IGNATIAN
INTERNATIONAL JOURNAL FOR MULTIDISCIPLINARY RESEARCH
www.icceph.com
ISSN 2984-9942

UTILIZATION OF CALABASH *(Crescentia cujete)* FRUIT EXTRACT AS GEL DESSERT

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https://doi.org/10.5281/zenodo.20359712

ABSTRACT

This Calabash *(Crescentia cujete)* is a locally available fruit in the Philippines that remains underutilized despite its potential for food product development. Converting calabash into familiar dessert forms may help increase consumer interest while promoting the use of indigenous and locally sourced materials. This study determined the use of calabash fruit extract as a gel dessert in three formulations: F1-pudding, F2-panna cotta, and F3-coffee jelly. An experimental research design was employed. This research also evaluated the products' sensory characteristics, level of acceptability in terms of appearance, aroma, taste, and texture. Results showed that of the three formulations, F2 panna cotta obtained the highest overall acceptability across, followed by F3 coffee jelly and F1 pudding, with significant differences observed across sensory attributes. The findings demonstrate that the Calabash Gel desserts are acceptable to consumers and can be successfully utilized in gel dessert production.

Keywords: *Calabash fruit extract, Crescentia cujete, gel dessert*

INTRODUCTION

Gel desserts provide an effective product form for introducing novel food ingredients because they are familiar, versatile, and widely accepted by consumers. Their soft texture, adaptable flavor profile, and accessibility make them suitable carriers for underutilized food resources such as calabash fruit extract. In the context of food innovation, transforming indigenous raw materials into familiar product forms may encourage consumer trial, improve acceptability, and support the broader utilization of

locally available resources. Tagud (2024) identified calabash as an underexplored raw material with strong potential for food product development, particularly when processed into products that enhance consumer acceptance and practical utilization.

The development of calabash-based gel desserts is anchored on the Theory of New Product Development. Gurbuz (2018) explained that a new product emerges from a novel and distinctive concept intended to satisfy consumer needs, emphasizing the role of creativity, market relevance, and product differentiation. In this regard, calabash fruit *(Crescentia cujete)* aligns with an innovation-driven approach because it is a tropical plant traditionally recognized for its medicinal value but remains rarely utilized in modern food systems (Gonzales, 2023). Its limited use in food applications presents a research gap and an opportunity for developing value-added products from indigenous resources.

Previous studies have emphasized the feasibility of developing functional food products from indigenous Philippine crops when innovation is supported by systematic product development and quality evaluation. Dizon et al. (2022) highlighted that many local fruits in the Philippines remain underutilized despite their food application potential, thereby strengthening the need for research-based food processing innovations.

The Diffusion of Innovation Theory further supports the present study by explaining how calabash fruit extract gel desserts may gain consumer awareness, trial, and acceptance when introduced in familiar product forms such as pudding, panna cotta, and coffee jelly. Rogers' theory explains that individuals adopt innovations at different rates depending on their readiness to accept change, and that adoption is influenced by awareness, evaluation, trial, and continued use. In relation to food innovation, Gunden et al. (2024) emphasized that consumer acceptance of novel foods may be enhanced when unfamiliar ingredients are incorporated into familiar food products. Thus, using calabash fruit extract in well-known gel desserts may reduce consumer hesitation and improve the likelihood of acceptance.

The role of early adopters is also relevant in the possible commercialization of calabash-based gel desserts. Menzli et al. (2022) emphasized the importance of early adopters in supporting the transfer and acceptance of innovations. In the context of the present study, café owners, dessert shop operators, food entrepreneurs, and consumers may serve as key agents in introducing calabash gel desserts to a wider market. Magdalita and San Pascual (2023) likewise showed that innovations presented in recognizable forms can facilitate acceptability, particularly when consumers are able to evaluate the product through direct sensory experience.

This study is also supported by Kolb's Experiential Learning Theory, which emphasizes learning through direct experience, reflection, and application. Palsodkar et al. (2023) explained that transforming raw materials into new food products involves practical experimentation and continuous refinement. In this study, the preparation, tasting, sensory evaluation, and improvement of calabash gel desserts reflect experiential learning. Consumers and evaluators do not merely respond to a theoretical product concept; rather, they directly interact with the product through sensory evaluation. This

process allows feedback to guide refinement and supports the development of a more acceptable food innovation.

The study is further anchored on national policies that promote research, innovation, and the utilization of indigenous resources. Article XIV, Section 10 of the 1987 Philippine Constitution recognizes science and technology as essential to national development and mandates the State to prioritize research, development, invention, innovation, and their utilization. Similarly, Republic Act No. 2067, also known as the Science Act of 1958, supports the integration, coordination, and intensification of scientific and technological research for national progress. These legal foundations affirm the relevance of developing value-added products from local resources such as calabash fruit.

Scientific evidence also supports the potential of calabash as a functional ingredient. Dasgupta et al. (2023) conducted qualitative and quantitative analyses of calabash fruit extracts and identified major bioactive secondary metabolites, including alkaloids, flavonoids, phenols, and saponins. These compounds are associated with antioxidant, antibacterial, and anti-inflammatory properties, providing biochemical support for the functional value of calabash fruit. Comparable Philippine-based chemical studies further reinforce its potential for product development and utilization.

Considering its underutilized status, functional properties, and local availability, calabash fruit presents a promising raw material for food product innovation. Incorporating calabash fruit extract into gel desserts offers a practical approach to improving its utilization while presenting it in forms that are familiar and acceptable to consumers. Therefore, this study explored the development of calabash fruit extract as a gel dessert in three formulations: pudding, panna cotta, and coffee jelly. Specifically, it aimed to evaluate the sensory characteristics and acceptability of the formulations and to support the possible development, adoption, and commercialization of calabash-based gel desserts.

Research Questions

Specifically, the study was conducted to determine the utilization, sensory characteristics and acceptability level of Calabash *(Crescentia cujete)* Fruit Extract as Gel Dessert in Bohol. It also aimed to answer the following questions:

1. What is the description of Calabash *(Crescentia cujete)* Fruit Extract as gel dessert in terms of ingredients and cost, materials, tools and equipment, procedures and shelf life?
2. What are the sensory characteristics of Calabash *(Crescentia cujete)* fruit extract in three gel dessert formulation in the aspect of appearance, aroma, taste and texture?
3. What is the acceptability level of Calabash (*Crescentia cujete)* fruit extract as applied in three gel dessert formula in the four attributes?

4. Is there a significant difference in the attributes and acceptability level of Calabash *(Crescentia cujete)* fruit extract as applied in three gel dessert formula?
5. What recommendations could be proposed based on the result of the study?

METHODOLOGY

The researcher used the mixed methods research design, combining experimental and descriptive approaches. The experimental method was used in the formulations of the gel dessert. The descriptive approach was applied to assess sensory characteristics and acceptability level in terms of appearance, aroma, taste, and texture across the three calabash *(Crescentia cujete)* gel dessert.

The sensory evaluation techniques of Meilgaard et al. (2016) were used in conjunction with a researcher-made sensory evaluation questionnaire that was adapted from the sensory quality measurement procedures of Gatchalian and Brannan (2011). In order to ascertain the acceptability level and sensory characteristics of Calabash *(Crescentia cujete)* fruit extract as Gel Dessert in terms of appearance, aroma, taste, and texture, the respondents were asked to select the appropriate scale for their assessment of the product. "5-Highly Acceptable" is the highest descriptor range, while "1-Unacceptable" is the lowest.

A structured questionnaire with coded samples for each formulation was distributed and used as the rating sheet during the sample testing process. An observation guide was utilized to monitor changes in the product's characteristics at low temperatures through refrigeration in individual packaging for a duration of seven (7) days in order to collect data on shelf life.

RESULTS and DISCUSSION

Table 1.1 shows the ingredients, cost and yield of the three treatments. For the three formulations, it varies on the process. The Panna cotta formulation recorded the highest total ingredient cost at ₱247.47, making it the most expensive among the three calabash gel dessert products. This higher cost may be attributed to the greater quantities and relatively higher prices of key ingredients, such as all-purpose cream, evaporated milk, and pectin powder, used in its preparation. The Pudding formulation on the other hand, registered the lowest total ingredient cost at ₱187.78, indicating that it is the most economical product to produce because it requires fewer and less expensive ingredients. Meanwhile, F3 Coffee jelly formulation had a total ingredient cost of P188.08 which is higher than F1 pudding.

Table 1.1
Ingredients and Cost

Ingredients	Unit	Unit Cost	F1 Pudding		F2 Panna Cotta		F3 Coffee Jelly	
			Qty	Cost	Qty	Cost	Qty	Cost
Calabash extract	ml	.25	480 ml	120.00				
Evaporated milk	ml	.08888	240 ml	21. 33				
Sugar	grams	.07295	120 g	8.75				
Pectin powder	grams	.16	25 g	4.00				
Salt	grams	.08666	1.5 g	.13				
Vanilla extract	Ml	2.73	5 g	13.65				
All purpose cream	ml	.332	60 ml	19.92				
Evaporated Milk	ml	.08888			250 ml	22.22		
Powdered gelatin	grams	4.40			7 g	30.80		
Sugar	grams	.07295			167 g	12.18		
All Purpose Cream	ml	.332			150 ml	49.80		
Vanilla extract	ml	2.73			4.5 g	12.29		
Salt	grams	.08666			1.5 g	0.18		
Calabash extract	ml	.25			480 ml	120.00		
Calabash extract	ml	.25					480 ml	120.00
Coffee grounds	grams	.3888					9 g	3.50
Sugar	grams	.07295					50 g	3.65
Powdered Gelatin	grams	4.40					9 g	39.60
Evaporated milk	ml	.08888					240 ml	21.33
Total cost of Ingredients			**187.78**		**247.47**		**188.08**	
Labor Cost (10%)			18.78		24.75		18.81	
Mark- up (20 %)			37.56		49.49		37.62	
Operating cost (15%)			28.17		37.12		28.21	
Running Total Cost			**P272.29**		**P 358.83**		**P 272.72**	
Yield: 180 ml/ jar/serving			4		4		4	
Selling Price/ jar			**P68.00**		**P 89.70**		**P 68.18**	

The results imply that the variation in ingredient composition and quantity greatly affects the total production cost of each formulation. Therefore, among the three formulations, F1 Pudding may be considered the most cost-efficient, while F2 Panna cotta may be regarded as the most-costly but potentially more premium product. Since F1 Pudding relies on starch-based thickening and uses fewer expensive dairy ingredients, it may be the most economical of the three recipes. However, this formulation may also be positioned as a premium product because dairy-rich chilled desserts are typically associated with indulgence and superior texture quality (Himashree, 2022). In contrast, F2 Panna cotta may be considered the most expensive because it is a cream-and-milk-based, gelatin-set dessert, which raises raw material costs. Any activity must be completed with the right instruments and equipment to guarantee the effective and correct execution of every procedure. Meanwhile, F3 Coffee jelly formulation had a total ingredient cost of P188.08 which is higher than F1 pudding.

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Table 1.2

Materials, Tools and Equipment

Quantity	Unit	Description
A. Materials		
12	pieces	Glass jars with lid
1	pack	2 Oz. Dessert cup with cover, transparent
1	pack	Long sticker paper
B. Tools		
6	pieces	4 quart mixing bowls, stainless
1	set	Measuring cup, plastic
1	set	Measuring spoon, plastic
1	piece	12x10” tray, stainless
1	piece	24 cube molder, silicon
3	pieces	Wooden ladle
1	Piece	Strainer
3	pieces	Stock pot, stainless
1	piece	Sauce pan, non-stick
1	piece	Rubber scraper
1	piece	Wire whisk
1	piece	Weighing scale, digital
1	Piece	Jar clipper
3	pieces	Cool rack
3	pieces	Utility knife
1	piece	Scooper, aluminum
1	piece	fine mesh sieve, aluminum
C. Equipment		
1	unit	Refrigerator
1	unit	Gas range with 8-burners

Table 1.2 shows the materials, tools, and equipment utilized in the preparation of the Calabash *(Crescentia cujete)* gel dessert formulations. The materials consisted of the ingredients required for each product formulation, while the tools and equipment were those used in the processes of extracting, measuring, mixing, heating, molding, packaging and chilling. The use of proper materials, tools and equipment greatly contributed to the accuracy, consistency, and quality of the developed gel dessert product formulations.

Table 1.3

Procedures in preparing Calabash *(Crescencia cujete)* Fruit extract as Gel Dessert

Formulation	Product	Procedure
Preliminary Procedure	**Preparation of Calabash Fruit Extract**	1. Select medium-sized mature calabash fruits that are yellowish-green in color and free from visible white spots or lines. 2. Wash the fruits thoroughly with clean water. 3. Cut the fruits in half, scoop out the flesh, and place it in a medium-sized pot. 4. Boil for approximately 40 minutes while stirring occasionally until the flesh turns blackish. 5. Extract the juice by pressing the cooked flesh through a fine mesh sieve. 6. Place the extracted juice in a mixing bowl and allow it to cool.
F1	**Calabash Pudding**	1. In a saucepan, combine calabash fruit extract, evaporated milk, and sugar. 2. Add pectin powder and stir until fully dissolved. 3. Add salt and mix well. 4. Cook over low heat until the mixture thickens. 5. Add vanilla extract and stir. 6. When the mixture becomes thick and smooth, add all-purpose cream, then remove from heat. 7. Pour the mixture into molds. 8. Allow to cool, then refrigerate for 1-2 hours before serving.
F2	**Calabash Panna Cotta**	1. In a saucepan with evaporated milk, sprinkle gelatin over the surface. 2. Allow the gelatin to soften for about 5 minutes until the surface appears wrinkled and wet. 3. In low heat, warm the milk while whisking frequently. Do not allow it to boil. 4. Add sugar and continue whisking until fully dissolved. 5. Turn off heat and whisk in all-purpose cream, vanilla extract, and salt. 6. In a molder, pour the milk-cream mixture then refrigerate for 10 minutes. 7. Combine calabash fruit extract, sugar, and gelatin until dissolved. 8. Add the calabash mixture over the chilled milk layer and refrigerate to set.
F3	**Calabash Coffee Jelly**	1. In a bowl, with the calabash extract, sprinkle gelatin to bloom for 5 minutes. 2. In a stock pot, mix the calabash fruit extract, coffee, and sugar in low heat then add the bloomed gelatin. Stir until smooth. 3. Put into molder to cool at room temperature. 4. Refrigerate for 2 hours or until set. 5. Cut into small cubes and serve in cups with milk.

Table 1.3 shows the steps involved in making the three Calabash *(Crescentia cujete)* fruit extract gel dessert formulations: F1 Calabash Pudding, F2 Calabash Panna Cotta, and F3 Calabash Coffee Jelly. To guarantee uniformity, precision, and standardization in product development, it covers the initial preparation of the calabash *(Crescentia cujete)* fruit extract as well as the particular processing techniques applied to each formulation. Recent Philippine studies support the potential of calabash *(Crescentia cujete)* as an underutilized fruit with promising applications in food research and product development.

Rellin, (2018), in a study published in the Philippine Journal of Science, analyzed Philippine-grown calabash fruit pulp and commercial fruit juice using GC-MS and UPLC-HRMS and confirmed the presence of multiple identifiable metabolites, highlighting the scientific relevance of locally grown calabash.

Tagud, (2024) reported that in terms of utilization, favorable sensory acceptability of calabash fruit jam, indicating that the fruit can be processed into an acceptable food product when properly formulated.

Similarly, Quezada (2025) documented the development of calabash pearl and showed that calabash can also be incorporated into another processed dessert-type product with acceptable qualities.

Said, (2023) also mentioned that the use of mature calabash fruit is aligned with gelling procedures because mature fruit provides more consistent raw material characteristics, which may help improve gel texture and stability. Taken together, these recent Philippine studies suggest that calabash is a locally available and research-worthy fruit that can be explored further for innovative food applications, including gel dessert development.

Table 1.4
Proximate Nutritional Analysis of "Calabash *(Crescentia cujete)* Fruit Extract
Reference No. MC2604-1861-01

Analysis	Unit	Results	Amount per 100g	RDI/PDRI basis	% contribution
Energy	-	-	34.37kcal	Male: 2,530 kcal/day Female: 1,930kcal/day	1.36% 1.78%
Moisture	g/100g	90.7 g	90.7 ml	Male AI: 2,530 ml/day Female: 1,930 ml/day	3.58% 4.70%
Ash	g/100g	0.907 g	0.907g	No direct RDI for total ash	Not computed
Crude fat	g/100g	0.155 g	0.155g	Adult AMDR: 15–30% of energy	Very low contribution
pH	-	4.54 @ 22.1°C	4.54	No direct RDI for total ash	Not computed
Carbohydrates	g/100g	7.66 g	7.66g	Adult AMDR: 55–75% of energy	Low contribution
Crude Protein (Nx6.25)	g/100g	0.583 g	.583g	Male RNI: 71 g/day Female RNI: 62 g/day	.82% .94%

Table 1.4 shows the proximate nutritional analysis and pH of calabash (*Crescentia cujete)* fruit extract. The result indicates that the sample was composed primarily of water, making it a high-moisture material. Its high moisture content makes it suitable for use as a liquid base in gel dessert formulation specifically for products requiring a smooth and soft texture.

Based on the measured solid components, carbohydrates had the largest proportion, while protein and fat were present only in very small amounts. The ash content further suggests that the sample contained a relatively small amount of total mineral residue. It indicates that 100g of calabash *(Crescentia cujete)* fruit extract contains approximately 34.37 kcal, indicating that it is a low calorie food material. Since the

calabash fruit extract contains only minimal amounts of protein and fat, it should not be regarded as a primary source of these nutrients. However, its carbohydrate content may contribute to the body and overall quality of the dessert.

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Table 1.5

Shelf life of "Calabash *(Crescentia cujete)* Fruit Extract as Gel Dessert"

Storage Condition: Refrigerated **Observation Period:** 7 Days

Sensory Attributes	Desirable characteristics		
Appearance	Appealing glossy smooth surface and uniform dark gray color		
Aroma	Strong pleasant, inviting herbal or woody scent		
Taste	Highly palatable with subtle sweetness and well-balanced flavor		
Texture	Very smooth, firm, creamy and gelatinous that melts pleasantly in the mouth		
Observation period	**Calabash Pudding F1**	**Calabash Panna Cotta F2**	**Calabash Coffee Jelly F3**
Day 1	Appealing glossy smooth surface and uniform dark gray color	Appealing glossy smooth surface and uniform dark gray color	Appealing glossy smooth surface and uniform dark gray color
Day 2	No changes	No changes	No changes
Day 3	No changes	No changes	No changes
Day 4	No changes	No changes	No changes
Day 5	Slight dullness on surface Visible moisture separation	Slight surface moisture observed Slight sour odor detected	Slight decrease in aroma, soft jelly but still gelatinous Slightly less pleasant
Day 6	Duller appearance with more moisture separation	Appealing glossy appearance Presence of mildew, less glossy Strong sour odor detected	Strong sour odor Softer jelly Deterioration detected Dull appearance
Day 7	Off odor	Off odor	Off odor

The DOST Region VI, (2021) explains that shelf life determination is centered on the product's mode of deterioration, suitability of packaging, and changes in sensory, chemical, and microbiological quality during storage and remains consistent with both Philippine and international literature on refrigerated dairy-based foods.

Moreno, (2022) highlighted a report from Philippine Dairy Research that refrigeration around 4°C helps delay deterioration by lowering microbial and enzymatic activity, but prolonged refrigerated storage still promotes spoilage microorganisms and quality loss.

Magno, (2021) also mentioned that moisture separation that became noticeable in the pudding formulation from Day 5 onward may be interpreted as syneresis, which has been reported to increase in milk puddings during refrigerated storage and is associated with reduced water-holding capacity and weakening of gel structure.

In addition, the emergence of sour odor, watery texture, and unstable body by Days 5 to 7 is consistent with international findings that "psychrotrophic" bacteria can still

grow in milk and milk products during refrigerated storage and produce spoilage related changes such as off odors and texture breakdown.

Although the FDA allows refrigerated ready-to-eat foods to be date-marked for up to 7 days at 5°C or below, the present observations show that the quality shelf life of this dairy-based dessert was shorter than the regulatory maximum. It provides that sensory deterioration occurred before the end of the allowable holding period.

The shelf life of gel desserts is formulation-dependent and should be established through actual shelf life testing using sensory, physical, and microbiological criteria. Based on the recorded observations, pudding and panna cotta showed earlier signs of quality deterioration than coffee jelly during the 7-day refrigerated storage period. This finding can be explained by the composition of the two products. The F1 pudding and F2 panna cotta contain dairy ingredients, which have high moisture, high nutrient availability, and neutral-to-slightly acidic conditions that favor faster spoilage, even under refrigeration. This means that high moisture and nutrients foods need careful temperature control to prevent the growth of harmful microorganisms.

Table 2

Sensory characteristics of Calabash *(Crescentia cujete)* fruit extract in three gel dessert formulations in terms of its appearance, aroma, taste, and texture

Sensory Characteristics	F1 Pudding		F2 Panna Cotta		F3 Coffee Jelly	
	F	%	F	%	F	%
Appearance						
Appealing glossy smooth surface and uniform dark gray color	43	53.75	79	98.75	7	8.75
Appealing dark gray, glossy smooth well-formed shape	37	46.25	1	1.25	73	91.25
Appealing dark gray, glossy smooth even edges	0	0	0	0	0	10
Appealing dark gray, glossy smooth uneven surface and edges	0	0	0	0	0	0
Appealing dark gray, soft glossy elastic gel	0	0	0	0	0	0
Aroma						
Strong pleasant, inviting herbal or woody scent	1	1.25	79	98.75	69	86.25
Gentle mix of plant-based with pleasant herbal scent	16	20.00	1	1.25	11	13.75
Delicate fragrance with minimal intensity like neutral and scent	63	78.75	0	0	0	0
Faint herbal or woody scent	0	0	0	0	0	0
Subtle natural scent reminiscent of dried herbs	0	0	0	0	0	0
Taste						
Highly palatable with subtle sweetness and well-balanced flavor	27	33.75	14	17.50	30	37.50
Palatable and acceptable flavor in neutral bland	27	33.75	66	82.50	7	8.75
Moderately palatable flavor in slightly sour flavor	26	32.50	0	0	43	53.75
Slightly palatable flavor in earthy and plant-like taste	0	0	0	0	0	0
Palatable flavor in mildly bitter-sweet flavor	0	0	0	0	0	0
Texture						
Very smooth, firm, creamy and gelatinous that melts pleasantly in the mouth	0	0	59	73.75	7	8.75
Smooth, firm, creamy and gelatinous that melts pleasantly in the mouth	69	86.25	21	26.25	32	40.00
Moderately smooth, firm, creamy and gelatinous	11	13.75	0	0	41	51.25
Slightly smooth, firm, creamy and gelatinous	0	0	0	0	0	0
Too soft that breaks into small pieces upon chewing	0	0	0	0	0	0

Table 2 shows the frequency and percentage distribution of respondents' descriptive evaluations of the sensory characteristics of the three calabash *(Crescentia cujete)* gel dessert formulations: F1 Pudding, F2 Panna Cotta, and F3 Coffee Jelly. In terms of appearance, F2 Panna Cotta exhibited the most consistent visual acceptability, as majority of the respondents (98.75%) described it as having an appealing glossy smooth surface with uniform dark gray color. Responses for the F1 Pudding were relatively evenly distributed, with 53.75% of respondents noting its appealing and uniform surface, while 46.25% emphasized its well-formed shape. In comparison, F3 Coffee Jelly was generally perceived as visually attractive, as a large majority of respondents (91.25%) described it as having an appealing dark gray color, along with a glossy, smooth surface and a well-defined shape. However, its visual ratings showed slightly greater variation compared with those of F2 Panna Cotta.

In terms of aroma, F2 panna cotta again emerged as the most favored formulation. A very high proportion of respondents with 98.75% described it as having a strong, pleasant, and inviting herbal or woody aroma. On the other hand, F1 pudding was mainly characterized by a delicate or neutral scent with low intensity, as reported by 78.75% of respondents, indicating a comparatively mild aroma profile. While F3 coffee jelly, also demonstrated favorable aroma qualities, with most respondents 86.25% perceiving it as strongly pleasant, while a smaller proportion (13.75%) described a gentler, mixed aroma.

In the aspect of taste, F1 Pudding received varied responses from the respondents. At about 40% described it as moderately palatable with a slightly sour flavor, while equal proportions of respondents, 30% each manifesting it as either highly palatable and well-balanced or palatable but neutral. In this formulation, responses exhibit some variability in taste perception. In striking contrast, F2 panna cotta was largely described as palatable and acceptable but neutral or mildly bland by most respondents by 82.50%, indicating that while its taste was generally well accepted, it was perceived as subtle and less pronounced. For F3 coffee jelly the responses were more divided. Slightly more than half of the respondents with 53.25% described it as moderately palatable with a slightly sour flavor, while 37.50% rated it as highly palatable, noting subtle sweetness and a balanced flavor. These results suggest a stronger overall flavor impact for F3 Panna Cotta even if a degree of sourness was still noted by some respondents.

In terms of texture, F2 panna cotta was favored with by majority of the respondents with 72.75% describing it as very smooth, firm, creamy, and gelatinous, which reflects a premium mouthfeel. F1 pudding also received high texture ratings, as 76.70% of respondents characterized it as smooth, firm, creamy, and gelatinous, noting that it melts pleasantly in the mouth. Strikingly F3 coffee jelly showed greater variation in texture perception with respondents nearly evenly divided between those who described it as smooth and firm with 40% and those who perceived it as moderately smooth and firm with 51.25% rate.

The pattern of responses indicates that F2 panna cotta displayed the strongest and most consistent sensory attributes across appearance, aroma, and texture. Nevertheless, F3 coffee jelly remained highly acceptable, although greater variation was

observed in respondents' perceptions of taste and texture. In general, F1 pudding was generally acceptable but was characterized by a milder aroma and a more mixed assessments of taste.

Table 3

Acceptability Level of Calabash *(Crescentia cujete)* Fruit Extract in Three Gel Dessert Formulations Based on Four Sensory Characteristics

Sensory Attributes	Formulation 1		Formulation 2		Formulation 3	
	Weighted Mean	**Descriptive Value**	**Weighted Mean**	**Descriptive Value**	**Weighted Mean**	**Descriptive Value**
Appearance	4.48	Highly Acceptable	4.99	Highly Acceptable	3.99	Acceptable
Aroma	3.20	Moderately Acceptable	4.99	Highly Acceptable	4.77	Highly Acceptable
Taste	3.90	Acceptable	4.27	Highly Acceptable	3.97	Acceptable
Texture	3.80	Acceptable	4.77	Highly Acceptable	3.62	Acceptable
Overall Composite Mean	**3.85**	**Acceptable**	**4.76**	**Highly Acceptable**	**4.09**	**Acceptable**
Rank	**3**		**1**		**2**	

Table 3 presents the acceptability levels of calabash *(Crescentia cujete)* fruit extract across the three gel dessert formulations (F1, F2, and F3) based on four sensory attributes. The results indicate that F2 panna cotta obtained the highest weighted mean scores across all sensory attributes appearance (WM = 4.99), aroma (WM = 4.99), taste (WM = 4.27), and texture (WM = 4.77) all interpreted as Highly Acceptable, resulting in the highest overall composite mean (WM = 4.76, Highly Acceptable) and placing F2 Panna Cotta as Rank 1. This pattern suggests that respondents consistently favored F2 panna cotta across key sensory aspects, including visual appeal, aroma intensity and pleasantness, flavor acceptability, and texture quality.

Clearly, F3 Coffee Jelly obtained an overall composite mean of 4.09 (Acceptable) and ranked 2nd. It was rated Highly Acceptable in aroma (WM = 4.77) but only Acceptable in appearance (WM = 3.99), taste (WM = 3.97), and texture (WM = 3.62). This suggests that while F3 Coffee jelly produced a strongly favorable aroma, its other sensory qualities were perceived as less outstanding than F2 Panna Cotta. F1 pudding ranked lowest in the overall composite mean score of 3.85, which corresponds to an Acceptable rating and placed it third among the formulations. It received a Highly Acceptable rating for appearance (WM = 4.48); however, it was rated only Moderately Acceptable in aroma (WM = 3.20) and Acceptable in both taste (WM = 3.90) and texture (WM = 3.80).

These results suggest that while F1 pudding was visually appealing, it was less preferred overall due to its weaker aroma and comparatively lower evaluations in taste

and texture. The findings suggest that among the three formulations, F2 panna cotta was the most acceptable gel dessert incorporating calabash fruit extract, followed by F3 coffee jelly. On the contrary, F1 pudding was the least preferred formulation based on respondents' overall sensory evaluations.

The highest acceptability rating among the three formulations belonged to F2 Panna cotta with an overall composite mean score of 4.76, which was interpreted as Highly Acceptable, and also ranked first in overall. This result means a strong and consistent respondent preference for F2 panna cotta across all four sensory attributes. F3 coffee jelly got the second rank among the three formulations, with an overall composite mean score of 4.09, interpreted as Acceptable. While F3 Coffee jelly demonstrated strong performance in terms of aroma, which received a high weighted mean of 4.77. It did not exceed F2 panna cotta in any of the evaluated sensory attributes. F1 pudding placed third in the rank among the three formulations, with an overall composite mean score of 3.85, interpreted as Acceptable. The appearance was its strongest attribute with a recording of 4.48 weighted mean.

In contrast, aroma is the weakest attribute with a weighted mean of 3.20 and an interpretation of Moderately Acceptable. Across all sensory attributes, F2 panna cotta consistently recorded the highest weighted mean scores, denoting that it was the most preferred formulation in terms of appearance, aroma, taste, and texture.

F2 panna cotta exhibited its strongest performance in appearance and aroma, both registering a weighted mean scores of 4.99. Although its lowest rating was observed for taste (WM = 4.27), this score was still interpreted as Highly Acceptable, indicating a consistent and strong sensory evaluation across all attributes. Meanwhile, F3 Coffee jelly exhibited strong performance in aroma, with a weighted mean score of 4.77, indicating that respondents found its smell highly appealing. However, its texture scored the lowest among its sensory attributes, with a weighted mean of 3.62. and F1 Pudding showed its best result in appearance with 4.48, but it had a noticeable decline in aroma, scoring only 3.20. This suggests that while F1 Pudding was visually acceptable, with its aroma.

Overall, F2 panna cotta was rated as the most acceptable and preferred gel dessert formulation using calabash fruit extract. Its consistently high ratings across all sensory attributes suggest that it has the best balance of appearance, aroma, taste, and texture. Therefore, F2 Panna Cotta may be considered the most suitable formulation for further product development or recommendation.

The results of the Friedman test and post-hoc pairwise comparisons are shown in Table 4 on the acceptability level of Calabash *(Crescentia cujete)* fruit extract gel dessert formulations in terms of appearance, aroma, taste, texture, and overall acceptability. For appearance, there is a statistically significant difference among the three treatments, $\chi^2(2) = 113$, $p < .001$. This indicates that the acceptability of appearance significantly differs across formulations. Post-hoc analysis shows that all pairwise comparisons are significant ($p < .001$), indicating that each treatment differs from the others.

Table 4

Significant Differences in Acceptability Level of Calabash *(Crescentia cujete)* Fruit Extract Applied in Three Gel Dessert Formulations

Characteristics	Treatment	Mean	Stat-Value (χ^2)	df	p-value	Decision	Interpretation	Post-Hoc Comparison	p-value	Decision	Interpretation
Appearance	F1	4.48	113	2	< .001	Reject Ho	Significant	F1 vs F2	< .001	Reject Ho	Significant
	F2	4.99						F2 vs F3	< .001	Reject Ho	Significant
	F3	3.99						F3 vs F1	< .001	Reject Ho	Significant
Aroma	F1	3.2	147	2	< .001	Reject Ho	Significant	F1 vs F2	< .001	Reject Ho	Significant
	F2	4.99						F2 vs F3	< .001	Reject Ho	Significant
	F3	4.77						F3 vs F1	< .001	Reject Ho	Significant
Taste	F1	3.9	23.1	2	< .001	Reject Ho	Significant	F1 vs F2	< .001	Reject Ho	Significant
	F2	4.27						F2 vs F3	< .001	Reject Ho	Significant
	F3	3.97						F1 vs F3	0.402	Fail to Reject Ho	Insignificant
Texture	F1	3.88	110	2	< .001	Reject Ho	Significant	F1 vs F2	< .001	Reject Ho	Significant
	F2	4.77						F2 vs F3	< .001	Reject Ho	Significant
	F3	3.62						F1 vs F3	0.006	Reject Ho	Significant
Overall	F1		155	2	<.001	Reject Ho	Significant	F1 vs F2	< .001	Reject Ho	Significant
	F2							F2 vs F3	< .001	Reject Ho	Significant
	F3							F3 vs F1	< .001	Reject Ho	Significant

significant at 0.05

Among the treatments, F2 Panna Cotta obtains the highest mean (M = 4.99), followed by F1 Pudding (M = 4.48), and F3 Coffee jelly (M = 3.99), suggesting that F2 Panna cotta is the most acceptable in terms of appearance.

For aroma, a significant difference is observed among treatments, $\chi^2(2) = 147$, $p < .001$. Post-hoc results reveal that all pairwise comparisons are significant ($p < .001$), indicating significant differences in aroma acceptability among the formulations. F2 Panna Cotta records the highest mean (M = 4.99), followed by F3 Coffee Jelly (M = 4.77), while F1 Pudding obtains the lowest mean (M = 3.20), indicating that F2 Panna cotta and F3 Coffee Jelly are more acceptable in aroma compared to F1.

In terms of taste, a significant difference is found among formulations, $\chi^2(2) = 23.1$, $p < .001$. Post-hoc analysis shows significant differences between F1 pudding and F2 Panna Cotta ($p < .001$) and between F2 Panna Cotta and F3 Coffee jelly ($p < .001$).

However, no significant difference is found between F1 Pudding and F3 Coffee jelly ($p = 0.402$), indicating that these two formulations have comparable taste acceptability. F2 Panna Cotta obtains the highest mean (M = 4.27), followed by F3 Coffee Jelly (M = 3.97), and F1 Pudding (M = 3.90), suggesting that F2 Panna Cotta is the most acceptable in terms of taste.

For texture, a significant difference is also observed among formulations, $\chi^2(2) = 110$, $p < .001$. Post-hoc comparisons indicate significant differences for most pairwise tests, including F1 Pudding vs F2 Panna Cotta ($p < .001$), F2 Panna Cotta vs F3 Coffee Jelly ($p < .001$), and F1 Pudding vs F3 Coffee Jelly ($p = 0.006$). These findings show that texture acceptability significantly differs across formulations. F2 Panna Cotta obtains the highest mean (M = 4.77), followed by F1 Pudding (M = 3.88), and F3 Coffee Jelly (M = 3.62), indicating that F2 Panna Cotta is the most acceptable in terms of texture.

For overall acceptability, a significant difference is likewise observed among the formulations, $\chi^2(2) = 155$, $p < .001$. Post-hoc analysis reveals that all pairwise comparisons are significant ($p < .001$), indicating that each formulation significantly differs from the others in terms of overall acceptability. Although individual means are not specified in the table, the results indicate that F2 Panna Cotta consistently performs best across sensory attributes, followed by F1 Pudding and F3 Coffee Jelly. Hence, the findings show that there are significant differences in the acceptability levels of Calabash *(Crescentia cujete)* fruit extract gel dessert formulations across all sensory attributes.

Among the three treatments, F2 Panna Cotta consistently obtains the highest sensory ratings, indicating that it is the most acceptable formulation in terms of appearance, aroma, taste, texture, and overall acceptability.

Conclusions

The study confirms that calabash *(Crescentia cujete)* fruit extract is a potential ingredient for gel dessert development with formulation differences that significantly influencing sensory quality and consumer acceptance. Among the three formulations, Panna cotta (F2) had the highest total ingredient cost (₱247.47) and the highest computed running cost/selling price per serving (₱89.70), indicating it is the most premium and cost-intensive formulation. Pudding (F1) was the most economical (total ingredient cost = ₱187.78; selling price = ₱68.00). Production utilized standard food processing materials, common kitchen tools, and basic equipment to ensure consistency and safe preparation. Nutritional Analysis further showed that Calabash *(Crescentia cujete)* fruit extract is a high-moisture, low-calorie, low-fat, and low-protein food material, with carbohydrates as its major solid nutrient component. Shelf life revealed that all formulations were generally acceptable during days 1–4, but showed deterioration signs beginning Day 5 onward indicating that quality shelf life is best to consume within the first 4 days under the refrigerated storage. The pattern of responses indicated that F2 panna cotta displayed the strongest and most consistent sensory attributes across appearance, aroma, taste and texture indicating its acceptability as gel dessert. It also highlighted the strong potential of calabash *(Crescentia cujete)* as an innovative yet underutilized local resource when formulations are carefully optimized for sensory quality and market positioning.

Recommendations

Based on the conclusions of the study, the following recommendations are proposed:

1. The F2 panna cotta formulation is recommended as the product prototype for calabash *(Crescentia cujete)* gel dessert development. The consistent high sensory ratings and strong overall acceptability suggest that it aligns well with consumer preferences making it a promising option for technology transfer initiatives, pilot-scale production, and future commercialization.
2. F1 pudding formulation may be improved further particularly in terms of aroma and taste. Refining the level of sweetness, adjusting flavoring, and optimizing the proportion of calabash fruit extract to enhance palatability and reduce variability in sensory perception.
3. Product development opportunities may be explored using calabash fruit extract by testing other gel dessert variations and alternative packaging options for a broader consumer trials that can further support potential commercialization and promote calabash as an underutilized local resource.
4. Consumer acceptability may be conducted in a broader study scope involving more diverse respondent groups with various age ranges, tourists and local consumers, and frequent café customers to validate market potential and improve the transferability of the findings.
5. Nutritional and functional properties of calabash based gel desserts may be investigated through additional analyses, such as micronutrient content, antioxidant activity, and bioactive compound screening. These data may support stronger scientific and health related claims.
6. Different packaging options may be assessed to identify the most suitable choice in terms of consumer appeal, cost effectiveness, durability, safety, and protection during storage and distribution.
7. Fully mature calabash fruits may be used for future product development and food applications. Mature fruits are identified typically large, heavy, firm, and hard-shelled, with a yellowish-green color, no visible white spots or surface lines, and a hollow sound when tapped. Selecting fruits at this stage can help ensure more reliable, consistent, and high quality product outcomes.

Compliance with Ethical Standards

The author hereby attest that all ethical guidelines were followed in the conduct of this study. Prior to their participation, all participants provided informed consent and were made aware of their right to withdraw from the study at any time without any consequences. The privacy of all respondents was safeguarded throughout the study, and their welfare was given utmost priority. This study was carried out without any conflicts of interest. To preserve the integrity and originality of the work, plagiarism was strictly avoided. The study's objectives were fulfilled with academic integrity and ethical responsibility by interpreting the results objectively and using them solely for research purposes.

Acknowledgments

The researcher would like to glorify our God Almighty for giving her the courage and strength to pursue and finish this piece of work.

The researcher is also thankful to her family for their support, prayers and love in the attainment of this research.

The researcher would like to express gratitude to Dr. Marcelina C. Celada, Dr. Chona C. Fullido, Dr. Eliza T. Jala and Dr. Marice E. Climaco for their inexhaustible patience, expertise, and continuous guidance from the beginning until the completion of this study.

Lastly, to all persons whose names although not mentioned, had manifested their support, prayers and love in the attainment of this research.

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APA Citation:

Cericos-Sentillas, L. (2026). UTILIZATION OF CALABASH (Crescentia cujete) FRUIT EXTRACT AS GEL DESSERT. Ignatian International Journal for Multidisciplinary Research, 4(5), 2332–2349. https://doi.org/10.5281/zenodo.20359712

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