

Malabar Spinach (*Basella alba*) as Ingredient for Chips

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ABSTRACT

This study developed Malabar spinach (*Basella alba*) flour as an ingredient for baked chips and assessed the product's sensory acceptability, observational shelf-life characteristics, and preliminary economic value. A descriptive-experimental and research-and-development approach was applied using a Stage-Gate product-development framework. Thirty purposively selected evaluators from Barangay F. Simeon, Ragay, Camarines Sur participated: 10 Technology and Livelihood Education teachers, 10 Technical-Vocational-Livelihood students, and 10 farmers. Three formulations were prepared by varying the quantity of Malabar spinach flour while keeping the complementary ingredients constant. Sensory acceptability was measured using a four-point hedonic scale for appearance, aroma, color, taste, and texture. Formulation 3, which contained

1 cup of Malabar spinach flour, obtained the highest overall weighted mean ($M = 3.53$) and was interpreted as Very Highly Acceptable. Formulation 2 obtained $M = 2.96$, while Formulation 1 obtained $M = 2.92$; both were interpreted as Highly Acceptable. Visual shelf-life monitoring of Formulation 3 showed acceptable physical quality from Days 1 to 90, initial color changes from Days 91 to 120, and substantial deterioration with visible mold after Day 120. The preliminary cost analysis reported total expenses of PHP 58.00, total sales of PHP 125.00 for 25 packs, and a projected profit of PHP 67.00 per recipe. The findings support the potential of Malabar spinach chips as a locally sourced food innovation. Laboratory nutrient analysis, microbiological testing, standardized packaging trials, and broader consumer studies are required before commercial claims or market-scale production are pursued.

Keywords: *Basella alba*, food product development, Malabar spinach chips, sensory acceptability, shelf-life observation, value-added snack

INTRODUCTION

Vegetable-based food products offer opportunities to improve dietary variety, use locally available crops, and create value-added products for community-level livelihood initiatives. Malabar spinach (*Basella alba*), locally known as alugbati, is an underutilized leafy vegetable that can be processed into flour and incorporated into snack products. Published literature has described the plant as a source of vitamins, minerals, and phytochemical compounds, although the nutrient composition of a finished processed product must still be verified through laboratory testing (Chaurasiya et al., 2021; Tongco et al., 2015).

The development of vegetable-based chips is relevant to Sustainable Development Goal 2, which encourages improved nutrition, food security, and sustainable agricultural practices (United Nations, n.d.). It also responds to consumer interest in convenient snacks that incorporate plant-based ingredients. Previous studies have explored chips and other food products produced from alternative flours and vegetables, demonstrating the feasibility of developing nutrient-oriented snacks through systematic formulation and sensory evaluation (Ali et al., 2019; Sangalang et al., 2020; Soriano et al., 2020).

In Barangay F. Simeon, Ragay, Camarines Sur, Malabar spinach is locally available but remains underutilized. Transforming its leaves into flour and incorporating the flour into baked chips may provide a practical

product-development opportunity for households, farmers, students, and small-scale entrepreneurs. However, the product's sensory acceptability, physical stability during storage, and preliminary production cost must be assessed before broader promotion.

This study aimed to identify the process for making Malabar spinach chips, determine the most acceptable formulation, assess sensory acceptability in terms of appearance, aroma, color, taste, and texture, describe the product's observational shelf-life characteristics, and determine the preliminary economic value of the developed chips.

Literature Review

Malabar Spinach as a Food Ingredient

Malabar spinach is a leafy vegetable with potential for food-product innovation. Tongco et al. (2015) reported nutritional and phytochemical characteristics of *Basella alba* leaves from the Philippines. Chaurasiya et al. (2021) reviewed the importance and applications of Malabar spinach, while Soriano et al. (2020) demonstrated the use of alugbati leaf powder to enrich fresh egg noodles. These studies support the exploration of Malabar spinach flour as an ingredient in other processed foods.

Alternative Flours and Vegetable-Based Snacks

Alternative flours and plant-based ingredients have been applied in snack-product development to improve resource utilization and diversify food options. Ali et al. (2019) developed chips using potato, green pea, and lupine flours. Sangalang et al. (2020) explored pechay chips, while Villanueva (2016) incorporated alugbati leaves into a processed meat product. These studies indicate that unconventional plant resources can be adapted into consumer products when formulations and processing conditions are carefully controlled.

Sensory Acceptability and Shelf-Life Considerations

Sensory evaluation is essential in product development because appearance, aroma, color, taste, and texture influence consumer acceptance. Maina (2018) emphasized the role of sensory factors in food acceptability. For baked products, storage stability is also important. Cauvain (2016) discussed the influence of moisture, packaging, and deterioration mechanisms on the shelf life of bakery products. Visual observation can provide an initial indication of quality changes, but microbiological and physicochemical analyses are needed to establish product safety and validated shelf-life claims.

Stage-Gate Product Development

The study applied the Stage-Gate approach to organize product development. Cooper (1990, 2008) described Stage-Gate as a structured process in which new-product ideas move through sequential development stages and decision gates. In the present study, the approach guided discovery, scoping, formulation, prototype development, sensory evaluation, preliminary shelf-life observation, and economic analysis.

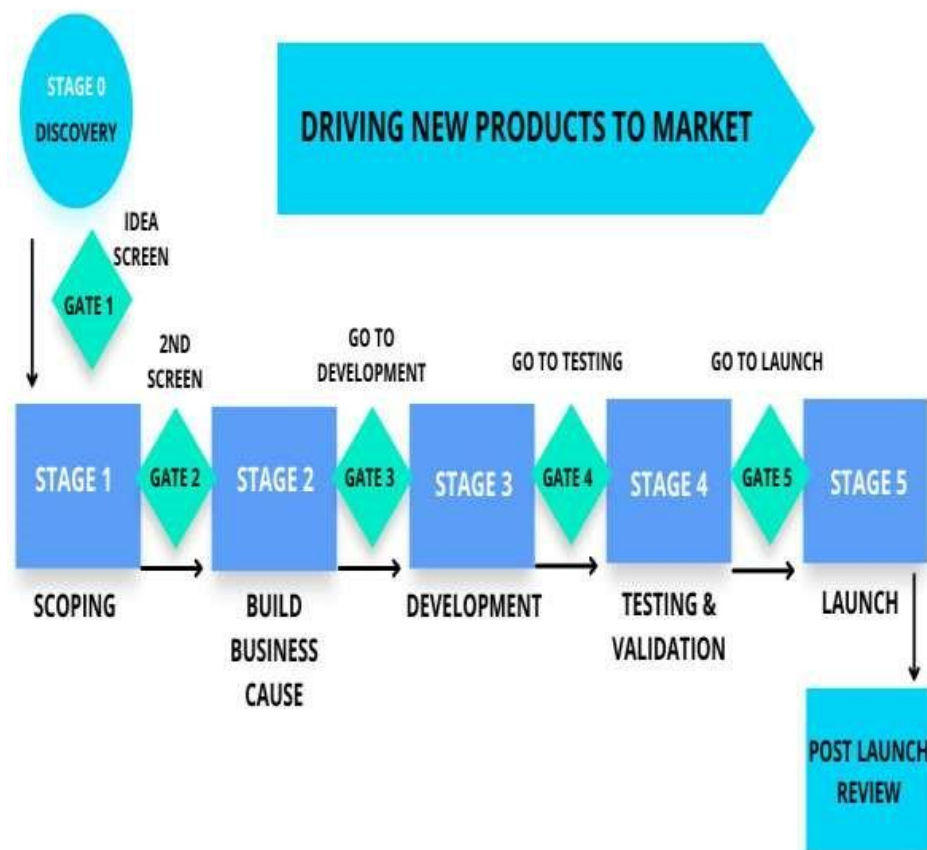


Figure 1. Stage-Gate Product Development Framework Used as a Guide for the Study

METHODS

Research Design

The study used descriptive-experimental and research-and-development methods. The experimental component involved the preparation of three formulations with varying quantities of Malabar spinach flour. The descriptive component summarized sensory ratings, shelf-life observations, and preliminary production costs. The Stage-Gate framework guided the development and refinement of the product.

Research Locale and Evaluators

The study was conducted in Barangay F. Simeon, Ragay, Camarines Sur, during School Year 2025-2026. Thirty evaluators were purposively selected because they represented stakeholders familiar with food preparation, technical-vocational learning, and local agricultural resources.

Table 1. *Distribution of Evaluators*

Evaluator Group	Frequency	Percentage
Technology and Livelihood Education teachers	10	33.33%
Technical-Vocational-Livelihood students	10	33.33%
Farmers	10	33.33%
Total	30	100.00%

Research Instrument

A bilingual English-Bikol evaluation sheet was used. It included evaluator information, a four-point hedonic scale, and an open-ended feedback section. The sensory indicators were appearance, aroma, color, taste, and texture. The interpretation scale was as follows: 3.26-4.00, Very Highly Acceptable; 2.51-3.25, Highly Acceptable; 1.76-2.50, Moderately Acceptable; and 1.00-1.75, Less Acceptable. The source manuscript described expert validation and pilot testing but did not present the final reliability coefficient; no unsupported coefficient is reported in this article.

Product Formulations

The formulations differed only in the quantity of Malabar spinach flour. Cake flour, all-purpose flour, garlic powder, onion powder, salt, butter, and warm water were kept constant.

Table 2. *Formulations of Malabar Spinach Chips*

Ingredient	Formulation 1	Formulation 2	Formulation 3
Malabar spinach flour	1/2 cup	3/4 cup	1 cup
Cake flour	1/2 cup	1/2 cup	1/2 cup
All-purpose flour	1/2 cup	1/2 cup	1/2 cup
Garlic powder	1/4 tsp	1/4 tsp	1/4 tsp
Onion powder	1/4 tsp	1/4 tsp	1/4 tsp
Salt	1/4 tsp	1/4 tsp	1/4 tsp
Butter	30 g	30 g	30 g
Warm water	As needed	As needed	As needed

Product Development Procedure

Mature, healthy Malabar spinach leaves were selected, washed, dehydrated through sun drying or mechanical drying for approximately four to five hours, pulverized, sieved, and stored in airtight containers. For chip production, the dry ingredients were measured and mixed. Butter was incorporated, and warm water was gradually added to form a firm but pliable dough. The dough was kneaded, rolled thinly, cut into shapes, and baked at 350°F (175°C) for approximately 10-15 minutes. The chips were cooled and stored in sealed packaging.

Data Gathering and Analysis

The three chip formulations were presented to the evaluators for sensory assessment. Weighted mean was used to summarize acceptability ratings. The formulation with the highest acceptability score was subjected to visual shelf-life monitoring under the storage conditions used in the study. Observations were recorded for Days 1-90, Days 91-120, and Days 121-150. A preliminary cost-benefit computation was also prepared based on local ingredient costs, packaging expenses, projected sales, and profit.

Ethical Consideration

Participation in the sensory evaluation was voluntary. The evaluators received information about the study and provided informed consent. Responses were treated confidentially and reported in aggregate form. The evaluators were informed that they could withdraw from participation at any time. Any future market or consumer study should include food-safety clearance and documented screening for allergies or ingredient sensitivities.

RESULTS AND DISCUSSION

Process for Producing Malabar Spinach Chips

The study established a replicable process consisting of leaf selection, washing, dehydration, pulverization, sieving, formulation, dough preparation, rolling, cutting, baking, cooling, and packaging. The procedure transformed an underutilized leafy vegetable into a flour-based baked snack. The use of a Stage-Gate process supported orderly prototype development and evaluation.

Sensory Acceptability of the Three Formulations

Table 3. *Sensory Acceptability of Malabar Spinach Chip Formulations*

Sensory Attribute	F1 WM	Int.	F2 WM	Int.	F3 WM	Int.
Appearance	3.06	HA	3.13	HA	3.60	VHA
Aroma	3.16	HA	2.76	HA	3.60	VHA
Color	2.16	MA	2.63	HA	3.40	VHA
Taste	3.10	HA	3.06	HA	3.60	VHA
Texture	3.10	HA	3.20	HA	3.47	VHA
Overall weighted mean	2.92	HA	2.96	HA	3.53	VHA
Overall rank	3		2		1	

Formulation 3 obtained the highest overall weighted mean ($M = 3.53$) and was interpreted as Very Highly Acceptable. Its ratings were within the Very Highly Acceptable range for appearance (3.60), aroma (3.60), color (3.40), taste (3.60), and texture (3.47). Formulation 2 ranked second ($M = 2.96$), while Formulation 1 ranked third ($M = 2.92$). The findings indicate that the formulation containing 1 cup of Malabar spinach flour was preferred by the evaluators.

The result supports the feasibility of incorporating a relatively higher amount of leaf flour without reducing sensory acceptability under the conditions used in the study. However, the sensory evaluation involved a small purposive panel from one locality. A broader consumer test is necessary before generalizing the preference pattern to a larger market.

Observational Shelf-Life Characteristics

Table 4. *Visual Shelf-Life Observations for Formulation 3*

Storage Period	Observed Condition	Interpretation
Days 1-90	No visible mold or contamination was reported. The chips retained acceptable physical quality under the storage conditions used.	Optimal observational quality-retention period reported by the study.
Days 91-120	Color changes were observed without reported visible mold. Gradual decline in appearance was noted.	Beginning of quality deterioration.
Days 121-150	Pronounced discoloration, softening, loss of crispness, and visible mold growth were observed.	Product no longer acceptable for consumption.



Figure 2. *Selected Product Photographs*

The visual monitoring results suggest that Formulation 3 retained acceptable physical characteristics for up to 90 days under the study's storage conditions. Color changes began after 90 days, while visible mold and substantial deterioration were observed beyond 120 days. These observations provide a preliminary basis for further testing but do not constitute laboratory confirmation of microbiological safety or a validated commercial expiration date.

Preliminary Economic Value

Table 5. Preliminary Production Cost and Projected Profit for Formulation 3

Cost Item	Amount
Malabar spinach flour	PHP 5.00
All-purpose flour	PHP 10.00
Cake flour	PHP 10.00
Garlic powder	PHP 3.00
Onion powder	PHP 3.00
Salt	PHP 1.00
Butter	PHP 5.00
Packaging	PHP 10.00
Labels	PHP 1.00
Gas	PHP 10.00
Total expenses	PHP 58.00
Projected yield	25 packs
Selling price	PHP 5.00 per pack
Projected total sales	PHP 125.00
Projected profit	PHP 67.00

The preliminary cost analysis reported PHP 58.00 in total expenses and PHP 125.00 in projected sales for 25 packs sold at PHP 5.00 per pack, resulting in a projected profit of PHP 67.00 per recipe. The result indicates potential for small-scale income generation. However, the computation should be treated as an initial estimate because labor, equipment depreciation, utilities beyond the reported gas expense, food-safety compliance, wastage, distribution, and scaling costs were not included.

Proposed Enhancement Priorities

Table 6. Recommended Product-Development Priorities

Priority Area	Recommended Action	Expected Outcome
Laboratory analysis	Conduct proximate, nutrient, moisture, and microbiological analyses.	Validated product composition and safety evidence
Packaging optimization	Test food-grade packaging options, sealing methods, and storage conditions.	More reliable shelf-life determination
Consumer testing	Expand sensory evaluation across larger and more diverse consumer groups.	Stronger evidence of market acceptability
Production standardization	Document batch size, process controls, yield, and quality checkpoints.	Consistent product quality
Economic feasibility	Include labor, utilities, depreciation, compliance, and distribution costs.	More realistic business model
Product diversification	Explore flavor variants and other Malabar spinach flour applications.	Broader consumer appeal and market opportunities

CONCLUSION

Malabar spinach flour was successfully incorporated into a baked chip product through a systematic development process involving leaf selection, dehydration, pulverization, formulation, baking, sensory evaluation, visual shelf-life monitoring, and preliminary economic analysis. Among the three formulations, Formulation 3, containing 1 cup of Malabar spinach flour, obtained the highest sensory acceptability rating and was interpreted as Very Highly Acceptable. Visual monitoring indicated acceptable physical quality from Days 1 to 90, initial deterioration from Days 91 to 120, and visible spoilage after Day 120. The preliminary cost computation also

indicated a positive projected profit. The study demonstrates the potential of Malabar spinach as a locally sourced ingredient for value-added snack development. However, laboratory nutrient analysis, microbiological testing, packaging validation, and broader consumer trials are necessary before commercial safety, nutritional, or shelf-life claims are made.

Recommendations

1. Food processors and small-scale entrepreneurs may use Formulation 3 as the starting prototype for further development because it obtained the highest sensory acceptability score.
2. Laboratory-based proximate, nutrient, moisture, and microbiological analyses should be completed before the product is promoted as nutrient-enriched or safe for a defined commercial shelf life.
3. Packaging trials should be conducted using food-grade materials and controlled storage conditions to determine how sealing, moisture exposure, and temperature affect quality retention.
4. Schools, local government units, and livelihood partners may explore supervised product-development activities that promote the responsible use of locally available Malabar spinach.
5. A larger and more diverse consumer panel should evaluate acceptability, pricing, preferred flavors, and purchasing intent.
6. Future researchers may investigate scale-up production, regulatory requirements, allergen considerations, detailed cost analysis, and the use of Malabar spinach flour in other food products.

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