarap, the wrapper compliments the filling but the aftertaste it giving a slight bitter taste, I think it's because of squash

Rohan (2023) emphasized the significance of complementing food flavors, blending the science of taste with culinary creativity through innovative combinations. While some flavors harmonize, others can clash, leading to unpleasant tastes. Flavor compatibility is crucial, as certain flavors enhance each other (Sipkin, 2023). To ensure better acceptability, avoiding overcooking is vital. Zihad (2022) noted that overcooking oats can render them tough and rubbery, resulting in undesirable flavors and odors. Additionally, Grant (2021) explained that squash, due to its cucurbitacin content, can become increasingly bitter with higher concentrations, highlighting the need to wait until it is fully ripe to avoid a bitter aftertaste.

Overall, the findings highlight the interplay between these sensory attributes and the importance of consumer feedback in product development. By addressing the recommendations provided by respondents, specifically relating to frying technique, aromatic enhancements, flavor adjustments, and color modifications, further refinement of the squash-oats siomai wrapper can be achieved, likely increasing its marketability and consumer satisfaction. Continued research into these sensory aspects will be invaluable in optimizing the development of innovative food products that align with consumer preferences.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study evaluated three samples of squash-oats siomai wrappers with varying proportions: Sample 1 (75% oats, 25% squash), Sample 2 (50% oats, 50% squash), and Sample 3 (25% oats, 75% squash). The wrappers were made by grinding oats and squash into flour. Through systematic trials, Sample 1 emerged as the most preferred choice based on taste, texture, color, and overall acceptability, while it was also rated acceptable in aroma. This indicates that using oats and squash in siomai wrappers is a feasible and flavorful alternative to

traditional flour-based wrappers. The positive sensory evaluation, combined with the nutritional benefits of oats and squash, highlights the potential for innovative and healthy culinary options. Additionally, the siomai pork fillings complement the squash-oats wrappers well, creating a delicious dish.

Recommendations

Optimize the Oats and Squash Ratio. While all samples were rated as "Very Much Acceptable", there were slight differences in the average scores and standard deviations. Further research could be conducted to optimize the ratio of oats and squash for the best balance of taste, texture, aroma, color and nutritional value.

Consistency in Preparation. The detailed procedures for making the Oat and Squash Flour and the Oat and Squash Wrapper should be strictly followed to ensure consistency in the product. This includes maintaining cleanliness and sanitation practices throughout the process.

Explore Filling Variations. Although the Squash-Oats Siomai Wrapper goes well together with the Siomai Pork Fillings, experimenting with other filling combinations could offer diversity and accommodate various preferences of the market. This could involve stuffing made of seafood, vegetables or other meats.

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