International Journal of Agricultural Technology 2026 Vol. 22(4):1821-1834
DOI: https://doi.org/10.63369/ijat.2026.22.4.1821-1834
Available online http://www.ijat-aatsea.com
ISSN 2630-0192 (Online)

Potential of Kimju guava (*Psidium guajava* L. cv. Kimju) in bakery products for enhancing food security in Nonthaburi Province, Thailand

Nitiworakarn, S., Vanijajiva, O. and Rattanapittayapron, A.*

Faculty of Science and Technology, Phranakhon Rajabhat University, Bangkok, 10220, Thailand.

Nitiworakarn, S., Vanijajiva, O. and Rattanapittayapron, A. (2026). Potential of Kimju guava (*Psidium guajava* L. cv. Kimju) in bakery products for enhancing food security in Nonthaburi Province, Thailand. International Journal of Agricultural Technology 22(4):1821-1834.

Abstract The compositional characteristics and polyphenolic content of Kimju guava (*Psidium guajava* L. cv. Kimju) and its potential as a functional ingredient in bakery products developed in Nonthaburi Province, Thailand were studied. The Folin–Ciocalteu method was used to determine the total phenolic content (TPC) and values ranged from 185.4 to 242.7 mg gallic acid equivalents (GAE) per 100 g dry weight in the guava-enriched bakery samples, significantly higher than the control (74.3 mg GAE/100 g; $p < 0.05$). Results confirmed the richness of the fruit in bioactive compounds such as flavonoids and phenolic acids. Sensory evaluation revealed good acceptance from consumers, where bread added with 20% guava puree (32 g) and chiffon cake added with 60% guava puree (81 g) had the highest scores for overall preference in terms of colour, aroma, texture and taste. The addition of guava improved the nutritional quality by providing dietary fibre, vitamin C and antioxidants, and also enhanced the sensory attributes of bakery products, thus making them healthier alternatives to conventional formulations. These findings highlight the nutritional and economic values of Kimju guava, deserving its application in functional bakery products that may help diversify food, strengthen local food security and sustain agricultural economies.

Keywords: *Psidium guajava*, Bread, Chiffon cake, Food security

Introduction

In many developing regions food security is still a major issue. People need regular access to healthy, affordable and culturally appropriate food to stay well (Sundram, 2023). Fast urbanisation, changing diets and climate risks in Thailand point to the need for more diverse and resilient local food systems. Efficient use of agricultural resources and prioritisation of high-value products are important steps to promote nutrition and economic stability (Dwiartama *et al*., 2023).

Guava (*Psidium guajava* L.) is a tropical fruit of the Myrtaceae family. It is one of the important agricultural resources with high potential (Kareem and

* **Corresponding Author:** Rattanapittayapron, A.; **Email:** atiya@pnru.ac.th

Kadhim, 2024). Guava can grow in agroecological conditions and is well adapted to tropical and subtropical regions. The Kimju guava variety (P. guajava L. cv. Kimju) is one of the many guava cultivars that are distinctive in Southeast Asia. With a crisp texture, slight sweetness and pale pink to white flesh. These attributes have contributed to its popularity in fresh markets (Siwarungson *et al*., 2013). Its relatively low seed count and soft flesh makes it attractive for direct consumption, juice and other minimally processed products.

Guava is a functional fruit, rich in bioactive compounds including vitamin C, dietary fibre and several antioxidants. These nutrients may help support the immune system, regulate blood sugar, reduce inflammation and even help prevent certain diseases. The Kimju variety has shown a high level of antioxidants, a strong ability to inhibit tyrosinase, and higher concentrations of phenolic acids and vitamin C than other guava varieties (Kalyani *et al*., 2024; Kareem and Kadhim 2024). These traits increase its nutritional value and attractiveness to consumers and create new potentials for Kimju guava utilisation in functional foods and other value-added products. Kimju Guava is already grown and consumed widely in Thailand, particularly in Nonthaburi Province, but mostly enjoyed in fresh or traditional dishes. The use of Kimju guava in bakery products could help to expand its applications and increase its market potential and promote healthier eating through innovative food products.

Bakery products play an important role in modern food industry because of their wide cultural acceptance and high consumption frequency. The inclusion of guava into these products increases their nutritional value by adding essential vitamins, minerals and phytochemicals. Guava also has specific sensory properties which can increase consumer attractiveness (Mahajan *et al*., 2024). In addition, the production of bakery products from guava can improve local agricultural value chains, generate extra income for farmers and improve regional food self-sufficiency. The inclusion of guava in bakery products responds to the demands of consumers and to broader objectives of food security (Khalifa *et al*., 2016; Mahajan *et al*., 2024).

Guava is frequently wasted after harvest because of its rapid ripening and quality deterioration, resulting in significant economic and resource loss (Chen *et al*., 2024). Some of the surplus fruit is made into juice or jam but a lot is wasted which is a waste of resources. Bakery products from excess guava can reduce waste, open new markets and create value in the agri-food industry (Munir *et al*., 2025). Kimju guava from Nonthaburi Province was tested for its suitability in bakery products with particular attention paid to sensory properties such as taste and texture.

Materials and methods

Feedstock preparation

The Kimju cultivar of guava (*Psidium guajava* L. cv. Kimju) is shown in Figure 1. It was collected from Thanaphorn Garden, Nonthaburi Province, Thailand (14°03′46″N, 100°19′37″E). This cultivar was selected for bakery product development suitability. The fruits were harvested at the optimum physiological ripening to ensure high quality. These were processed into guava puree which was used as the main ingredient in experimental bakery formulations.

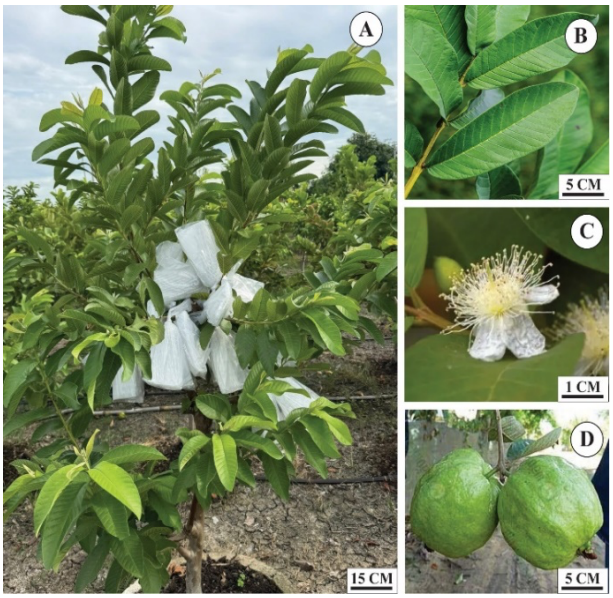

Figure 1. Appearance of Kimju cultivar, A. stem, B. leaves, C. flower, and D. fruits

Estimation of total phenolic content

Total phenolic content (TPC) was estimated by the method of Mahajan *et al.* (2024) with slight modification. 100 mg of the sample was extracted with 5 mL of methanol. Then, 1 mL of the extract was mixed with 7.5 mL of distilled water in a test tube. After mixing, 0.5mL Folin–Ciocalteu reagent (1 N) was added. The tubes were vortexed and incubated for 3 minutes. Then 1 mL of saturated sodium carbonate (35%) was added and the volume was made up to 10

mL with distilled water. The tubes were allowed to stand for 1 h and the absorbance was measured at 725 nm in a spectrophotometer. The total phenol content was determined using standard curve plotted with gallic acid and expressed as mg gallic acid equivalent (GAE)/100 g dry weight.

Guava developed a bakery product preparation

Two bakery products (bread and chiffon cake) were used to evaluate the potential of guava as an ingredient. Guava puree was used to replace some of the sugar and fat, making the products more nutritious. The guava pulp improved the bread dough and the fermentation times were changed due to the higher moisture content. Guava puree was added to the batter of the chiffon cake and the amount of flour and liquid was adjusted to obtain the right consistency and rise.

Guava bread preparation

The study utilised an experimental research design to formulate a standardised recipe of guava-enriched bread. The process was done in two phases: base recipe formulation and sensory evaluation. The first phase was the systematic adaptation of a bread recipe (Hamelman, 2021). The formulation contained bread flour, all-purpose flour, water, granulated sugar, milk, unsalted butter, yeast, salt, eggs and whipping cream as shown in Table 1.

Table 1. Comparison of ingredients across three selected basic bread and three basic chiffon cake recipes

Basic bread recipes				Basic chiffon cake recipes			
Ingredient	**Recipe 1**	**Recipe 2**	**Recipe 3**	**Ingredient**	**Recipe 1**	**Recipe 2**	**Recipe 3**
Bread Flour	360g	510g	160g	Cake Flour	90g	120g	135g
All-Purpose Flour	360g	-	-	Baking Powder	4g	6g	6g
Water	240ml	-	80ml	Sugar (Egg Yolk)	60g	135g	100g
Milk	240ml	240ml	-	Sugar (Egg White)	60g	12g	50g
Sugar	50g	100g	80g	Egg Yolk	54g	72g	54g
Yeast	20g	20g	6g	Egg White	90g	120g	150g
Salt	12g	3g	1.5g	Vanilla Extract	2.5ml	5ml	5ml
Shortening	1.5g	-	-	Salt	3g	3g	-
Unsalted Butter	-	115g	20g	Soybean Oil	40g	80g	60g
Whipping Cream	-	-	60g	Water	80g	-	-
Eggs	-	120g	-	Lemon Juice	-	-	10ml
				Cream of Tartar	2.5g	1.25g	-
				Fresh Milk	-	160ml	120ml

Three basic bread recipes were prepared, using similar procedures but different ingredients and processing methods. In recipe 1, bread flours and all-purpose flour were sifted together, then a mixture of water, milk, sugar, shortening and salt, was added while hot, before the yeast was mixed in. More flour was added and the dough kneaded for 10 minutes. Then let rise for 30 to 45 minutes, shaped and baked at 175°C for 30 minutes for recipe 2, the flour and salt were sifted, and the milk, butter and sugar mixture was heated to dissolve the sugar. It was cooled and then yeast and eggs added. Add the remaining flour and knead the dough for 10 to 15 minutes. Then it was proofed for 30 to 40 minutes, made into balls and brushed with egg wash and baked at 185°C for 15 minutes. Recipe 3 began by combining dry ingredients with water and whipping cream, then adding butter and mixing until smooth. The dough was rested for 30-60 minutes, divided into 8 balls and baked at 175°C for 25-30 minutes. Each recipe was evaluated for colour, aroma, texture, taste and overall preference. The sensory panel picked the best bread recipe.

Guava puree was added at 10%, 20% and 30% of the weight of flour to the basic bread formula. Then bread samples were evaluated for colour, aroma, texture, taste and overall preference. A consumer panel was used to rate the breads to determine the most preferable guava bread recipe. The results were used to determine the best guava bread.

Guava chiffon cake preparation

The purpose of this study was to develop the standard recipe of guava chiffon cake through experimental research. The work was divided into two major steps: developing the base recipe and then testing it through tasting. First, three chiffon cake recipes were modified from Talley (2021). The ingredients in each recipe were cake flour, baking powder, sugar, eggs, cream of tartar, lemon juice, vanilla, salt, soybean oil, fresh milk, and water (Table 1). The three chiffon cake recipes are similar in procedure, with minor differences in ingredients and baking conditions. Cake flour, baking powder and salt are sifted together in Recipe 1. The egg yolks are combined with sugar, vanilla, water and oil. Beat the egg whites with the cream of tartar and sugar to stiff peaks, then fold into the yolk mixture. The batter is baked for 30 to 35 minutes at 180°C. Recipe 2: Bake in a preheated oven at 170°C for 25-30 minutes. Recipe 3 is made the same way, except that the egg whites are mixed with milk and lemon juice and the cake is baked in the oven at 170°C for 25 minutes. The key to a light and airy texture is proper folding and mixing. Sensory evaluation assessed colour, aroma, texture, taste and overall preference. The results identified the optimum recipe.

After the first choice of the base recipe, the most preferred version was afterwards improved. Pureed ripe guava was added at 40%, 50% and 60% of the total weight of the cake. The guava chiffon cakes were evaluated for colour, aroma, taste, texture and overall preference. Consumer feedback identified the best formulation.

Sensory evaluation

Sensory attributes: colour, texture, aroma, taste and overall acceptance were determined by quantitative descriptive analysis. Untrained panellists aged 20–60 years were recruited from the local community, with equal numbers of male and female participants for each product. The organoleptic properties of bakery products with partial substitution of flour by guava powder were assessed in a standardised test room in the morning sessions from 9.00 to 12.00. Sensory evaluation of basic bread, guava bread, basic chiffon cake and guava chiffon cake was done on a 9-point hedonic scale with 1 being extremely dislike, 5 being neither like nor dislike and 9 being extremely like. Sensory evaluations were carried out in a controlled laboratory with sensory booths and fresh water for palate cleansing. The Acceptability Index (AI) was calculated following the method described by Castelo-Branco et al. (2017).

$$AI\ (\%) = (\text{Mean Score})/(\text{Maximum Score}) \times 100$$

For the bakery, whole wheat flour was used instead of the original flour in the method (Segura-Badilla *et al*., 2022). The experiment was carried out in randomised complete block design with triplicates and the statistical analysis was performed using SPSS software.

Statistical analysis

According to the experimental design, SPSS software (version 19) was used to perform statistical analysis of the data. All results were significant at the 0.05 level. Differences among groups were compared using the Least Significant Difference (LSD) method as recommended by Bate and Downham (2012). For each of these analyses, the substituted product was identified in each group to be evaluated by the sensory panel, which allowed a thorough and accurate interpretation of the data.

Ethical aspects

The authors mentioned that the sensory analysis was performed by volunteer panellists. Before the evaluation, they were fully informed about the

nature and procedures of the evaluation and gave their consent to participate. The authors also confirm that all food samples and ingredients used in the sensory evaluation were edible and completely safe for consumption, and clarify whether any substitutions of food samples or ingredients were made in the assessment.

Results

Compositional analysis and polyphenolic content of guava

The total phenolic content (TPC) of Kimju guava incorporated in bakery products was successfully investigated. The calibration curve obtained with gallic acid standards showed high linearity ($R^2 > 0.99$) and reliable quantification of phenolic compounds.

The results showed that bakery products added with Kimju guava puree had significantly higher phenolic content compared to the control group ($p < 0.05$). TPC of the enriched bakery samples of Kimju guava ranged from 185.4 ± 6.2 to 242.7 ± 5.8 mg GAE/100 g dry weight depending on the level of guava incorporation. The control samples without guava addition had only 74.3 ± 4.1 mg GAE/100 g dry weight.

The increase of TPC was attributed to the high antioxidant potential of Kimju guava that contains bioactive compounds like flavonoids and phenolic acids. The addition of guava to bakery formulations enhanced the nutritional profile and was conducive to food diversification strategies that might aid in the strengthening of local food security in Nonthaburi Province, Thailand. These results suggest that Kimju guava can be a potential functional ingredient for bakery products with additional health benefits and sustainable use of local agricultural resources.

Development of guava bread

Sensory evaluation played a key role in the development of the guava bread with clear preferences emerging among the consumers (Table 2). The three basic bread recipes were tried and recipe 3 was the favourite, especially for colour and texture. Recipe 1 was rated lowest, especially for taste, which was rated as neutral by most people, and recipe 2 received middle-of-the-road ratings. Overall, Recipe 3 was preferred and was selected for further development.

Table 2. Sensory evaluation scores for three basic bread recipes and the percentage of the guava in bread

Basic bread recipes						
Recipe	Colour	Aroma	Texture	Taste	Overall Preference	Average
1	5.60 ±0.14	5.65 ±0.12^{b}	5.45 ±0.18^{b}	4.80 ±0.11^{b}	5.30 ±0.12^{a}	5.36 ±0.18^{b}
2	7.35 ±0.18^{a}	6.55 ±0.13	6.80 ±0.12	7.20 ±0.12	7.20 ±0.18	7.02 ±0.12
3	7.60 ±0.12^{b}	6.80 ±0.22^{a}	7.10 ±0.13^{a}	6.90 ±0.15^{b}	7.15 ±0.28^{b}	7.11 ±0.16^{b}
% of Guava in bread recipes						
Guava percentage	Colour	Aroma	Texture	Taste	Overall Preference	Average
10%(16g)	6.40 ±0.18^{b}	6.05±0.12	6.35±0.16^{b}	6.40±0.16^{b}	6.75±0.12^{b}	6.28±0.48^{a}
20%(32g)	7.30±0.22	6.75±0.13^{a}	7.10±0.12	6.65±0.13^{a}	6.65±0.11	6.71±0.18
30%(48g)	7.30±0.15^{b}	6.45±0.15^{b}	6.40±0.22^{b}	6.10±0.17^{b}	6.20±0.15^{a}	6.49±0.15^{b}

Means in the same column with different superscript letters are significantly different at $p \leq 0.05$.

Guava concentrate was added at 10, 20 and 30 % of flour weight. The best sensory results were obtained with 32g of guava concentrate, which implies that this amount increased the taste of bread and was the preferred recipe among the evaluated options. After the basic recipe was approved, the composition of ingredients and the steps for preparation were modified to develop a western style of bread. The modified formula was 160 g of bread flour, 60 g of white sugar, 1.5 g of salt, 6 g of yeast, and 32 g of guava puree mixed in a mixing bowl. Then 90 mL water mixed with 40 g whipping cream was gradually added until the dough was formed. Then 20 g butter were added and kneaded into the dough for 15 to 20 minutes into a smooth, uniform mass. The dough was then formed into a ball and left to rest for 30 to 60 minutes or until it had doubled in volume. When the first fermentation was complete, the dough was divided into 8 equal portions and each portion was shaped into a ball. The pieces were placed on a baking sheet and proofed until they had risen to about 80% of their final volume. The surfaces of the dough were brushed with milk and baked at 180 °C for 30-35 minutes until they became golden brown (Figure 2A).

Figure 2. Guava bakery products of the Kimju cultivar: A. guava bread, B. guava chiffon cake

Development of guava chiffon cake

The development of guava chiffon cake was based on the results of the sensory evaluation and the differences of the consumer preference was evident (Table 3). Tested 3 basic recipes for chiffon cake. The third recipe was preferred in all sensory categories, especially in colour and aroma. Recipe 1 rated average and recipe 2 rated lowest, mainly for colour. Overall, Recipe 3 was the preferred option and was chosen for further development.

The sensory evaluation was done on guava chiffon cakes formulated with pureed ripe guava at 40%, 50% and 60% of the weight of cake flour. The panel evaluated colour, aroma, texture, flavour and overall preference. The cakes with 60% guava (which corresponded to 81 grams of puree) scored the highest for all sensory attributes and were the preferred by the panellists indicating high consumer acceptance.

The modifications were done on a basic chiffon cake recipe to get the desired characteristics of a guava chiffon cake. The process starts by sifting 135 g cake flour and 6 g baking powder with 100 g white sugar. In another bowl, 54 g of egg yolks, 120 g of fresh milk, 60 g of vegetable oil and 5 g of vanilla extract are whisked together and added to the dry ingredients. In separate bowl, beat 50 g egg whites with 10 g lemon juice then add 50 g white sugar gradually until stiff peaks form. Gently fold the egg whites into the batter. The mixture is poured into a cake pan, tapped to release any air bubbles and baked at 170 °C for 20–30 min until the cake has set completely and is of the desired texture (Figure 2B).

Table 3. Sensory evaluation scores for three basic chiffon cake recipes and the percentage of guava in the chiffon cake

Basic chiffon cake recipes						
Recipe	Colour	Aroma	Texture	Taste	Overall Preference	Average
1	7.70 ±0.28^{b}	6.75 ±0.12^{b}	6.70 ±0.22^{b}	6.95 ±0.11^{b}	7.05 ±0.12	7.03 ±0.18
2	5.95 ±0.22	6.00 ±0.11	6.60 ±0.13^{b}	6.90 ±0.12	7.00 ±0.12	6.49 ±0.17
3	7.40 ±0.22^{b}	7.40 ±0.12^{b}	6.90 ±0.15	6.85 ±0.12^{b}	7.00 ±0.15^{a}	7.11 ±0.13^{b}
% of Guava in chiffon cake recipes						
Guava percentage	Colour	Aroma	Texture	Taste	Overall Preference	Average
40% (54g)	7.55 ±0.22	7.20 ±0.11^{b}	7.05 ±0.15	7.10 ±0.13^{a}	7.25 ±0.21^{b}	6.19 ±0.18^{a}
50% (68g)	7.10 ±0.18	6.75 ±0.12	7.05 ±0.16^{a}	6.85 ±0.19	6.95 ±0.15	6.11 ±0.15
60% (81g)	7.05 ±0.18^{a}	7.10 ±0.13^{a}	7.20 ±0.14^{b}	7.10 ±0.18^{b}	7.15 ±0.17^{b}	6.43 ±0.16^{b}

Means in the same column with different superscript letters are significantly different at $p \leq 0.05$.

Discussion

The addition of Kimju guava to bakery products significantly enhanced the total phenolic content (TPC) from 74.3 mg GAE/100 g in the control to 185.4–242.7 mg GAE/100 g dry weight. This increase confirms the high concentration of bioactive compounds, including flavonoids and phenolic acids, in the Kimju guava, demonstrating its potential as a functional food ingredient. These results are in accordance with previous studies on the antioxidant potential of guava and its potential to improve the nutritional value of commonly consumed foods (Khalifa *et al*., 2016; Mahajan *et al*., 2024). Moreover, in Nonthaburi Province, where the guava is widely cultivated, the use of Kimju guava in bakery products provides an opportunity to diversify diets and improve food quality. The approach also enhances local food security and resilience of communities through the integration of traditional agricultural resources with modern food

innovation. Future studies should focus on the sensory acceptability, bioavailability and stability of phenolic compounds in bakery products fortified with guava to validate their functional food potential and facilitate wider adoption in local and regional markets.

The use of Kimju cultivar guava puree from Nonthaburi Province, Thailand in bakery products, such as bread and chiffon cake shows its potential as a functional ingredient. Guava-based bakery products are a good source of dietary fibre and immune and digestive health-promoting antioxidants (Kalyani, 2024). These nutritional properties are linked to a lower risk of chronic disease such as obesity, diabetes and cardiovascular disease (Zhao *et al*., 2016). The substitution of some quantities of sugar and fat with guava puree improves the nutritional quality of bakery products and provides them as healthier options to traditional bakery products that are mostly rich in refined sugars and fats. Moreover, the unique tropical flavour of guava contributes to the sensory properties of these products, which makes it a useful ingredient for many bakery products like bread, cakes and pastries (Mollestad and Jørgensen, 2017).

The use of guava in bakery products helps to promote local agricultural economies, particularly in areas where guava grows in abundance. This practice fosters food security, economic sustainability and reduction of food wastage (Sarma *et al*., 2018). The production of guava bread required modification of the baking process with the addition of the guava puree to compensate for the increased moisture content. The addition of guava at 10%, 20% and 30% of flour weight enhanced the sensory characteristics of bread. The 20% concentration (32 grams of guava puree) was most preferred due to its balanced texture, colour and aroma. The incorporation of guava puree (60%, 81 grams) in guava chiffon cake resulted in the highest sensory scores for colour, aroma and taste without affecting the light and airy texture of the cake. The results have shown the potential of guava as an ingredient to improve flavour and nutritional value, without affecting the product quality.

The present study also evidenced the great potential of guava as a functional ingredient to improve sensory and nutritional quality of bakery products (Khalifa *et al*., 2016; Mahajan *et al*., 2024). Further research is needed to build on these findings and to evaluate the applicability of guava in a broader range of bakery products such as pastries, cookies and muffins. Additionally, systematic evaluations of the physicochemical properties and microbiological stability of guava-enriched products during storage are necessary. Future research should also focus on optimising processing and preservation methods for retaining the nutritional and organoleptic qualities of guava. The research will bring novelty in the bakery sector and will contribute to the public health, by

allowing the development of functional bakery products with prolonged shelf life.

This study showed the potential of guava as functional ingredient in bakery products enhancing the nutritional value and sensory attributes. The addition of guava pulp and concentrate at different levels (10, 20 and 30% for bread and 40, 50 and 60% for chiffon cake) improved sensory characteristics significantly. The consumers most preferred guava concentrate (20%) in bread and pureed guava (60%) in chiffon cake. These results indicate that guava could be a healthier alternative to traditional bakery ingredients, imparting important nutrients such as dietary fibre and vitamin C, as well as improving flavour and texture. More research is required to explore the application of guava in other bakery products, to examine its long-term health benefits and enhance the processing methods to prolong its shelf life and nutritional values.

Acknowledgements

This study was funded by the Fundamental Fund (67A140000031) of Phranakhon Rajabhat University and Thailand Science Research and Innovation. We are very grateful to all participants for their valuable contributions, especially for the plant materials required for this work. We also acknowledge the very important contribution of Nakanate Ngampak during the fieldwork that has significantly enhanced our research.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

Bate, S. and Downham, M. (2012). Statistical methods for sensory evaluation: The least significant difference test. Journal of Sensory Studies, 27:272-283.

Castelo-Branco, V. N., Guimarães, J. N., Souza, L., Guedes, M. R., Silva, P. M., Ferrão, L. L., Zago, L. *et al*. (2017). The use of green banana (Musa balbisiana) pulp and peel flour as an ingredient for tagliatelle pasta. Brazilian Journal of Food Technology, 20: e2016119.

Chen, N., Wei, W., Yang, Y., Chen, L., Shan, W., Chen, J. and Wu, C. (2024). Postharvest physiology and handling of guava fruit. Foods, 13:805.

Dwiartama, A., Kelly, M. and Dixon, J. (2023). Linking food security, food sovereignty and foodways in urban Southeast Asia: cases from Indonesia and Thailand. Food Security, 15:505-517.

Hamelman, J. (2021). Bread: a baker's book of techniques and recipes. John Wiley & Sons.

Kareem, A. T. and Kadhim, E. J. (2024). *Psidium guajava*: a review on its pharmacological and phytochemical constituents. Biomedical and Pharmacology Journal, 17:1079-1090.

Kalyani, G. (2024). Medicinal and nutritional importance of *Psidium guajava* Linn. in human health. In: Medicinal plants and their bioactive compounds in human health: Volume 1, Springer Nature Singapore, pp.301-314.

Khalifa, I., Barakat, H., El-Mansy, H. A. and Soliman, S. A. (2016). Influencing of guava processing residues incorporation on cupcake characterization. Journal of Nutrition & Food Sciences, 6:513.

Mahajan, M., Dhillon, G. K., Bons, H. K., Singla, P. and Zahir, A. (2024). Nutrient-rich cookies enhanced with guava flour: Development and characterisation. Cogent Food & Agriculture, 10:2436134.

Mollestad, L. and Jørgensen, B. (2017). The role of tropical fruits in modern bakery products. Food Research International, 93:123-134.

Munir, S., Zia Ul Haq, M., Shafiq, S., Azeem, A. and Ali, I. (2025). From waste to value: traditional to innovative approaches for agricultural and food waste valorization. Journal of Material Cycles and Waste Management, 27:2119-2141.

Sarma, S., Bose, S. and Ghosh, R. (2018). The impact of guava on local economies and food security. Agricultural Economics Review, 12:201-213.

Segura-Badilla, O., Kammar-García, A., Mosso-Vázquez, J., Sánchez, R. Á. S., Ochoa-Velasco, C., Hernández-Carranza, P. and Navarro-Cruz, A. R. (2022). Potential use of banana peel (*Musa cavendish*) as ingredient for pasta and bakery products. Heliyon, 8.

Siwarungson, N., Ali, I. and Damsud, T. (2013). Comparative analysis of antioxidant and antimelanogenesis properties of three local guava (*Psidium guajava* L.) varieties of Thailand. Journal of Food Measurement and Characterization, 7:207-214.

Sundram, P. (2023). Food security in ASEAN: progress, challenges and future. Frontiers in Sustainable Food Systems, 7:1260619.

Talley, A. L. (2021). The chiffon trenches: a memoir. Ballantine Books.

Zhao, W., Zhang, Y. and Wu, C. (2016). Guava: a functional fruit for health. Journal of Functional Foods, 24:1-13.

(Received: 25 August 2025, Revised: 12 June 2026, Accepted: 2 July 2026)