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Nutritional composition, microbial quality, sensory characteristics and bioscience-based market potential of Lasam's traditional tinupig

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ABSTRACT

This study assessed the nutritional composition, microbial quality, sensory attributes, and bioscience-based market potential of tinupig, a traditional rice-coconut delicacy from Lasam, Cagayan, Philippines. Proximate analysis showed that tinupig contains appreciable crude fiber (7.67%) and crude protein (3.63%), indicating its potential contribution to dietary energy and digestive health. The moisture content (31.89%) suggests the need for improved packaging to enhance stability and shelf life. Microbial assessments revealed low aerobic plate count (16 CFU/g), minimal yeasts and molds (10 CFU/g), and acceptable *Escherichia coli* levels (<3.0 MPN/g), confirming the product's microbiological safety. Moderate coliform levels (123 MPN/g) indicate possible post-processing contamination, highlighting the need for improved sanitation. Sensory evaluation among 50 consumers showed high acceptability across aroma (8.42), taste (8.36), texture (8.22), and general acceptability (8.28). Cost analysis demonstrated a feasible profit margin of 33% per batch, supporting its viability for community livelihood. Overall, tinupig demonstrates strong potential as a culturally rooted food with promising nutritional, microbial, and sensory attributes, with improvements in hygiene and packaging recommended for broader distribution.

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INTRODUCTION

Tinupig, a traditional delicacy of Lasam in Cagayan Valley, Philippines, has long been valued for its characteristic sweetness, distinct preparation method, and cultural importance. Made from pounded glutinous rice combined with freshly grated coconut, shaped, wrapped in banana leaves, and grilled over charcoal, Tinupig represents a biologically rich food matrix composed of carbohydrates, dietary fiber, lipids, and other plant-derived functional compounds. Despite its popularity as a festive food and "pasalubong," the product has remained largely unchanged over generations, continuing to rely on traditional molding and packaging practices using wooden strips and recycled containers. As consumer interest shifts toward healthier, safer, and culturally rooted products, the absence of scientific evaluation highlights the need for bioscience-based investigations to support modernization without compromising authenticity (Del Mundo, 2013; Flores *et al.*, 2020).

Scientific assessment of Tinupig is essential for understanding its nutritional composition, microbial quality, and overall acceptability. Laboratory analyses—including measurements of moisture, macronutrients, ash, fiber, and energy value—are foundational in improving traditional foods, particularly rice- and coconut-based delicacies that are widely consumed across the Philippines. Prior studies on Filipino rice snacks show that coconut–rice combinations provide substantial energy and macronutrients but may require further characterization for micronutrients and diet-related properties (Santiago *et al.*, 2016). Alongside nutritional analysis, microbial safety evaluation plays a critical role, especially for small-scale producers who often rely on household-level preparation methods. Codex Alimentarius (2021) and Philippine FDA (2020) guidelines emphasize the importance of assessing total coliforms, aerobic plate counts, yeasts, molds, and *E. coli* to determine hygiene conditions and potential health risks. Research shows that microbial loads in kakanin-type products can be significantly reduced through improved sanitation, heat processing, and packaging (Guevarra *et al.*, 2017), making similar evaluations vital for Tinupig, particularly if it is to be introduced to wider retail or export markets.

Sensory evaluation further contributes to understanding consumer perception of Tinupig's flavor, aroma, texture, and visual qualities. Sensory-driven reformulation is a key strategy in food innovation, enabling traditional foods to adapt to modern preferences while preserving cultural identity. Studies indicate that any modification in ingredients or processing must maintain or enhance sensory attributes to ensure acceptance (Zhu *et al.*, 2015; Castro *et al.*, 2019). Evaluating consumer and expert responses to Tinupig's sensory profile provides valuable insights into its potential for product improvement, diversification, or commercialization.

Beyond its biological and sensory characteristics, Tinupig plays a meaningful role in regional food heritage and contributes to the local economy. Traditional foods have demonstrated value in strengthening food tourism, community identity, and rural development (Hall and Sharples, 2008). Promoting Tinupig as a cultural symbol of Lasam aligns with contemporary strategies for sustainable food tourism, where local products are elevated through standardized production, improved packaging, compelling narratives, and food safety compliance (Tolentino and Mendoza, 2021; DOST-FNRI, 2019). Modernizing Tinupig using evidence-based food processing and bioscience provides an opportunity to expand market reach, improve livelihood opportunities, and preserve culinary traditions.

The present study addresses existing research gaps by generating scientific data on Tinupig's nutritional properties, microbial safety, and sensory quality. While previous studies have commonly examined general rice-based snacks or other regional delicacies, there remains minimal research specifically dedicated to Tinupig. By integrating laboratory analysis, food safety assessment, and consumer-driven evaluation,

this study supports the enhancement of Tinupig as a culturally significant and biologically valuable food product. It also aligns with global development goals by contributing to food security, health promotion, sustainable production, and community-based economic growth—corresponding to SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-Being), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 17 (Partnerships for the Goals). Through science-guided modernization, Tinupig can maintain its heritage value while becoming a safer, more nutritious, and market-ready delicacy for future generations.

The general objective of the study is to determine the nutritional, microbial, and sensory characteristics of Lasam's traditional Tinupig, as well as its bioscience-based market potential.

MATERIALS AND METHODS

Preparation of raw materials

Tinupig, a traditional Filipino snack, was prepared using the following ingredients: 500 g powdered glutinous rice, 150 g brown sugar, 56.7 g butter, 200 g coconut strips, and 710 g water. The glutinous rice powder was thoroughly mixed with water in a large pot until a uniform consistency was achieved. Brown sugar, butter, and coconut strips were subsequently incorporated, and the mixture was homogenized. Portions of the mixture were placed onto banana leaves and rolled into compact packets.

The wrapped packets were baked in a pugon (traditional Filipino oven) or a preheated conventional oven at 180 °C for 30–45 minutes, until the banana leaves were slightly charred and the contents fully cooked. After baking, the packets were allowed to cool prior to unwrapping and further analyses.

Proximate analysis

Samples (250 g per batch) were collected in clean plastic containers and transported to the Regional Food Technology Development and Incubation Center, Department of Agriculture–RF02. Proximate composition was determined following standard published methods for crude protein, crude fiber, crude fat, moisture, and ash content. Additionally, serving size and nutritional facts were calculated based on these analyses.

Crude protein determination

Crude protein content was analyzed using the Kjeldahl method, which estimates total nitrogen in the sample and converts it to protein. A 20 g sample of Tinupig was subjected to digestion, distillation, and titration. Protein content was expressed as a percentage of total sample weight. The results provide an estimate of nitrogenous compounds in the product and can inform future fortification strategies to enhance protein content.

Fat and fiber determination

Fat and fiber contents were measured using the Filter Bag Technique (Ankom Apparatus 200). Lipids were extracted, evaporated, and expressed as a percentage of the sample weight. Fiber content was determined enzymatically; non-fiber components were hydrolyzed, and the remaining fiber was dried and weighed. Both soluble and insoluble fibers were quantified to assess their contribution to digestion and nutritive value.

Moisture and ash determination

Moisture content was determined gravimetrically by drying a 250 g sample at 105 °C to constant weight. Ash content was measured by combusting the sample at 550 °C to remove organic matter; the remaining inorganic residue was weighed to calculate mineral content. Moisture and ash levels provide insight into product stability, safety, and nutritional value.

Nutritional facts and serving size

Serving size and nutritional composition, including calories, calories from fat, total fat, protein, crude fiber, and carbohydrates, were calculated based on proximate analysis with assistance from the Department of Agriculture–Food Technology Division.

Microbial analysis

Microbial quality was assessed using the Compact Dry Method (CDM) at the Regional Food Technology Development and Incubation Center, Department of Agriculture – Region 2, Carig Sur, Tuguegarao City, to ensure product safety and compliance with food standards.

RESULTS AND DISCUSSION

Proximate analysis

The proximate composition of Tinupig is presented in Table 1. The sample exhibited a crude protein content of 3.63%, crude fiber 7.67%, crude fat 4.84%, moisture 31.89%, and ash 0.52%.

The fiber and protein contents indicate potential benefits for digestive health and metabolic function. The high moisture content, characteristic of semi-moist foods, may reduce shelf life and influence texture, emphasizing the need for moisture-proof packaging. Fat content, although slightly above recommended levels, is acceptable when consumed in moderation, contributing to palatability and energy. The low ash content indicates limited mineral content, suggesting that future fortification with mineral-rich ingredients could enhance nutritive value. These findings are consistent with previous studies on traditional rice-based snacks (Micha *et al.*, 2017; Astrup *et al.*, 2020).

Table 1. Proximate analysis of cacao tinupig

Lab. No.	Sample description	Crude protein, %	Crude fiber, %	Crude fat, %	Moisture, %	Ash, %
FT-24-0348	Tinupig	3.63	7.67	4.84	31.89	0.52

Nutritional facts of Tinupig

The nutritional content of a 20 g serving of Tinupig is summarized in Fig. 1. Each portion provides approximately 60 kcal, 1 g of fat (13 kcal from fat), 11 g carbohydrates, 1 g crude fiber, and 1 g protein, contributing modestly to daily nutrient requirements. These values suggest that Tinupig is suitable as a light snack, providing a balanced intake of energy, fiber, and macronutrients. The nutritional profile can guide consumers in integrating Tinupig into a varied diet while supporting overall health.

Fig. 1. Nutrifacts of the tinupig product

Microbial analysis

Microbiological assessment results are presented in Table 2. Total coliform count was 123 MPN/g, indicating moderate bacterial presence potentially from post-processing handling. Aerobic Plate Count (APC) was low at 16 CFU/g, and yeasts and molds were minimal at 10 CFU/g. *Escherichia coli* was below detectable limits (<3.0 MPN/g), complying with Philippine FDA and Codex Alimentarius safety standards. These results suggest that proper cooking and moisture control contribute to microbial stability, whereas post-processing hygiene should be improved to reduce coliform contamination (Jay *et al.*, 2019; Kumar *et al.*, 2022; Srey *et al.*, 2015; Rodrigues *et al.*, 2020).

Table 2. Microbial analysis of tinupig

Sample code	Sample description	Test method	Result
MIC-1154	Tinupig	Total coliform count	123 MPN/g
		Aerobic plate count	$1.6x10^{1*}$CFU/g
		Yeasts and molds	$1.0x10^{1*}$CFU/g
		Escherichia coli count	<3.0 MPN/g

Profile of the respondents

The study surveyed 50 participants from Cagayan State University–Lasam Campus, the Local Government of Lasam, and Lasam Academy Incorporated.

Table 3. Socio-demographic profile of participants

	Category	Frequency (n=50)	Percentage (%)
Sex	Male	14	14
	Female	36	36
Age	15-20	7	7
	21-25	12	12
	26-30	10	10
	31-35	6	6
	36-40	2	2
	41-45	3	3
	46-50	4	4
	51-55	3	3
	56-60	0	0
	61-65	3	3
	66-70	0	0
Consumption of tinupig	Yes	47	47
	No	3	3
Innovations or new flavors of tinupig	Yes	44	44
	No	6	6
Frequency consumption of tinupig	Daily	3	3
	Once to twice a week	20	20
	Multiple	27	27
Tinupig characteristic	Attractive Appearance	20	20
	Flavor	15	10
	Health benefits	10	10
	Others	5	5

Female participants comprised 36% of the sample, while males comprised 14%.The largest age group was 21–25 years (12%). Most respondents (47%) regularly consumed Tinupig, and 44% expressed interest in trying innovative flavors. Frequency of consumption was highest among those consuming the product several times per week (27%). Flavor, health benefits, and appearance were the primary factors influencing consumer preference (Table 3). These results indicate a loyal consumer base, with potential market expansion through product innovation and health-oriented formulations (Ghosh *et al.*, 2021; Singh *et al.*, 2019).

Test result of the sensory evaluation of the experimental product

Sensory evaluation of Tinupig had high mean scores for all the attributes, which ranged from 7.96 for appearance to 8.42 for aroma indicating very satisfactory consumer acceptability for all attributes. However, the presence of standard deviations, which has the largest standard variation (SD = 0.999149), indicating the level of homogeneity of consumer responses for most of the attributes.

Table 4. Computed mean, standard deviation and t-test result of the sensory evaluation of the experimental product

Category	Tinupig		t-test
	Mean	SD	
Appearance	7.96	0.9991493	11.27
Color	8.18	0.7266782	15.92
Aroma	8.42	0.6770032	17.59
Taste	8.36	0.8340133	14.18
Texture	8.22	0.8232382	14.12
Mouthfeel	8.28	0.8416254	13.91
General Acceptability	8.28	0.6770032	17.30

*significant at p=0.05

Table 5. Costing and product generation of tinupig

Item	Quantity per batch	Unit cost (₱)	Total cost (₱)
Glutinous rice	500 g	30.00	30.00
Coconut milk	250 mL	15.00	15.00
Sugar	100 g	10.00	10.00
Butter	50g	5.00	5.00
Banana leaves (wrapping)	20 pcs	0.50 each	10.00
Fuel/Utilities	-	-	5.00
Labor	-	-	20.00
Packaging (decorative box)	1	5.00	5.00
Total production cost	-	-	100.00
Product generation			
Selling price per Box (20 pcs): ₱150.00			
Production cost per batch: ₱100.0			
Profit per batch: ₱150.00 – ₱100.00 = ₱50.00			
Profit margin: (₱50 ÷ ₱150) × 100 = 33.33%			

Data analysis using t-test showed that the difference between the groups being compared was statistically significant (p<0/05) for all sensory quality attributes. The high t-values also indicate more of these differences, indicating the differences observed in sensory scores were not likely chance ones. These results strongly suggest that, in the resulting chocolate, the Cacao Tinupig variety contributes in large part to the sensory profile (Table 4).

Costing and product generation of tinupig

The production cost analysis (Table 5) indicated that one box of Tinupig (20 pieces) can be produced at ₱100, with a selling price of ₱150 yielding a 33% profit margin. Ingredients (glutinous rice and coconut milk) and labor represented the largest cost components. Economies of scale, bulk procurement, and optimization of production processes may improve profitability.

These results suggest that small-scale Tinupig production is economically viable and could provide a sustainable income source for local producers while preserving cultural heritage.

CONCLUSION

The present study demonstrates that Lasam's Traditional Tinupig exhibits favorable nutritional, microbiological, and sensory characteristics, supporting its potential as a safe, culturally significant, and nutritionally relevant food product. Proximate analysis indicated that Tinupig contains appreciable levels of crude fiber (7.67%) and crude protein (3.63%), contributing to digestive health and dietary energy. Its semi-moist nature, with a high moisture content (31.89%), suggests a need for improved packaging to enhance stability and shelf life.

Microbiological assessment confirmed the product's safety, with low aerobic plate count (16 CFU/g), minimal yeasts and molds (10 CFU/g), and *Escherichia coli* levels below detectable limits (<3.0 MPN/g). Moderate total coliform counts (123 MPN/g) highlight potential post-processing contamination, indicating the importance of improved hygiene during handling.

Sensory evaluation revealed high consumer acceptability across all attributes, including aroma, taste, texture, and overall acceptability, reflecting the product's potential for broader market appeal. Economic assessment demonstrated a feasible profit margin of 33% per batch, suggesting the product is viable for small-scale production and community livelihood. Overall, Tinupig represents a bioscience-informed, culturally rooted food with promising nutritional, microbial, sensory, and economic characteristics.

RECOMMENDATIONS

Based on the findings, several strategies are recommended to improve the quality, safety, and market potential of Lasam's Traditional Tinupig. Enhancing hygiene and food safety is essential, including implementing stricter post-cooking sanitation protocols to reduce coliform contamination and providing regular training for food handlers on Good Manufacturing Practices (GMP) and proper hygiene techniques. Packaging and storage can be optimized by using food-grade, moisture-resistant materials, such as vacuum-sealed or resealable packaging, and conducting studies to evaluate shelf life under different storage conditions to ensure accurate expiration labeling. Nutritional promotion should emphasize Tinupig's fiber and protein content through product labeling and marketing, with consideration for fortification using mineral-rich or functional ingredients to improve nutritive value without compromising sensory qualities.

Sensory and consumer-centered development is encouraged, including expanding sensory evaluation to a broader demographic and exploring product diversification through new flavors, fillings, and health-oriented variants to increase consumer appeal. Cultural and market promotion can be strengthened by highlighting Tinupig's heritage and traditional preparation in marketing campaigns and fostering partnerships with local institutions, retail outlets, and pasalubong centers to expand distribution and support food tourism initiatives. Finally, economic viability can be enhanced by optimizing production processes, leveraging bulk procurement, improving labor efficiency,

and integrating Tinupig production into community-based livelihood programs, thereby supporting local economic growth while preserving this culturally significant delicacy.

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