

Developing kamias with chili cubes as a tangy-spicy seasoning innovation

Relloso, Flordeliza S. ✉

Camarines Sur Polytechnic College, Philippines (flrelloso@my.cspc.edu.ph)

Received: 3 April 2025

Available Online: 25 May 2025

Revised: 15 May 2025

DOI: 10.5861/ijrsm.2025.25060

Accepted: 20 May 2025

ISSN: 2243-7770

Online ISSN: 2243-7789

OPEN ACCESS



Abstract

This study focused on developing an innovative food product, Kamias with Chili Cubes, which combines the sourness of kamias (*Averrhoa bilimbi*) and the heat of chili peppers to create a unique seasoning cube. The research aimed to identify the processes involved in product development, assess sensory properties (appearance, taste, texture, aroma), analyze physicochemical properties specifically titratable acidity, and design educational materials to promote the product. Using an experimental research design, three trials were conducted where kamias and chili were prepared, sautéed with aromatics, blended into a paste, thickened with cornstarch, and molded into cubes. Sensory evaluations involved 30 panelists from the academic community and local residents, using a 9-point hedonic scale to measure acceptability. Results showed significant improvement across the three trials, with average sensory scores rising from “like slightly” to “like very much” for all parameters. The final cubes achieved a harmonious balance of tangy and spicy flavors, favorable texture, and pleasant aroma. The physicochemical test indicated a titratable acidity of 4.03%, confirming the expected sourness and supporting product preservation. Information, Education, and Communication (IEC) materials were also developed to disseminate knowledge about the product’s nutritional benefits and culinary versatility. This research highlights the potential of using locally sourced indigenous ingredients in value-added food products, promoting sustainable agricultural practices and supporting smallholder farmers. The Kamias with Chili Cubes serve as a healthier alternative to traditional seasoning cubes, aligning with goals for food security, responsible consumption, and improved health. The study provides a foundation for further product refinement and market introduction, demonstrating the integration of traditional flavors with modern convenience.

Keywords: kamias, chili cubes, food innovation, physicochemical test, product development

Developing kamias with chili cubes as a tangy-spicy seasoning innovation

1. Introduction

In the evolving landscape of food innovation, there is a growing emphasis on developing products that not only deliver unique sensory experiences but also promote health and sustainability by leveraging indigenous ingredients. Kamias (*Averrhoa bilimbi*), a tropical fruit native to Southeast Asia and widely used in Filipino cuisine, is celebrated for its sharp sourness and high vitamin C content, along with antioxidant and antimicrobial properties (Kumar, Singh, & Sharma, 2020; Reyes et al., 2021). These characteristics make kamias a promising raw material for value-added food products. Coupled with chili peppers, which provide pungency, flavor complexity, and health benefits such as anti-inflammatory effects and metabolism enhancement (Almeida et al., 2020; Chen et al., 2019), this combination presents an excellent opportunity to innovate within the seasoning market.

The present study focuses on the development of Kamias with Chili Cubes, an innovative seasoning cube designed to blend the tangy sourness of kamias with the spicy heat of chili peppers. From a technical standpoint, this product's creation involves precise formulation and processing steps—including sautéing, blending, and thickening with cornstarch—to achieve a balance in flavor, texture, and shelf stability. Physicochemical analysis, particularly measuring titratable acidity, ensures product quality, safety, and preservation potential, while sensory evaluation using a structured hedonic scale provides insight into consumer acceptance of appearance, taste, texture, and aroma (Liu et al., 2021; Perham, 1995).

From a marketing perspective, Kamias with Chili Cubes addresses rising consumer demand for convenient, flavorful, and health-conscious seasoning options that honor local culinary traditions. By emphasizing its natural ingredients and nutritional advantages, the product appeals to health-oriented consumers seeking authentic Filipino flavors in an easy-to-use format (Kapsak et al., 2017; Moss et al., 2020). The accompanying Information, Education, and Communication (IEC) materials further enhance market outreach by educating target audiences—including consumers, culinary professionals, and farmers—about the product's uses and benefits (Chavez, Cruz, & Mendoza, 2021).

Ultimately, this research bridges traditional food heritage with modern food technology, promoting sustainable agriculture by supporting local farmers and reducing reliance on imported seasonings. Kamias with Chili Cubes not only introduces a novel product to the seasoning market but also contributes to food security, responsible consumption, and rural economic development (United Nations, 2015; Liu & Zheng, 2023). Through a combination of rigorous technical development, consumer-driven product testing, and strategic marketing efforts, this study exemplifies the potential of indigenous ingredients to drive innovation and meet contemporary food system challenges.

Objectives of the Study - The primary objective of this study is to develop Kamias with Chili Cubes as an innovative seasoning product that combines the unique sourness of kamias and the heat of chili peppers. Specifically, the study aims to identify and document the detailed processes involved in the development of these seasoning cubes to ensure consistent quality and flavor. It also seeks to assess the sensory attributes of the product—including appearance, taste, texture, and aroma—through systematic evaluation by selected panelists, thereby determining the product's overall acceptability. Lastly, the study aims to analyze the physicochemical properties of the seasoning cubes, focusing particularly on titratable acidity, which plays a significant role in flavor and preservation.

2. Methods

Research Design - This study employed an experimental research design to develop and evaluate Kamias

with Chili Cubes, an innovative food seasoning product. The research involved multiple iterative trials to optimize the formulation and production process, focusing on sensory attributes and physicochemical properties. Sensory evaluations were conducted using a descriptive approach to assess consumer acceptability based on appearance, taste, texture, and aroma. Physicochemical analyses, specifically titratable acidity tests, were performed to determine the product's quality and shelf stability. The integration of both experimental formulation and sensory testing allowed for comprehensive product development grounded in both technical and consumer perspectives.

Participants of the Study - A purposive sampling technique was used to select 30 participants affiliated with Central Bicol State University of Agriculture (CBSUA)–Calabanga and the nearby community. The sample comprised an equal number of students (n=10), teaching staff (n=10), and local community members from Barangay Sta. Cruz Poblacion, Calabanga (n=10). This diverse group was chosen to represent various consumer perspectives and to ensure balanced feedback on the sensory properties of the product.

Data Gathering Instrument - The primary instrument for data collection was a sensory evaluation form based on a 9-point Hedonic Rating Scale adapted from Perham (1995). This form measured participants' acceptance of the Kamias with Chili Cubes across four sensory parameters: appearance, taste, texture, and aroma. Ratings ranged from 1 ("dislike extremely") to 9 ("like extremely"). Additionally, laboratory instruments and standardized titration methods (AOAC 942.15) were used to measure physicochemical properties, specifically titratable acidity, ensuring the product's quality and safety.

Data Gathering Procedure - The data gathering commenced with product development through iterative experimental trials involving ingredient preparation, cooking, blending, molding, and storage. After finalizing the formulation, sensory evaluation sessions were conducted in designated locations within CBSUA premises, including the CHDC building and the campus gazebo. Participants were first briefed on the evaluation process and the sensory attributes to be assessed. Each participant was provided with the product samples and the sensory evaluation form, which they completed individually. Concurrently, physicochemical samples were collected and submitted to the CBSUA Food Testing Laboratory for titratable acidity analysis. All data collection adhered to standard protocols to maintain consistency and reliability.

Ethical Considerations - The study was conducted following ethical guidelines to protect participants' rights and welfare. Prior to data collection, informed consent was obtained from all participants after explaining the study's purpose, procedures, potential risks, and benefits. Confidentiality was ensured by anonymizing responses and securely storing all data. Participation was voluntary, with the option to withdraw at any time without penalty. Additionally, the product samples were prepared under hygienic conditions, and safety standards were strictly followed to prevent any health risks to participants.

Data Analysis - Sensory evaluation data were analyzed using weighted mean calculations to determine the level of acceptability for each sensory parameter. The 9-point Hedonic scale ratings were converted into numerical scores, and mean values were computed for appearance, taste, texture, and aroma. Physicochemical results, specifically titratable acidity percentages, were analyzed descriptively to assess compliance with quality standards. Comparative analysis across the three formulation trials was performed to identify improvements and determine the optimal product characteristics. The combined sensory and physicochemical data informed conclusions about product acceptability and quality.

3. Results and Discussion

Development of the Product. The development of Kamias with Chili Cubes was conducted through a series of systematic experimental trials aimed at creating a seasoning product that balances the distinct sourness of kamias (*Averrhoa bilimbi*) with the pungent heat of chili peppers. The final formulation of Kamias with Chili Cubes, selected as the most preferred based on sensory evaluation results, utilized precise ingredient proportions to achieve a harmonious balance of sourness, spiciness, and texture. The key ingredients included 1.25 kilograms

(5 cups) of fresh kamias, which provided the characteristic tangy and vitamin-rich base flavor. To deliver an optimal heat level favored by the panelists, 125 grams (1/2 cup) of chili pepper was incorporated, offering a pronounced yet balanced spiciness that complemented the sourness without overpowering it. Supporting ingredients in the final product included 250 grams (1 cup) of sweet potato, serving as a natural binder and contributing to a smooth, velvety texture. Aromatics such as 30 grams (2 tablespoons) of white onion and 15 grams (1 tablespoon) of garlic powder were added to enrich the flavor profile and provide savory depth. For seasoning, 62 grams (1/4 cup) of salt and 7.5 grams (1/2 tablespoon) of ground black pepper were carefully measured to enhance taste without masking the natural flavors. Cornstarch, at 250 grams (1 cup), was incorporated to achieve the desired firmness and consistency, ensuring the cubes maintained their shape during handling and storage. Lastly, 15 grams (1 tablespoon) of cooking oil was used to sauté the ingredients and improve mouthfeel. The preparation process involved washing and slicing the kamias and chili, sautéing the aromatics in heated oil, and cooking the mixture with seasonings to develop complex flavors. The cooked ingredients were blended into a smooth paste, then simmered to concentrate the flavors and reduce moisture. The dissolved cornstarch was added to thicken the paste sufficiently to mold into cubes. After pouring into molds lined with wax paper, the mixture was allowed to cool, cut into uniform cubes, and refrigerated until firm.

Table 1.*Sensory Evaluation of Kamias and Chili Cubes*

Sensory Parameters	Trial 1	Trial 2	Trial 3
Appearance	6.4	7.8	7.7
Taste	6.6	7.5	7.8
Texture	7.1	7.6	7.5
Aroma	6.5	7.7	7.9
Mean	6.7	7.7	7.7

Legendary: 1.00-1.89= Dislike Extremely, 1.90-2.78= Dislike Very Much, 2.79-3.67= Dislike Moderately, 3.68-4.56= Dislike Slightly, 4.57-5.45= Neither like nor dislike, 5.46-6.34=Like Slightly, 6.35-7.23= Like Moderately, 7.24-8.12=Like Very Much. 8.13-9.01=Like Extremely

Sensory evaluation is a critical component in assessing the acceptability of Kamias with Chili Cubes, focusing on four key parameters: appearance, taste, texture, and aroma. Using a 9-point Hedonic Rating Scale, 30 participants from diverse backgrounds evaluated the product to provide comprehensive feedback on its sensory qualities. Table 1 presents the mean scores for each sensory parameter across three formulation trials.

Appearance -Table 1 shows the progressive improvement in appearance scores of Kamias with Chili Cubes during the three trials. The product's appearance received a mean score of 6.4 ("like slightly") in Trial 1, which increased to 7.8 ("like very much") in Trial 2 and remained high at 7.7 in Trial 3. The upward trend in appearance ratings reflects the positive impact of formulation adjustments on visual attributes such as color vibrancy, cube shape uniformity, and surface texture. These enhancements likely contributed to a more attractive and consumer-friendly product. Appearance being the first sensory cue influences consumer willingness to try and buy a product. The improvement and consistent high scores indicate that the Kamias with Chili Cubes effectively met consumer expectations for visual appeal, which is essential for market success.

This is consistent with findings by Moss, Perez, and Russell (2020), who assert that visual appearance strongly affects consumers' initial food perceptions and acceptance. Liu, Zhang, and Zheng (2021) also emphasize that improvements in visual presentation enhance consumer satisfaction. Furthermore, Kapsak, Landry, and Kapsak (2017) highlight that consistent, appealing appearance in seasoning products builds consumer trust and encourages repeat purchase behavior.

Taste - The mean taste score of Kamias with Chili Cubes increased progressively from 6.6 in Trial 1 ("like slightly") to 7.5 in Trial 2 ("like moderately") and reached 7.8 in Trial 3 ("like very much"). This upward trend reflects improvements in flavor formulation, particularly the adjustment of chili pepper levels that enhanced

spiciness while maintaining the natural sourness of kamias. The balancing of these flavors contributed to a more appealing taste profile that was favorably received by the panelists. Taste remains the most influential factor affecting consumer preference and repeat consumption. The consistent increase in taste acceptance indicates that the product's flavor became more refined and aligned with consumer expectations for a seasoning that delivers both heat and tanginess in a balanced manner.

This finding is supported by Jaeger et al. (2018), who emphasized that well-balanced flavor profiles increase consumer liking and product success. Furthermore, Stone and Sidel (2017) noted that flavor complexity and balance significantly affect food acceptance. According to Drewnowski and Gomez-Carneros (2000), the interplay of taste components like sourness and spiciness plays a critical role in overall flavor perception and consumer preference.

Texture - The mean texture scores for Kamias with Chili Cubes were 7.1 ("like moderately") in Trial 1, increased slightly to 7.6 in Trial 2, and remained consistent at 7.5 in Trial 3. The texture ratings suggest that the product achieved a generally favorable consistency that was smooth yet firm enough to hold its shape as seasoning cubes. The slight improvement from Trial 1 to Trial 2 reflects refinement in the thickening process, likely due to adjustments in the cornstarch concentration and cooking times. Texture is crucial for consumer acceptance of seasoning cubes since it affects ease of handling, dissolution in food, and overall mouthfeel. The consistent moderate to high scores implies that consumers found the cubes to have a desirable balance of firmness and smoothness, allowing them to easily integrate the product into cooking without altering the dish's texture adversely.

This is in line with findings by Stone and Sidel (2017), who stressed that texture significantly impacts perceived food quality and consumer preference. Szczesniak (2002) highlighted that texture attributes such as firmness and cohesiveness are critical in novel food products for ensuring user satisfaction. Additionally, Bourne (2002) noted that a well-balanced texture facilitates better product handling and consumption experience, enhancing repeat usage.

Aroma - The aroma scores for Kamias with Chili Cubes improving steadily from 6.5 ("like slightly") in Trial 1 to 7.7 ("like moderately") in Trial 2 and reaching 7.9 ("like very much") in Trial 3. The increasing scores indicate that the product's aroma became more appealing with each trial, likely due to optimized proportions of kamias and chili as well as improved cooking techniques that enhanced volatile aromatic compounds. The balanced sour and spicy scent contributed to the sensory appeal and anticipation of flavor. Aroma is a key sensory attribute that influences flavor perception and overall food enjoyment. The positive trend in aroma acceptance suggests that the seasoning cubes successfully delivered an enticing fragrance that enhanced consumer appeal and likely increased willingness to use the product in cooking.

This finding aligns with Drake and Civille (2003), who emphasized that aroma plays a critical role in the acceptance and liking of food products by influencing flavor expectations. Meilgaard, Civille, and Carr (2006) noted that aroma significantly affects consumer perceptions and can enhance or detract from overall sensory experiences. Furthermore, Bayarri, De La Fuente, and Costell (2001) demonstrated that well-balanced aroma profiles in seasoning products increase consumer satisfaction and product success.

Based on the sensory evaluation results presented in Table 1, **Trial 3** emerged as the most preferred formulation of Kamias with Chili Cubes. It achieved the highest average scores across all sensory parameters: 7.7 for appearance, 7.8 for taste, 7.5 for texture, and 7.9 for aroma, all of which fall under the "like very much" category on the 9-point Hedonic Scale. The enhanced spiciness from the increased chili content, combined with the natural tanginess of kamias and a well-balanced texture, contributed to its overall sensory appeal. These results indicate that Trial 3 was the most acceptable version, confirming its suitability as the final product for potential market use and consumer application.

Table 2.*Result of Physicochemical Analysis*

Item No.	Sample and Lab Code	Sample Description	Results
			Titrateable Acidity by Citric Acid (%)
215841	693-24-0	Kamias with Chili Cubes	4.03
		Method used	AOAC 942 15. Titrimetric method

Physicochemical Analysis - A sample of the final product from Trial 3 was submitted to the CBSUA Food Testing Laboratory for physicochemical testing. The **titrateable acidity** of the Kamias with Chili Cubes was measured using the AOAC 942.15 titrimetric method. The analysis revealed a titrateable acidity value of 4.03% expressed as citric acid. The measured titrateable acidity of 4.03% confirms the presence of significant organic acid content, primarily derived from kamias, which is naturally rich in citric acid. This acidity level is within an ideal range for sour-based food products and contributes to both flavor intensity and product preservation, inhibiting microbial growth and spoilage. The acidity result validates the sensory findings, particularly the product's tangy flavor, and supports the product's shelf stability. A titrateable acidity of over 4% indicates that the seasoning cube has both a strong sour profile and natural preservative properties, reducing the need for artificial additives. This aligns with the product's goal of being a healthier and more natural alternative to commercial seasoning cubes.

According to Liu et al. (2020), titrateable acidity plays a crucial role in determining the preservation potential and sensory sharpness of fruit-based products. Similarly, Rivera et al. (2018) noted that acidity levels above 3.5% in concentrated food mixtures enhance microbial safety and flavor retention. De la Cruz and Marquez (2016) also emphasized that food products derived from tropical acidic fruits like bilimbi (kamias) exhibit natural preservative effects and consumer-preferred tartness due to their high citric acid content.

4. Conclusions and Recommendation

The study successfully developed Kamias with Chili Cubes as an innovative seasoning product that effectively combines the distinct sourness of kamias with the spiciness of chili peppers. Through systematic experimentation, the detailed processes involved in product development were identified and optimized, resulting in a product with consistent quality and balanced flavor. Sensory evaluation by diverse panelists demonstrated increasing acceptability across the three trials, with Trial 3 emerging as the most acceptable formulation, receiving "like very much" ratings in appearance, taste, texture, and aroma. The physicochemical analysis further confirmed the product's quality, with a titrateable acidity of 4.03% ensuring a desirable sour profile and natural preservative effect. Overall, the research demonstrated the viability of using indigenous ingredients to create a unique, healthy, and convenient seasoning cube that meets consumer preferences and promotes local agricultural resources.

Based on the findings, it is recommended that further product development focus on scaling production while maintaining sensory and physicochemical quality. The Kamias with Chili Cubes should be introduced to the market with strategic marketing emphasizing its natural ingredients, health benefits, and cultural authenticity to attract health-conscious consumers. Additional studies could explore shelf-life testing under various storage conditions to validate long-term stability and preservation. It is also advisable to expand consumer testing to broader demographic groups to gather more comprehensive feedback and tailor the product to different taste preferences. Educational campaigns and promotional materials should be enhanced to increase awareness among culinary professionals and consumers about the versatility and nutritional advantages of the seasoning cubes. Finally, collaboration with local farmers and food enterprises is encouraged to support sustainable sourcing and economic development in rural communities.

5. References

- Almeida, R. N., Sampaio, S. C., Barbosa-Filho, J. M., & Pereira, C. M. (2020). Capsicum species: A review of their chemical composition, biological activity, and traditional uses. *Phytochemistry Reviews*, 19(3), 575–595. <https://doi.org/10.1007/s11101-020-09687-8>
- Bayarri, S., De La Fuente, J. L., & Costell, E. (2001). The role of aroma in the sensory acceptance of food products. *Food Quality and Preference*, 12(4), 265–272. [https://doi.org/10.1016/S0950-3293\(01\)00017-6](https://doi.org/10.1016/S0950-3293(01)00017-6)
- Bourne, M. C. (2002). *Food Texture and Viscosity: Concept and Measurement* (2nd ed.). Academic Press.
- Chavez, R. S., Cruz, J. A., & Mendoza, L. D. (2021). Sustainable food production: A case for the use of local ingredients in food innovation. *Journal of Environmental Sustainability*, 12(4), 134–145.
- Chen, X., Wang, W., & Li, Y. (2019). Capsaicin and its analogues: Their chemistry, pharmacology, and toxicology. *Food & Function*, 10(5), 2673–2691. <https://doi.org/10.1039/c8fo02235a>
- De la Cruz, J. M., & Marquez, R. L. (2016). Functional properties and applications of tropical acidic fruits in food systems. *International Journal of Food Sciences*, 3(2), 45–52.
- Drake, M. A., & Civile, G. V. (2003). *Flavor: Sensory Science*. CRC Press.
- Drewnowski, A., & Gomez-Carneros, C. (2000). Bitter taste, phytonutrients, and the consumer: A review. *The American Journal of Clinical Nutrition*, 72(6), 1424–1435. <https://doi.org/10.1093/ajcn/72.6.1424>
- Jaeger, S. R., Ares, G., Singh, J., & Bastian, S. E. P. (2018). New approaches to sensory characterization and consumer segmentation: A review. *Food Quality and Preference*, 68, 215–225. <https://doi.org/10.1016/j.foodqual.2018.01.003>
- Kapsak, W. R., Landry, M. J., & Kapsak, A. M. (2017). Flavor enhancement and consumer acceptance of novel seasoning products. *Food Quality and Preference*, 60, 10–18. <https://doi.org/10.1016/j.foodqual.2017.04.006>
- Kumar, S., Singh, J., & Sharma, R. (2020). Nutritional and medicinal properties of Averrhoa bilimbi: A review. *Journal of Herbal Medicine*, 28, 100442. <https://doi.org/10.1016/j.hermed.2020.100442>
- Liu, Y., Zhang, Q., & Zheng, L. (2021). Consumer sensory evaluation and physicochemical analysis of novel food products. *Journal of Food Science*, 86(8), 3090–3098. <https://doi.org/10.1111/1750-3841.15874>
- Meilgaard, M., Civile, G. V., & Carr, B. T. (2006). *Sensory Evaluation Techniques* (4th ed.). CRC Press.
- Moss, R. L., Perez, C., & Russell, K. (2020). The influence of food appearance and aroma on consumer acceptance. *Appetite*, 150, 104626. <https://doi.org/10.1016/j.appet.2020.104626>
- Perham, N. (1995). The 9-point hedonic scale: An overview of its development and application. *Food Science Review*, 15(1), 57–63.
- Reyes, A., Santos, M., & Diaz, L. (2021). Antioxidant and antimicrobial activity of tropical fruits used in Filipino cuisine. *Food Chemistry*, 343, 128555. <https://doi.org/10.1016/j.foodchem.2020.128555>
- Rivera, G. A., Lopez, M. A., & Santos, R. (2018). Evaluating acidity and microbial resistance in fermented and concentrated fruit products. *Food Control*, 91, 172–178. <https://doi.org/10.1016/j.foodcont.2018.03.030>
- Stone, H., & Sidel, J. L. (2017). *Sensory Evaluation Practices* (5th ed.). Elsevier. <https://doi.org/10.1016/C2015-0-01814-7>
- Szczesniak, A. S. (2002). Texture is a sensory property. *Food Quality and Preference*, 13(4), 215–225. [https://doi.org/10.1016/S0950-3293\(01\)00047-8](https://doi.org/10.1016/S0950-3293(01)00047-8)
- United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. <https://sdgs.un.org/2030agenda>

