



Utilization of wild bush passion fruit in making yogurt and ice cream

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Abstract

Aim: This study aimed to develop innovative yogurt and ice cream formulations enhanced with wild bush passion fruit (*Passiflora foetida*) and evaluate their potential contribution to sustainable food innovation, functional dairy product development, and hospitality-related food enterprises.

Methodology: The study utilized a mixed descriptive-experimental research design. Phytochemical analysis, microbial safety testing, sensory evaluation, shelf-life analysis, packaging assessment, nutrient profiling, and return on investment (ROI) analysis were conducted to determine product quality, safety, acceptability, and economic feasibility. Thirty evaluators composed of 15 students and 15 teachers participated in the sensory evaluation.

Results: Findings revealed that wild bush passion fruit contains bioactive compounds that support its functional food potential. Yogurt and ice cream formulations with 180 ml fruit juice concentration obtained the highest acceptability ratings. Statistical analysis showed a significant difference in the overall acceptability of yogurt formulations, indicating that fruit concentration influenced consumer preference. The developed products were microbiologically safe, nutritionally enriched, commercially feasible, and supported by sustainable packaging preferences.

Conclusion: Wild bush passion fruit is a viable functional ingredient for yogurt and ice cream production and demonstrates strong potential for sustainable food innovation, hospitality product development, and local food enterprise commercialization. The study supports Sustainable Development Goal 3 on good health and well-being and Sustainable Development Goal 12 on responsible consumption and production through the utilization of indigenous fruit resources in functional dairy products.

Keywords: Wild bush passion fruit, yogurt, ice cream, functional food development, sustainable food innovation, hospitality food enterprise

Introduction

The increasing concern regarding public health, environmental sustainability, and food security has strengthened the demand for innovative and sustainable food systems. In support of Sustainable Development Goal 3 on Good Health and Well-Being and Sustainable Development Goal 12 on Responsible Consumption and Production, the food and hospitality industries are encouraged to develop nutritious and environmentally responsible food products. One strategy that supports these goals is the utilization of indigenous and underutilized fruits in food innovation.

Moreover, consumers are becoming more conscious of nutrition, wellness, and environmental responsibility, resulting in a growing preference for natural and functional food products. Restaurants, cafés, and hospitality establishments have begun incorporating locally sourced ingredients and functional foods into their offerings to improve nutritional value and sustainability. Functional foods are recognized for their antioxidant, antimicrobial, anti-inflammatory, and digestive benefits.

Sustainable gastronomy and culinary tourism have also encouraged the use of indigenous ingredients to promote local culture, biodiversity, and farm-to-table practices. Baysal et al. (2024) emphasized that gastronomy strengthens tourism destination marketing by connecting tourists with local culture, traditions, and sustainable practices. The utilization of native fruits helps strengthen local agriculture, reduce dependence on imported ingredients, and enhance authentic culinary experiences.

One underutilized fruit with strong potential for food innovation is wild bush passion fruit (*Passiflora foetida*), which grows abundantly in tropical regions, including the Philippines. Han et al. (2023) reported that the fruit contains flavonoids, phenolics, fiber, and other bioactive compounds associated with antioxidant, anti-



inflammatory, antimicrobial, and anti-diabetic properties. Its sweet, aromatic, and citrus-like flavor makes it suitable for dairy-based products such as yogurt and ice cream.

Yogurt and ice cream remain among the most preferred dairy products worldwide because of their sensory appeal. Previous studies revealed that fruit-infused dairy products exhibit enhanced nutritional quality and greater consumer acceptability. Molina-Hernández et al. (2024) found that passion fruit by-products can serve as a partial fat substitute in ice cream while maintaining desirable texture and stability. Likewise, Liang et al. (2022) reported that pectin extracted from passion fruit peel improved yogurt texture and shelf life, while De Toledo et al. (2018) revealed that passion fruit by-products are suitable for nutritional, technological, and sensory enhancement of drinkable yogurt.

Despite the increasing interest in sustainable gastronomy and functional food innovation, limited studies have explored the use of wild bush passion fruit in dairy formulations within the Philippine context, particularly regarding sensory acceptability, nutritional value, and sustainability implications. Therefore, this study aimed to develop wild bush passion fruit-flavored yogurt and ice cream and evaluate their nutritional composition, consumer acceptability, and contribution to sustainable food innovation. The study also supports sustainable gastronomy, responsible utilization of indigenous resources, and the development of innovative and culturally relevant dairy products.

Review of Related Literature and Studies

The growing demand for healthier, natural, and sustainable food products has influenced the food, hospitality, and tourism industries. Consumers now prefer functional foods that provide nutritional benefits while supporting sustainability and authentic culinary experiences. Studies revealed that incorporating fruits into dairy products enhances nutritional and sensory qualities without reducing acceptability. According to Al-aswad et al. (2025), fruit-enriched yogurt improves both nutritional and sensory attributes, while Priyashantha et al. (2025) emphasized that fruits such as passion fruit possess antioxidative and cardioprotective properties and can improve the stability and nutrient content of dairy products.

Sustainable gastronomy and culinary tourism have also encouraged the use of indigenous and locally available ingredients in food innovation. Baysal et al. (2024) stated that gastronomy strengthens tourism destination marketing by connecting tourists with local culture, traditions, and sustainable practices. In hospitality operations, the use of native fruits and locally sourced ingredients supports food innovation, sustainability, and cultural authenticity.

Wild bush passion fruit (*Passiflora foetida*) shows strong potential as a functional ingredient due to its flavonoids, antioxidants, fiber, and bioactive compounds. Babu et al. (2024) highlighted its anti-inflammatory, antimicrobial, antioxidant, and anti-diabetic properties, while Chiavaroli et al. (2020) reported its possible medicinal benefits for anxiety, insomnia, cough, convulsion, and cancer treatment. These properties support its application in yogurt and ice cream production.

Recent studies also confirmed the technological advantages of passion fruit in dairy processing. Molina-Hernández et al. (2024) found that passion fruit by-products can partially replace fat in ice cream while maintaining desirable texture and stability. Likewise, Liang et al. (2022) reported that pectin from passion fruit peel improved yogurt texture and shelf life, while De Toledo et al. (2018) revealed that passion fruit by-products are suitable for nutritional, technological, and sensory enhancement of drinkable yogurt.

Sustainable food innovation also supports tourism entrepreneurship and environmental sustainability. Baysal et al. (2024) emphasized that innovative products using local ingredients strengthen tourism and hospitality enterprises. Sachumol et al. (2023) further encouraged the use of sustainable packaging to reduce environmental impact. Moreover, the United Nations World Tourism Organization (UNWTO, 2023) stated that sustainable gastronomy contributes to biodiversity conservation, rural development, and responsible consumption. Ildikó et al. (2022) also reported that consumers are willing to pay more for nutritious and sustainable food products.

Overall, the reviewed literature supports the potential of wild bush passion fruit as a sustainable, nutritious, and marketable additive for yogurt and ice cream. However, limited studies have explored its application in dairy products within the Philippine context, particularly regarding consumer acceptability and sustainability implications. Therefore, this study aims to develop and evaluate wild bush passion fruit-flavored yogurt and ice cream.

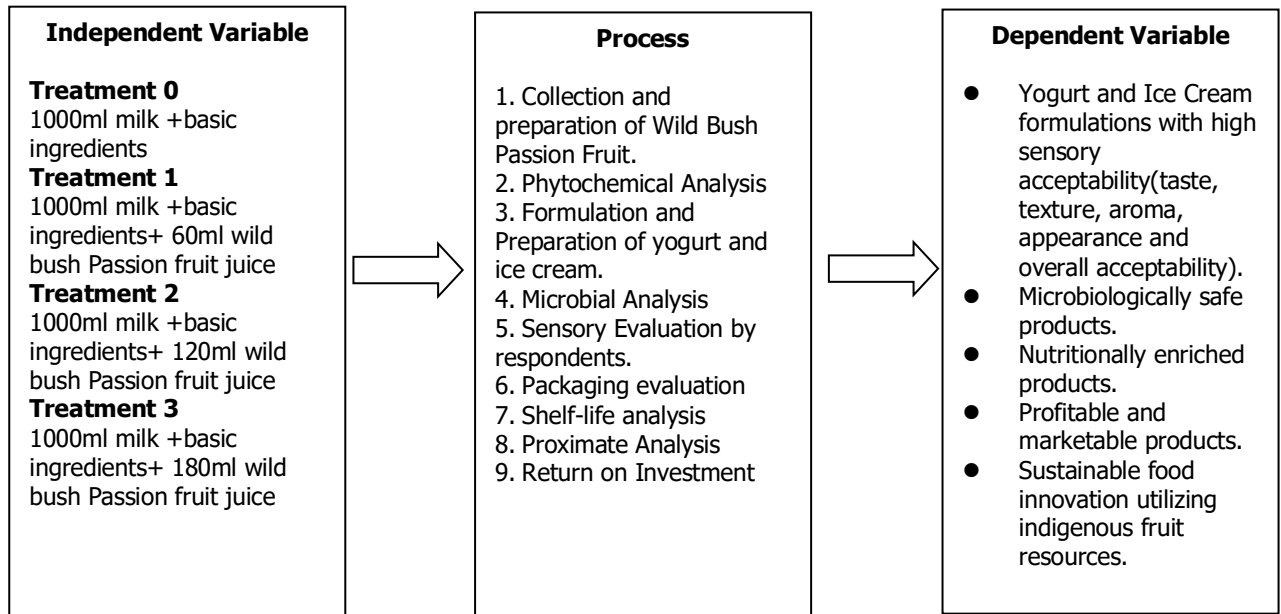
Theoretical Framework

This study is anchored on the Sustainable Food Systems Theory, Sensory Evaluation and Consumer Acceptance Theory, Functional Food Development Framework, and Sustainable Gastronomy and Hospitality Innovation Framework. These theories emphasize sustainability, nutrition, consumer preference, food innovation, and tourism development. The Sustainable Food Systems Theory supports the responsible use of indigenous resources and sustainable food production aligned with SDG 12. The Sensory Evaluation and Consumer Acceptance Theory explain how sensory attributes influence consumer preference and product acceptability. The



Functional Food Development Framework highlights the nutritional benefits of bioactive compounds found in wild bush passion fruit, while the Sustainable Gastronomy and Hospitality Innovation Framework promotes the use of local ingredients to support culinary identity, sustainable tourism, and hospitality entrepreneurship. Together, these theories provide the foundation for developing sustainable, nutritious, and marketable dairy products.

Conceptual Framework



Statement of the Problem

Wild bush passion fruit (*Passiflora foetida*) is an underutilized indigenous fruit with recognized nutritional, antioxidant, and medicinal properties. Despite its potential as a functional food ingredient, its application in dairy-based products such as yogurt and ice cream remains limited, particularly within the Philippine context. The growing consumer demand for healthier, naturally flavored, and sustainable food products has encouraged food researchers and hospitality enterprises to explore innovative ingredients that may enhance nutritional value, consumer acceptability, and product sustainability.

Moreover, the increasing emphasis on sustainable food systems and responsible consumption highlights the importance of utilizing locally available fruit resources in food innovation and hospitality product development. However, limited studies have examined the phytochemical properties, microbial safety, sensory acceptability, shelf life, packaging preferences, nutritional quality, and economic feasibility of wild bush passion fruit incorporated into yogurt and ice cream products. There is also insufficient research exploring its potential contribution to sustainable food innovation, hospitality food enterprises, and functional dairy product development.

Therefore, this study was conducted to develop yogurt and ice cream formulations enhanced with wild bush passion fruit and evaluate their nutritional quality, acceptability, marketability, microbial safety, shelf life, and economic feasibility.

Research Objectives

General Objective

To develop and evaluate wild bush passion fruit-enhanced yogurt and ice cream in terms of phytochemical properties, microbial safety, sensory acceptability, nutritional quality, shelf life, marketability, and economic feasibility.

Specific Objectives

1. To determine the phytochemical components present in wild bush passion fruit.
2. To assess the microbial load content of yogurt and ice cream enhanced with wild bush passion fruit.
3. To determine the level of acceptability of the developed wild bush passion fruit yogurt and ice cream in terms of:



- a. taste;
 - b. texture;
 - c. aroma;
 - d. appearance; and
 - e. overall acceptability.
4. To determine the significant differences among the developed wild bush passion fruit yogurt and ice cream treatments in terms of the evaluated sensory parameters.
 5. To determine the evaluators' perception of the marketability of the developed products in terms of preferred packaging relative to:
 - a. technical performance;
 - b. economic viability;
 - c. environmental soundness; and
 - d. social acceptability.
 6. To determine the shelf life of the developed wild bush passion fruit yogurt and ice cream.
 7. To determine the nutrient composition of the best wild bush passion fruit yogurt and ice cream formulation.
 8. To determine the return on investment (ROI) of the developed wild bush passion fruit yogurt and ice cream.

Research Questions

1. What phytochemical components are present in wild bush passion fruit?
2. What is the microbial load content of the developed wild bush passion fruit yogurt and ice cream?
3. What is the level of acceptability of the developed wild bush passion fruit yogurt and ice cream in terms of:
 - a. taste;
 - b. texture;
 - c. aroma;
 - d. appearance; and
 - e. overall acceptability?
4. Are there significant differences among the developed wild bush passion fruit yogurt and ice cream treatments in terms of the evaluated sensory parameters?
5. What are the evaluators' perceptions regarding the marketability of the developed products in terms of preferred packaging relative to:
 - a. technical performance;
 - b. economic viability;
 - c. environmental soundness; and
 - d. social acceptability?
6. What is the shelf life of the developed wild bush passion fruit yogurt and ice cream?
7. What is the nutrient composition of the best wild bush passion fruit yogurt and ice cream formulation?
8. What is the return on investment (ROI) of the developed wild bush passion fruit yogurt and ice cream?

Hypothesis

There is no significant difference among the treatments in terms of taste, texture, aroma, appearance, and overall acceptability.

METHODOLOGY

Research Design

The study utilized a mixed descriptive-experimental research design to evaluate the feasibility, acceptability, and sustainability of incorporating wild bush passion fruit into yogurt and ice cream formulations. The experimental component focused on product formulation, phytochemical testing, microbial analysis, and shelf-life evaluation, while the descriptive component assessed sensory acceptability, packaging preferences, and marketability perceptions. This research design was appropriate because it enabled the simultaneous evaluation of product quality, consumer acceptability, and commercial feasibility relevant to sustainable food innovation and hospitality-related food enterprises.

Population and Sampling

A purposive sampling technique was employed in selecting thirty evaluators composed of fifteen students and fifteen teachers from Abra High School. The participants were selected based on their availability



and willingness to participate in the sensory evaluation. Their inclusion provided diverse perspectives regarding product acceptability, sensory quality, and marketability.

Instruments

The study utilized researcher-developed sensory evaluation questionnaires designed to assess taste, texture, aroma, appearance, and overall acceptability using a five-point Likert scale. Packaging evaluation forms were also developed to assess technical performance, economic viability, environmental soundness, and social acceptability. The instruments underwent content validation by seven English teachers and eight Technology and Livelihood Education teachers to ensure clarity, relevance, and appropriateness of the items.

Data Collection

Data collection was conducted through laboratory preparation of yogurt and ice cream formulations containing varying concentrations of wild bush passion fruit extract. The products were prepared under sanitary laboratory conditions and subjected to phytochemical and microbial analyses. Sensory evaluation sessions were conducted at Abra High School, where evaluators assessed the products using structured sensory evaluation forms. Packaging surveys were subsequently administered to determine marketability and packaging preferences.

Treatment of Data

Weighted Mean was used to determine the level of acceptability of the developed products in terms of taste, texture, aroma, appearance, and overall acceptability. Analysis of Variance (ANOVA) was employed to determine significant differences among treatment groups at a 0.05 level of significance. Return on Investment (ROI) computation was also performed to assess the economic feasibility and commercialization potential of the developed yogurt and ice cream products.

Ethical Considerations

Ethical considerations were strictly observed throughout the study. Permission to conduct the study was secured from the school administration prior to data collection. All participants provided informed consent, participation was voluntary, and confidentiality of responses was maintained. The study ensured respect for participant rights, privacy, and data protection throughout the research process.

RESULTS AND DISCUSSION

Phytochemical Analysis

The phytochemical analysis revealed that wild bush passion fruit contains significant amounts of flavonoids, phenolics, tannins, saponins, glycosides, and alkaloids, particularly in the peel portion. The strong presence of these bioactive compounds indicates that the fruit possesses high functional and therapeutic potential. The peel exhibited the richest phytochemical profile because it contained all identified phytochemical groups, suggesting that protective plant tissues may accumulate greater concentrations of secondary metabolites responsible for antioxidant and antimicrobial activities.

The findings are consistent with Han et al. (2023) and Babu et al. (2024), who reported that *Passiflora* species contain bioactive compounds associated with antioxidant, anti-inflammatory, and antimicrobial functions. The similarity of findings may be attributed to the natural defense mechanisms of *Passiflora* plants, which synthesize phenolic compounds and flavonoids to protect against environmental stress, microbial attack, and oxidative damage. These compounds are also known to contribute to disease prevention and immune support in humans, making them valuable in functional food development.

The present study extends previous research by demonstrating that wild bush passion fruit (*Passiflora foetida*), an underutilized indigenous fruit, possesses bioactive properties suitable for dairy product innovation within the Philippine context. Unlike earlier studies that focused mainly on medicinal applications, the present research highlights its practical application in yogurt and ice cream production. The incorporation of phytochemical-rich indigenous fruits into dairy products may improve nutritional quality while supporting sustainable gastronomy and culturally relevant food innovation.



Table 1
Phytochemical Constituents of Wild Bush Passion Fruit

Test for Constituents	Constituents Detected	Peel	Juice	Seed
Mayer's Test	Alkaloids	(+)	(-)	(-)
Wagner's Test	Alkaloids	(+)	(-)	(-)
Dragendorff's Test	Alkaloids	(+)	(-)	(-)
Liebermann-Burchard Test	Unsaturated sterols/triterpenes	(+)	(+)	(+)
Keller-Killiani Test	Cardiac glycosides	(+)	(+)	(+)
Anthraquinone Glycosides	Anthraquinone	(+)	(+)	(+)
Shinoda's Test	Flavanones	(-)	(-)	(-)
Lead Acetate Test	Flavonoids	(+)	(+)	(+)
Froth Test	Saponins	(+)	(+)	(+)
Ferric Chloride Test	Phenolics	(+)	(+)	(+)
Gelatin Test	Tannins	(+)	(+)	(+)

Note. (+) = present; (-) = absent.

Microbial Analysis

The microbial analysis demonstrated that both wild bush passion fruit yogurt and ice cream maintained low aerobic microbial counts and tested negative for pathogenic microorganisms throughout the evaluation period. The findings indicate that the incorporation of wild bush passion fruit did not compromise the microbiological safety of the products. Ice cream samples showed more stable microbial profiles than yogurt, which may be explained by the lower storage temperature that slowed microbial growth and metabolic activity.

The microbial stability observed in the products may also be associated with the natural antimicrobial compounds present in wild bush passion fruit. Flavonoids, tannins, and phenolic compounds are known to inhibit bacterial growth by disrupting microbial cell membranes and interfering with enzyme activity. This explains why the products remained microbiologically safe despite the addition of fruit extract. Similar findings were reported by Molina-Hernández et al. (2024) and Liang et al. (2022), who noted that passion fruit compounds contribute to microbial inhibition and product preservation in dairy systems.

The study contributes additional knowledge by demonstrating that wild bush passion fruit can be incorporated into dairy formulations without increasing contamination risks. This is particularly important in hospitality and tourism food operations where food safety strongly influences customer trust, operational reputation, and regulatory compliance. The findings therefore support the commercial feasibility of wild bush passion fruit yogurt and ice cream as safe and sustainable food products.

Table 2a
Microbial Analysis of Wild Bush Passion Fruit Ice Cream

Product Sample Code	Aerobic Plate Count (cfu/g ×10 ³)	Escherichia coli	Salmonella sp.	Staphylococcus aureus	Listeria monocytogenes	Molds
T0	11.0	Negative	Negative	Negative	Negative	Negative
T1	12.0	Negative	Negative	Negative	Negative	Negative
T2	6.0	Negative	Negative	Negative	Negative	Negative



Product Sample Code	Aerobic Plate Count (cfu/g ×10 ³)	Escherichia coli	Salmonella sp.	Staphylococcus aureus	Listeria monocytogenes	Molds
T3	11.0	Negative	Negative	Negative	Negative	Negative

Table 2b

Microbial Analysis of Wild Bush Passion Fruit Ice Cream

Product Sample Code	Aerobic Plate Count (cfu/g ×10 ³)	Escherichia coli	Salmonella sp.	Staphylococcus aureus	Listeria monocytogenes	Molds
T0	9.0	Negative	Negative	Negative	Negative	Negative
T1	9.0	Negative	Negative	Negative	Negative	Negative
T2	11.0	Negative	Negative	Negative	Negative	Negative
T3	7.0	Negative	Negative	Negative	Negative	Negative

Sensory Evaluation

The sensory evaluation results revealed that Treatment 3 (180 ml wild bush passion fruit concentration) achieved the highest acceptability in both yogurt and ice cream products, particularly for overall acceptability. In yogurt, Treatment 3 achieved the highest mean score of 4.33, while in ice cream, it obtained 4.30. Statistical analysis revealed no significant differences among treatments in taste, texture, aroma, or appearance. However, a significant difference was observed in the overall acceptability of the yogurt formulations ($p = 0.011$), indicating that varying concentrations of wild bush passion fruit influenced the respondents' overall preference for the product.

The favorable acceptability may be attributed to the balanced sweet-sour flavor, natural acidity, and tropical aroma of wild bush passion fruit, which complemented the creamy characteristics of yogurt and ice cream. The fruit's organic acids and aromatic compounds likely enhanced flavor complexity and freshness, improving overall sensory perception. Increased fruit concentration also improved aroma and appearance without negatively affecting texture stability.

The findings are consistent with De Toledo et al. (2018), who reported that passion fruit-based dairy products achieved high consumer acceptability due to their pleasant aroma and compatibility with milk-based formulations. However, the present study extends previous findings by demonstrating that *Passiflora foetida*, an underutilized indigenous fruit, can also be successfully incorporated into dairy products while maintaining desirable sensory quality. Similarly, Priyashantha et al. (2025) explained that fruit incorporation enhances sensory appeal because fruit sugars, acids, and volatile compounds improve flavor perception while dairy proteins stabilize texture and reduce excessive sourness.

The significant difference observed in overall acceptability of yogurt suggests that fruit concentration influenced the respondents' combined sensory experience of the product. Meanwhile, the absence of significant differences in most sensory attributes indicates formulation flexibility for food manufacturers, cafés, restaurants, and hospitality enterprises. Producers may adjust fruit concentrations according to cost efficiency, availability, and consumer preferences without greatly affecting product acceptability. Furthermore, the successful incorporation of wild bush passion fruit supports sustainable gastronomy, menu diversification, and innovative food development using indigenous resources.

Table 3a.

F-Test Results for Acceptability of Wild Bush Passion Fruit Yogurt

TREATMENTS	Sensory Characteristics of Wild Bush Passion Fruit Yogurt				
	Taste	Texture	Aroma	Appearance	Overall Acceptability
T0	3.63 ^a	3.49 ^a	3.58 ^a	3.47 ^a	3.61 ^b
T1	3.88 ^a	3.74 ^a	3.73 ^a	3.74 ^a	3.99 ^{ab}
T2	3.94 ^a	3.69 ^a	3.84 ^a	3.68 ^a	4.03 ^a



T3	4.00 ^a	3.80 ^a	4.07 ^a	4.10 ^a	4.33 ^a
Computed F	1.436	0.617	1.241	2.176	3.884
P-value	0.236	0.606	0.298	0.095	0.011
Significance	ns	ns	ns	ns	*

Note. *- significant at 0.05 level. ns – not significant

Table 3b

F-Test Results for Acceptability of Wild Bush Passion Fruit Yogurt

TREATMENTS	Sensory Characteristics of Wild Bush Passion Fruit Ice Cream				
	taste	Texture	Aroma	Appearance	Overall Acceptability
T0	3.63 ^a	3.69 ^a	3.84 ^a	3.92 ^a	3.80 ^a
T1	3.88 ^a	3.90 ^a	4.00 ^a	3.76 ^a	4.08 ^a
T2	3.94 ^a	3.77 ^a	3.92 ^a	4.02 ^a	4.16 ^a
T3	4.00 ^a	3.90 ^a	3.69 ^a	4.08 ^a	4.30 ^a
Computed f	0.126	0.423	0.857	0.923	1.852
P-value	0.945	0.737	0.466	0.432	0.142
Significance	ns	ns	ns	ns	ns

Note. *- significant at 0.05 level. ns – not significant

Shelf-Life Analysis

The shelf-life analysis revealed that yogurt remained microbiologically safe for four weeks, while ice cream maintained microbial safety for approximately eight weeks under proper refrigerated and frozen storage conditions. The absence of *Escherichia coli*, *Salmonella sp.*, *Staphylococcus aureus*, and *Listeria monocytogenes* indicates that the products possessed strong microbial stability and acceptable storage potential.

The extended shelf life may be attributed to both proper sanitation practices and the antimicrobial properties of wild bush passion fruit. The acidic nature of passion fruit creates an unfavorable environment for microbial growth, while flavonoids and phenolic compounds may inhibit the survival of spoilage microorganisms. In ice cream, freezing temperatures further reduced microbial activity, explaining the longer shelf stability observed in comparison with yogurt.

The findings support Babu et al. (2024), who reported that *Passiflora* species possess antimicrobial compounds capable of suppressing pathogenic microorganisms. However, the present study extends these findings by applying the antimicrobial potential of *Passiflora foetida* in actual dairy-based food systems rather than purely laboratory settings. This demonstrates the fruit's practical value in sustainable food preservation and functional dairy product development.

From a hospitality perspective, longer shelf life improves inventory management, minimizes food waste, and enhances operational efficiency in cafés, restaurants, and tourism enterprises. Products with stable shelf life are also more suitable for commercial distribution and sustainable food entrepreneurship.

Table 4a

Shelf-Life Analysis of Wild Bush Passion Fruit in Making Yogurt

Date of observation	Detection of Pathogens			
	<i>Escherichia coli</i>	<i>Salmonella sp.</i>	<i>Staphylococcus aureus</i>	<i>Listeria monocytogenes</i>
01-05-2026	negative	negative	negative	negative
01-12-2026	negative	negative	negative	negative
01-19-2026	negative	negative	negative	negative
01-26-2026	negative	negative	negative	negative



Table 4b

Shelf-Life Analysis of Wild Bush Passion Fruit in Making Ice Cream

Date of observation	Detection of Pathogens			
	<i>Escherichia coli</i>	<i>Salmonella sp.</i>	<i>Staphylococcus aureus</i>	<i>Listeria monocytogenes</i>
01-05-2026	negative	negative	negative	negative
01-12-2026	negative	negative	negative	negative
01-19-2026	negative	negative	negative	negative
01-26-2026	negative	negative	negative	Negative
02-02-2026	negative	negative	negative	negative
02-09-2026	negative	negative	negative	negative
02-16-2026	negative	negative	negative	negative
02-23-2026	negative	negative	negative	negative

Packaging Analysis

The packaging analysis identified glass packaging as the most suitable material for yogurt, obtaining the highest overall mean score of 4.40, while plastic packaging was rated as the most acceptable for ice cream with a higher overall mean of 4.57. The preference for glass containers in yogurt may be explained by their physicochemical stability and non-reactive properties, which prevent chemical interaction between the packaging and the acidic components of yogurt. This helps maintain flavor integrity, microbial stability, and sensory quality over time. In addition, glass provides superior barrier protection against oxygen and moisture, reducing oxidation and spoilage, which contributes to its higher perceived technical performance and environmental soundness. These properties likely influenced respondents' perception of glass as more suitable for preserving yogurt quality.

In contrast, plastic packaging achieved the highest acceptability for ice cream with an overall mean of 4.57, supported by its high ratings in technical performance, economic viability, and social acceptability. This preference can be attributed to the thermophysical properties of plastic materials such as polyethylene and polypropylene, which maintain structural integrity under freezing conditions and reduce the risk of cracking or breakage during storage and transport. From an economic standpoint, plastic is more cost-effective to produce and distribute, making it more accessible for producers and consumers. Behaviorally, respondents likely associate plastic packaging with convenience, portability, and ease of handling in frozen product applications, which further reinforces its acceptability for ice cream.

The findings are consistent with Sashumol et al. (2023), who reported that consumer preferences are increasingly influenced by both functional performance and sustainability considerations in food packaging. The similarity of results may be explained by the evolving consumer evaluation framework, where packaging is no longer viewed solely as a protective container but also as an indicator of product quality, usability, and environmental responsibility. The present study extends this perspective by demonstrating that packaging preferences are not uniform across product types; instead, they are context-dependent and influenced by food characteristics such as temperature sensitivity, acidity, and storage requirements. This explains why glass is favored for yogurt preservation, while plastic is more suitable for frozen products like ice cream.

Overall, the present study contributes to sustainable hospitality and food innovation research by showing how packaging material selection—reflected in high mean scores of 4.40 (glass for yogurt) and 4.57 (plastic for ice cream)—influences perceived product quality, usability, and market acceptability. In tourism and hospitality settings, these findings suggest that packaging functions as both a preservation tool and a communication element for sustainability and product quality. Therefore, selecting appropriate packaging materials enhances not only product stability but also consumer trust, market positioning, and alignment with sustainable gastronomy and responsible consumption practices.



Table 5a

Overall Acceptability of Packaging Material for Wild Bush Passion Fruit Yogurt

Social Acceptability	GLASS		PLASTIC		STAND-UP POUCH	
	Weighted Mean	Descriptive Equivalent	Weighted Mean	Descriptive Equivalent	Weighted Mean	Descriptive Equivalent
1. Technical Performance	4.48	Much Acceptable (MA)	4.26	Much Acceptable (MA)	4.31	Much Acceptable (MA)
2. Economic Viability	4.13	Much Acceptable (MA)	4.61	Much Acceptable (MA)	4.39	Much Acceptable (MA)
1. Environmental Soundness	4.66	Much Acceptable (MA)	4.27	Much Acceptable (MA)	4.06	Much Acceptable (MA)
2. Social Acceptability	4.32	Much Acceptable (MA)	4.28	Much Acceptable (MA)	4.10	Much Acceptable (MA)
OVERALL MEAN	4.40	Much Acceptable (MA)	4.35	Much Acceptable (MA)	4.21	Much Acceptable (MA)

Table 5b

Overall Acceptability of Packaging Material for Wild Bush Passion Fruit Ice Cream

Social Acceptability	GLASS		PLASTIC		STAND-UP POUCH	
	Weighted Mean	Descriptive Equivalent	Weighted Mean	Descriptive Equivalent	Weighted Mean	Descriptive Equivalent
1. Technical Performance	4.27	Much Acceptable (MA)	4.49	Much Acceptable (MA)	4.23	Much Acceptable (MA)
2. Economic Viability	4.24	Much Acceptable (MA)	4.70	Much Acceptable (MA)	4.37	Much Acceptable (MA)
1. Environmental Soundness	4.60	Much Acceptable (MA)	4.49	Much Acceptable (MA)	4.27	Much Acceptable (MA)
2. Social Acceptability	4.22	Much Acceptable (MA)	4.59	Much Acceptable (MA)	4.14	Much Acceptable (MA)
OVERALL MEAN	4.33	Much Acceptable (MA)	4.57	Much Acceptable (MA)	4.25	Much Acceptable (MA)

Nutritional Profile

The nutritional analysis revealed that wild bush passion fruit yogurt and ice cream contained essential nutrients such as carbohydrates, protein, fat, sodium, and energy value. The incorporation of wild bush passion fruit contributed to the enhancement of nutritional and functional properties of the dairy products, indicating their potential as healthier and value-added food alternatives.

The improved nutritional quality may be attributed to the bioactive compounds and natural nutrients present in wild bush passion fruit, including antioxidants, dietary fiber, and phytochemicals. These compounds may contribute to improved digestive health, antioxidant activity, and overall nutritional value. The integration of fruit into dairy systems also creates a balanced combination of carbohydrates, proteins, and bioactive substances that may support health-conscious dietary preferences.

The findings support Al-aswad et al. (2025) and Pereira et al. (2023), who reported that fruit-enriched dairy products exhibit enhanced nutritional and antioxidant properties compared with conventional formulations. However, the present study extends previous findings by demonstrating the nutritional potential of *Passiflora foetida* specifically in yogurt and ice cream development within the Philippine setting.



The findings are particularly relevant in hospitality and tourism industries where consumers increasingly demand nutritious, natural, and functional food products. The development of nutrient-enriched dairy products using indigenous fruits supports sustainable food innovation while providing unique and health-oriented menu options for cafés, restaurants, and tourism enterprises.

Table 6a

Proximate Analysis of Yogurt

Carbohydrates	Crude Fat	Crude Protein	Moisture	Energy	Total sugar	Sodium
5.20	2.42	2.72	88.82	53	3.99	36

Table 6b

Proximate Analysis of Ice Cream

Carbohydrates	Crude Fat	Crude Protein	Moisture	Energy	Total sugar	Sodium
27.03	2.66	4.00	64.17	148	26.08	77

Return on Investment (ROI)

The return on investment analysis demonstrated that all treatments of wild bush passion fruit yogurt and ice cream were economically viable and profitable. The profitability of the products indicates strong commercialization potential and suggests that wild bush passion fruit may serve as a cost-effective and sustainable ingredient for dairy product development.

The positive ROI may be attributed to the local availability of wild bush passion fruit, which reduces dependence on imported flavoring agents and synthetic additives. Utilizing indigenous fruit resources may lower raw material costs while increasing product uniqueness and market appeal. Furthermore, consumers are increasingly attracted to innovative, health-oriented, and environmentally sustainable food products, which may contribute to higher market demand and willingness to pay.

The findings support Ildikó et al. (2022) and Baykal et al. (2024), who emphasized that consumers are willing to support nutritious and sustainable food products linked to local culture and tourism experiences. However, the present study contributes additional evidence by demonstrating the practical profitability of incorporating an underutilized indigenous fruit into dairy product entrepreneurship.

The findings also highlight the importance of sustainable food innovation in hospitality and tourism industries. Small-scale food entrepreneurs, cafés, and tourism enterprises may benefit from incorporating wild bush passion fruit products into their operations as unique and culturally relevant offerings. The commercialization of indigenous fruit-based products may therefore strengthen local economies, encourage community-based livelihood opportunities, and support sustainable gastronomy initiatives.

Table 7a

Cost and Return Analysis of Yogurt

Particulars	Treatment			
	T0	T1	T2	T3
Total Expenses	172	195	221	247
Yield	5	6	7	8
Selling Price	51.6	48.75	47.35	46.31
Total Sales	258	292.5	331.45	370.48
Net Income	86	97.5	110.45	123.48
Return on Investment	50%	50%	49.9%	49.9%



Table 7b

Cost and Return Analysis of Ice Cream

Particulars	Treatment			
	T0	T1	T2	T3
Total Expenses	312	335	358	382
Yield	17	20	23	27
Selling Price	27.53	25.12	23.35	21.22
Total Sales	468.01	502.4	537.05	572.94
Net Income	156.01	167.4	179.05	190.94
Return on Investment	50%	49.9%	50%	49.9%

Conclusions

Based on the findings of the study, the following conclusions were drawn:

1. Wild bush passion fruit possesses significant phytochemical and bioactive properties, confirming its potential as a functional ingredient for innovative and health-oriented dairy product development.
2. The developed wild bush passion fruit yogurt and ice cream products were microbiologically safe for consumption when prepared and stored under proper sanitary conditions, indicating their suitability for commercial food production and hospitality operations.
3. The incorporation of wild bush passion fruit produced yogurt and ice cream formulations that were highly acceptable in terms of appearance, aroma, flavor, texture, and overall sensory quality, with Treatment 3 obtaining the highest level of acceptability.
4. There were no significant differences among treatments in taste, texture, aroma, or appearance. However, a significant difference was observed in the overall acceptability of the yogurt formulations, indicating that fruit concentration influenced consumer preference.
5. Glass packaging for yogurt and plastic packaging for ice cream were identified as the most appropriate packaging materials based on product suitability, practicality, and consumer preference, supporting both quality preservation and marketability.
6. Shelf-life evaluation confirmed that wild bush passion fruit yogurt remained microbiologically safe for four weeks, while ice cream remained safe for eight weeks under freezing conditions, demonstrating good product stability and storage potential.
7. Nutritional analysis revealed that the developed products contained essential nutrients and functional properties that support their potential as nutritious and health-oriented dairy products for consumers seeking natural and sustainable food alternatives.
8. The study demonstrated that wild bush passion fruit yogurt and ice cream are economically feasible and possess strong commercialization potential, supporting sustainable food entrepreneurship, local livelihood generation, and the utilization of indigenous fruit resources.
9. The findings contribute to hospitality and tourism innovation by demonstrating how indigenous fruits may be transformed into marketable and culturally relevant food products that support sustainable gastronomy, culinary tourism, and environmentally responsible food enterprises.
10. Overall, the study highlights the importance of integrating indigenous ingredient utilization, food innovation, sustainability, and consumer acceptability in developing functional dairy products that contribute to sustainable food systems and local economic development.

Recommendations

In light of the conclusions, the following recommendations are proposed:

1. Future researchers may explore additional applications of wild bush passion fruit in other food and beverage products to further expand its functional, nutritional, and commercial potential.
2. Hospitality operators, food producers, and tourism enterprises may maintain strict sanitary and quality control practices during product preparation, storage, and distribution to ensure consumer safety and product consistency.



3. Food entrepreneurs and product developers may optimize fruit concentration levels and formulation techniques to further improve sensory quality, nutritional value, and market competitiveness.
4. Future studies may investigate additional variables such as texture enhancement, natural sweeteners, probiotic incorporation, and alternative dairy or plant-based formulations to diversify product applications.
5. Hospitality establishments, cafés, and local food enterprises may utilize appropriate and sustainable packaging materials to improve product preservation, presentation, environmental sustainability, and consumer appeal.
6. Tourism enterprises and local producers may develop branding and marketing strategies that emphasize indigenous identity, sustainable gastronomy, and authentic culinary experiences to strengthen product recognition and destination appeal.
7. Future researchers and food enterprises may conduct additional shelf-life studies under varying storage conditions, packaging systems, and transportation environments to improve product stability and commercial distribution potential.
8. Product developers and nutrition-oriented food businesses may further enhance the nutritional profile of the products by incorporating additional nutrient-rich ingredients and reducing sugar content to address evolving health-conscious consumer preferences.
9. Local producers, hospitality operators, educational institutions, and policymakers may support the commercialization and promotion of wild bush passion fruit products to encourage sustainable food entrepreneurship, indigenous resource utilization, and community-based livelihood opportunities.
10. Policymakers and tourism stakeholders may promote indigenous food innovation programs and sustainable gastronomy initiatives that encourage the integration of local ingredients into hospitality and tourism development strategies.
11. Educational institutions and training centers may integrate indigenous food innovation, sustainable culinary practices, and functional food development into hospitality and tourism education to strengthen research, entrepreneurship, and sustainable food systems awareness among future professionals.

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