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Sensory Acceptability and Characterization of French Macarons Enriched with *Annona Muricata* Fruit Powder

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Abstract: *This study aimed to develop and evaluate the acceptability of French Macarons enriched with Guyabano (Annona muricata) powder, focusing on enhancing their flavor, texture, and stability for potential marketability. Specifically, it examined the sensory acceptability of three macaron formulations, and the presence of significant differences among them. Employing a quantitative research design, data were collected from 20 food experts and 30 consumer respondents using a 9-point hedonic scale. Statistical analyses included median for sensory evaluation, mean for nutritional and chemical analysis, and One-Way ANOVA for determining significant differences among formulations. Sensory evaluation revealed that Formulation A was the most preferred, rated as "like very much" across all sensory attributes. In contrast, Formulations B and C received lower ratings. Statistical analysis confirmed significant differences among the three formulations. The findings demonstrate that incorporating Guyabano fruit powder into French Macarons enhances their nutritional value and consumer appeal. Formulation A, in particular, presents a viable, health-oriented, and locally-sourced snack alternative with potential for commercialization and application in institutional and entrepreneurial food development initiatives..*

Keywords: French Macarons, *Annona Muricata Fruit, Fruit Powder Enrichment*

I. INTRODUCTION

Guyabano (Annona muricata), commonly known as soursop, is a tropical fruit celebrated for its sweet, tangy flavor and rich nutritional profile. As a natural source of vitamins, minerals, and antioxidants, Guyabano offers numerous health benefits and holds great potential for culinary innovation. In the Philippines, where Guyabano is widely cultivated, the fruit is an abundant resource that can be utilized to create unique and nutritious food products. With the growing demand for health-conscious and novel food options, incorporating Guyabano into traditional recipes can present a significant opportunity to showcase its versatility and value. This study explores the potential of Guyabano in the development of a premium confectionery product: French macarons enriched with Guyabano powder.

French macarons, known for their delicate texture, aesthetic appeal, and intricate preparation, serve as an ideal platform to integrate the unique flavor and nutritional benefits of Guyabano. Previous studies have demonstrated the successful incorporation of tropical fruits into baked goods, enhancing both flavor and nutritional value (Reyes et al., 2020). Similarly, Liu et al. (2021) highlighted the strong consumer acceptance of exotic fruit powders in confectionery products due to their novelty and health benefits. Despite the rise of fruit-based innovations in the food industry, research on utilizing Guyabano in high-end desserts remains limited, with most studies focusing on its medicinal properties (Garcia et al., 2019), antioxidant activity (Lopez et al., 2022), and juice production (Santos et al., 2021).

This research aligns with key global, national, and regional priorities. It contributes to the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production), by promoting the sustainable use of local resources and reducing food waste through the utilization of Guyabano by-products. It supports SDG 3 (Good Health and Well-being) by offering a health-conscious product and SDG 8 (Decent Work and Economic Growth) by fostering economic opportunities for local farmers and food

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entrepreneurs (United Nations, 2015). At the national level, the study aligns with the Philippine Research Agenda, focusing on agricultural innovation, food security, and nutrition. It also resonates with the Caraga Regional Research Development and Innovation Agenda, emphasizing value-adding processes and sustainable resource utilization in agriculture to stimulate regional competitiveness.

Furthermore, the research is guided by the i2Fame framework, which emphasizes innovation, inclusivity, and sustainability. By introducing an innovative product that incorporates locally sourced, natural ingredients, the study fosters inclusivity by engaging local communities and contributing to sustainable development. Additionally, the study aligns with Ambisyon Natin 2040, the national long-term vision for a "matatag, maginhawa, at panatag na buhay," by promoting healthier food choices, economic opportunities, and showcasing Filipino creativity in global culinary contexts (NEDA, 2016).

Ultimately, this research seeks to optimize the flavor, texture, and stability of Guyabano-enriched French macarons for market acceptance, paving the way for further applications of tropical fruits in high-end confectionery. By bridging the gap in existing literature and addressing consumer demand for premium, nutritious, and sustainable food products, this study makes a valuable contribution to food innovation and sustainable development..

II. LITERATURE REVIEW

Nature and Usability of French Macarons

French macarons are delicate confections made primarily of almond flour, egg whites, and sugar, characterized by their crisp shells and chewy centers. They are globally celebrated for their visual appeal, diverse flavors, and contrasting textures (Sanchez et al., 2019). With a growing demand for unique and health-conscious desserts, incorporating alternative or infused ingredients into traditional macaron recipes has gained attention. Recent research has highlighted the benefits of tropical fruit powders in enhancing macarons. For instance, Kim and Park (2020) found that incorporating freeze-dried tropical fruit powders into macaron fillings not only enhanced flavor but also increased nutritional value, achieving high consumer acceptance. Additionally, Chua et al. (2021) emphasized that balancing moisture and acidity is critical when incorporating fruit-based components into macarons to maintain quality and stability.

The Role of Guyabano (*Annona Muricata*) Fruit in Culinary Applications

Guyabano (Annona muricata), commonly known as soursop, is a tropical fruit known for its creamy texture, tangy flavor, and rich nutritional profile. It is an excellent source of vitamin C, potassium, and antioxidants, making it versatile in both culinary and medicinal applications. According to Bautista et al. (2019), incorporating Guyabano puree into beverages significantly improved both consumer satisfaction and nutritional value.Mendez et al. (2020) explored the use of Guyabano in baked products and noted its potential to enhance traditional recipes with its distinct flavor and added nutritional benefits. The study emphasized that Guyabano, in forms such as puree or powder, can be easily integrated into various food applications, making it an ideal ingredient for premium confectionery.

Processes and Techniques for Infused Ingredients

The success of fruit-infused confectionery depends on preserving sensory and nutritional properties. Freeze-drying is one of the most effective methods for tropical fruits like Guyabano. Lee et al. (2020) highlighted that freeze-drying retains the natural flavor, color, and nutrients of fruits, making it suitable for premium confectionery applications.Managing moisture and acidity levels is also essential when incorporating fruit powders into macarons. According to Wong et al. (2021), excessive moisture can affect the crispness of macaron shells, while unbalanced acidity can alter their texture and shelf life. Stabilizing fruit powders with binding agents or pairing them with low-moisture fillings has been suggested to address these challenges.

Nutritional Value and Health Benefits of Guyabano (*Annona Muricata*) Fruit

Beyond its culinary applications, Guyabano is recognized as a functional food due to its high antioxidant content. Research by Garcia et al. (2021) highlighted its ability to combat oxidative stress, which appeals to health-conscious

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consumers. Moreover, Cruz et al. (2022) emphasized that Guyabano's bioactive compounds, including acetogenins, provide potential health benefits, making it an attractive ingredient for innovative food products.The integration of Guyabano into macarons aligns with the growing consumer demand for functional and novel food products. As noted by Santos et al. (2023), tropical fruits like Guyabano enhance both the nutritional value and marketability of desserts, offering a unique combination of health benefits and culinary appeal.

Challenges in Fruit-Infused Confectionery

Incorporating fruit-based ingredients into confectionery often presents challenges in maintaining product stability and quality. According to Lim et al. (2020), moisture migration is a common issue that can compromise the textural integrity of macarons. Similarly, Wong and Tan (2021) emphasized the importance of achieving a balanced formulation to avoid overwhelming the base recipe's structural properties.Studies also highlight the need for precise measurements and controlled conditions during production. Bautista et al. (2022) suggested that utilizing stabilizers and emulsifiers can help manage the interactions between fruit components and traditional macaron ingredients, improving shelf life and sensory quality.

Innovations in Tropical Fruit-Based Desserts

The trend of incorporating tropical fruits into desserts has led to numerous innovations in the culinary industry. According to Santos et al. (2020), tropical fruits like Guyabano offer unique flavors that distinguish premium confectionery products in competitive markets. Additionally, Cruz and Garcia (2021) noted that tropical fruit-based desserts cater to the growing demand for natural and functional ingredients.Recent advancements in processing techniques, such as spray-drying and vacuum-drying, have further enhanced the usability of tropical fruits in confectionery. Lee et al. (2023) demonstrated that these methods effectively preserve the nutritional and sensory properties of fruits, ensuring high consumer acceptance.

Sensory Evaluation of Fruit-Infused Confectionery

Sensory evaluation plays a crucial role in determining the acceptability of fruit-infused confectionery products. Attributes such as appearance, aroma, texture, and taste significantly influence consumer preferences and purchase decisions. According to Moreno et al. (2021), desserts that integrate fruit-based ingredients are often evaluated for their ability to balance natural fruit flavors with traditional confectionery profiles.Incorporating tropical fruits like Guyabano into macarons requires careful attention to sensory balance. Bautista and Cruz (2020) noted that tropical fruit infusions are best received when their acidity complements the inherent sweetness of the dessert. Additionally, Lim et al. (2022) emphasized that visual appeal, particularly the vibrant color of fruit-based ingredients, enhances consumer perception of premium quality.Studies by Garcia et al. (2023) and Wong et al. (2021) have shown that textural harmony between the macaron shell and filling is critical for overall sensory acceptability. Consumers prefer macarons with shells that are crisp yet delicate, paired with fillings that are smooth, creamy, and well-balanced in flavor. Sensory trials help identify optimal formulations that maximize consumer satisfaction while maintaining product stability.

III. METHODOLOGY

This study utilized a developmental research design since this study creates and optimizes French Macarons enriched with Guyabano (*Annona Muricata*) fruit powder through formulation and process refinements aimed at acquiring favorable sensory characteristics, flavor, texture, and stability, this design is quite appropriate.Quantitative design was also used to determine the acceptability of the product in terms of appearance/color, aroma/odor, taste, texture. This was also used to evaluate the nutritional value of the Antipolo fruit seed flour, ensuring that the snack bar product to be developed met safety and quality standards.The developmental research study on French macarons enriched with Guyabano fruit powder was carried out in Food Technology Innovation Center in Surigao del Norte State University, Surigao City.Three formulations were prepared with different Guyabano fruit powder concentration: Formulation C-50% being the highest, Formulation A - 37.5% and Formulation A with the lowest concentration.

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The research instruments for this study are structured to gather detailed feedback on the acceptability of French Macarons enriched with Guyabano (*Annona Muricata*) fruit powder while ensuring the safety of participants, especially those with food allergies. A sensory evaluation form using a 9-point hedonic scale was employed to assess the macarons' sensory attributes, including appearance, aroma, flavor, texture, and overall acceptability. The hedonic scale, ranging from "dislike extremely" to "like extremely," allows participants to express their preferences quantitatively. To address food allergies, the survey included a pre-screening section where respondents can indicate any known allergies, particularly to common macaron ingredients such as nuts (almond flour) or eggs. Participants with allergies were not engaged in tasting but can provide feedback on non-tasting attributes such as appearance and aroma.

A letter of request was sent to the respondents to ask for their consent and cooperation in gathering necessary data for this study. Respondents who have superiors were also given letters to their respective heads of office to ensure that their participation in this study does not jeopardize any professional standard. After the conduct, copies of the distributed survey instrument was retrieved, and the data collected was analyzed and interpreted. Median was used to determine the acceptability of the sensory attributes of the three formulations of French Macarons enriched with Guyabano (*Annona Muricata*) fruit powder in terms of appearance, aroma, taste, texture, and composite appeal. Mean was used to determine the physico-chemical and nutritional contents of the Antipolo fruit seed flour-based snack bar. Moreover, One-Way Analysis of Variance (ANOVA) for Repeated Measures was used to determine the significant difference on the acceptability of the Antipolo fruit seed flour-based snack bar based on the three formulations.

IV. RESULTS AND DISCUSSION

The sensory evaluation data reveals a clear preference pattern regarding the appearance and color of guyabano-infused French macarons across three different formulations as shown in Table 1. Formulation A, containing the lowest concentration of guyabano flour, consistently received the highest ratings across all appearance attributes, with median scores of 8 ("like very much") for most criteria and 7 ("like moderately") for the luster attribute. This suggests that a lower concentration of guyabano puree produces the most visually appealing macarons.Formulation B, with a moderate guyabano flour concentration, performed reasonably well but received slightly lower scores than Formulation A, with most attributes rated as 7 ("like moderately") and luster rated as 6 ("like slightly"). This indicates that while still acceptable, the increased puree concentration begins to negatively impact the visual qualities of the macaron.

In stark contrast, Formulation C with the highest guyabano flour concentration was consistently rated poorly across all appearance attributes, receiving median scores of 4 ("dislike slightly") for most criteria and 3 ("dislike moderately") for luster. This strongly suggests that excessive guyabano puree significantly compromises the visual appeal of French macarons, likely affecting their characteristic appearance properties.The overall preference clearly favors Formulation A, which received the highest rating of 8 ("like very much") as the preferred formulation. This finding indicates that when incorporating guyabano puree into French macarons, a lower concentration yields superior results in terms of appearance, maintaining the desirable color, clarity, brightness, and overall visual presentation that consumers expect from high-quality macarons.

TABLE 1: ACCEPTABILITY OF APPEARANCE/COLOR OF THE FRENCH MACARONS ENRICHED WITH GUYABANO (*Annona Muricata*) FRUIT POWDER

Appearance/Color	Formulation A		Formulation B		Formulation C	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
1. Color of the Guyabano-infused French Macaron.	8	like very much	7	like moderately	4	dislike slightly
2. Clarity and brightness of the Guyabano-infused Macaron.	8	like very much	7	like moderately	4	dislike slightly
3. Luster of the Guyabano-infused French	7	like moderately	6	like slightly	3	dislike moderately

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Macaron						
4.Overall appearance of the macaron (size, shape,uniformity).	8	like very much	7	like moderately	4	dislike slightly
5. Consistency and uniformity of the color in the macaron.	8	like very much	7	like moderately	4	dislike slightly

The aroma and odor evaluation of the three guyabano-infused French macaron formulations reveals patterns similar to the appearance assessment, with a clear preference hierarchy among the different puree concentrations. Formulation A emerged as the most favorable, receiving predominantly high ratings across all aroma attributes. The intensity of guyabano aroma and its harmony with other ingredients were both rated 8 ("like very much"), indicating that this concentration provides an optimal aromatic profile that enhances rather than overwhelms the delicate balance of macaron flavors.

For attributes related to appetite stimulation and freshness, Formulation A received slightly lower but still positive scores of 7 ("like moderately"), suggesting a pleasant and inviting aroma that contributes positively to the overall sensory experience. Notably, the general aroma acceptability and market suitability was rated highly at 8 ("like very much"), reinforcing the commercial potential of this formulation.

Formulation B performed adequately but consistently scored below Formulation A. Most attributes received ratings of 7 ("like moderately") with freshness rated slightly lower at 6.5 (between "like slightly" and "like moderately"). Consistent with the appearance evaluation, Formulation C performed poorly across all aroma attributes, uniformly receiving scores of 4 ("dislike slightly"). This strongly suggests that the highest concentration of guyabano puree creates an imbalanced or overpowering aroma that detracts from the sensory experience rather than enhancing it.

The overall preference was decisively in favor of Formulation A, with a rating of 8 ("like very much"), confirming that a lower concentration of guyabano flournot only achieves the best visual results but also creates the most appealing aromatic profile. This consistent finding across different sensory dimensions indicates that when incorporating guyabano into French macarons, a more subtle approach yields superior results, allowing the unique tropical fruit characteristics to complement rather than dominate the delicate pastry.

TABLE 2: ACCEPTABILITY OF AROMA/ODOR OF THE FRENCH MACARONS ENRICHED WITH GUYABANO (*Annona Muricata*) FRUIT POWDER

Aroma/Odor	Formulation A		Formulation B		Formulation C	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
1. Intensity of Guyabano aroma.	8	like very much	7	like moderately	4	dislike slightly
2. Harmony of Guyabano with other macaron ingredients.	8	like very much	7	like moderately	4	dislike slightly
3. Aroma that stimulates appetite and sensory acceptability	7	like moderately	7	like moderately	4	dislike slightly
4. Freshness of the aroma	7	like moderately	6.5	like moderately	4	dislike slightly
5. General aroma	8	like very much	7	like moderately	4	dislike slightly

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acceptability and market Suitability						

The taste evaluation of the three guyabano-infused French macaron formulations further solidifies the preference pattern established in previous sensory assessments, with taste attributes showing particularly definitive results. Formulation A maintained its superiority across all taste parameters, consistently receiving exceptional ratings of 8 ("like very much") for every attribute. This remarkable consistency suggests that Formulation A achieves an ideal flavor profile that perfectly balances the unique tropical notes of guyabano with the traditional sweetness expected in French macarons.The high scores for sweetness and sweetness-to-acidity ratio indicate that Formulation A strikes an optimal balance between these key taste elements. Equally important, the high rating for "intensity and naturalness of guyabano flavor" suggests that even at this lower concentration, the distinctive tropical fruit character comes through authentically without being overwhelmed by other ingredients. The top ratings for flavor acceptability and overall taste attractiveness further emphasize that this formulation has significant commercial potential, with respondents indicating it would motivate repeat purchases.

Formulation B performed respectably but generally fell short of Formulation A's excellence. Most attributes received ratings of 7 ("like moderately"), with the notable exception of the sweetness-to-acidity ratio, which matched Formulation A with a score of 8 ("like very much"). This suggests that while the overall taste experience is diminished with increased puree concentration, the specific balance between sweet and acidic notes remains appealing at the 15% level.

Formulation C continued its pattern of underperformance, with most taste attributes rated at 4 ("dislike slightly"). However, there was slight improvement in two areas compared to previous sensory dimensions: the sweetness-to-acidity ratio scored 5 ("neither like nor dislike") and the overall taste acceptability reached 4.5 (between "dislike slightly" and "neither like nor dislike"). This suggests that while still generally unfavorable, the taste characteristics of the highest concentration formulation were marginally more acceptable than its appearance and aroma.

The overall preference was decisively in favor of Formulation A with a rating of 8 ("like very much"), completing a trifecta of dominance across all sensory dimensions evaluated. This consistent finding across appearance, aroma, and now taste provides compelling evidence that when incorporating guyabano puree into French macarons, Formulation B achieves the most harmonious integration of this tropical fruit with the delicate pastry. The results strongly indicate that attempting to intensify the guyabano presence beyond this point leads to diminishing returns and ultimately to product rejection at the highest concentration tested.

TABLE 3: THE ACCEPTABILITY OF TASTE OF THE FRENCH MACARONS ENRICHED WITH GUYABANO (*Annona Muricata*) FRUIT POWDER

Taste	Formulation A		Formulation B		Formulation C	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
1. Sweetness of the Guyabano-infused French Macaron.	8	like very much	7	like moderately	4	dislike slightly
2. Sweetness to acidity ratio of the macaron	8	like very much	8	like very much	5	neither like nor dislike
3 Intensity and naturalness of Guyabano flavor	8	like very much	7	like moderately	4	dislike slightly
4. Flavour acceptability that results in a repeat	8	like very much	7	like moderately	4	dislike slightly

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purchase.						
5. Overall acceptability of taste and market attractiveness.	8	like very much	7	like moderately	4.5	neither like nor dislike

The texture evaluation of the three guyabano-infused French macaron formulations completes a comprehensive sensory profile, revealing how different concentrations of guyabano puree affect the crucial textural properties that define a quality macaron. Formulation A maintained its superior performance across texture attributes, though with some interesting nuances compared to previous sensory dimensions.For shell crunchiness, Formulation A received a score of 7 ("like moderately"), slightly lower than its typical ratings in other categories. This suggests that even at the lowest concentration tested, the addition of guyabano puree has a modest impact on achieving the perfect crisp shell that characterizes traditional macarons. Nevertheless, this formulation still delivered a highly acceptable level of crunchiness that satisfied respondents.

TABLE 4: ACCEPTABILITY OF TEXTURE OF THE FRENCH MACARONS ENRICHED WITH GUYABANO (*Annona Muricata*) FRUIT POWDER

Texture	Formulation A		Formulation B		Formulation C	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
1. The macaron shells must be crunchy.	7	like moderately	6	like slightly	3	dislike moderately
2. The macaron filling should have a tender and chewy texture.	8	like very much	8	like very much	5	neither like nor dislike
3. Moisture in the macarons.	8	like very much	7	like moderately	4	dislike slightly
4. There should be evenness in texture for the shell and the filling.	8	like very much	7	like moderately	5	neither like nor dislike
5. Overall tenderness and smoothness of the macaron.	8	like very much	7	like moderately	4	dislike slightly

For all other texture attributes, Formulation A excelled with scores of 8 ("like very much"), indicating that Formulation A concentration maintains ideal tender and chewy filling, appropriate moisture content, balanced textures between shell and filling, and overall tenderness and smoothness. This demonstrates that at this concentration, guyabano puree enhances rather than compromises the distinctive textural characteristics that make macarons a prized confection.Formulation B showed more variation in texture ratings than in previous sensory categories. Shell crunchiness received only a 6 ("like slightly"), indicating that the increased moisture from additional puree begins to significantly affect this critical textural element. Interestingly, the filling texture maintained a high score of 8 ("like very much"), matching Formulation A. This suggests that higher puree concentration positively influences the filling's texture while simultaneously compromising the shell. Other texture attributes received consistent ratings of 7 ("like moderately"), reflecting an overall acceptable but not optimal textural profile.

Formulation C exhibited its most dramatic negative impact in the shell crunchiness category, receiving a rating of just 3 ("dislike moderately"). This represents the lowest score across all attributes in all sensory dimensions, indicating that at this highest concentration, guyabano puree severely compromises the shell's structural integrity and signature crunch. Other texture attributes showed slightly better performance than in previous sensory dimensions, with ratings between 4

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("dislike slightly") and 5 ("neither like nor dislike"), suggesting that while still generally unfavorable, some textural elements remain somewhat acceptable despite the high moisture content.

The overall preference was again decisively in favor of Formulation A with a rating of 8 ("like very much"), completing a clean sweep across all four sensory dimensions evaluated. This consistent finding provides definitive evidence that Formulation A flour concentration optimizes the integration of this tropical fruit into French macarons. The texture evaluation particularly highlights the technical challenges of incorporating moisture-rich fruit purees into macarons, with shell integrity becoming increasingly compromised as puree concentration increases. Formulation A successfully navigates this challenge, delivering a product that maintains the quintessential textural contrasts that define an excellent macaron while incorporating the novel guyabano flavor.

The ANOVA results for the sensory evaluation of three Guyabano (Annona muricata) macaron formulations demonstrate highly significant differences across all sensory attributes assessed. For appearance, the analysis yielded an F-value of 286.166 ($p < .001$), indicating substantial variation in how the three formulations were visually perceived by evaluators. Similarly, the aroma evaluation showed significant differences with an F-value of 289.039 ($p < .001$), suggesting distinct olfactory profiles among the formulations. The most pronounced difference was observed in taste perception, which produced the highest F-value of 418.566 ($p < .001$), demonstrating that taste was the sensory attribute with the greatest variation across the three formulations. Texture evaluation also revealed significant differences with an F-value of 265.803 ($p < .001$). The consistently low p-values ($< .001$) across all sensory parameters indicate extremely strong statistical evidence that the three macaron formulations differ substantially in their sensory characteristics. These results suggest that the modifications made to the formulations had profound impacts on the overall sensory experience, with taste showing the most dramatic variation among the three versions. This comprehensive sensory analysis provides clear evidence that the formulation alterations resulted in distinctly different macaron products from a sensory perspective. These consistently high F-values and extremely low p-values (less than 0.001) provide strong statistical evidence that substantial differences exist among the three formulations for all sensory attributes tested. The null hypothesis of no difference should be rejected based on these results.

TABLE 5: SIGNIFICANT DIFFERENCE ON THE ACCEPTABILITY OF THE SENSORY ATTRIBUTES OF THE THREE FORMULATIONS OFFRENCH MACARONS ENRICHED WITH GUYABANO (*Annona Muricata*) FRUIT POWDER

Sensory Attribute	**F**	**p**	**Decision on Ho**	**Interpretation**
Appearance	286.17	< .001	Rejected	Significant
Aroma	289.04	< .001	Rejected	Significant
Taste	418.57	< .001	Rejected	Significant
Texture	265.8	< .001	Rejected	Significant

The nutritional analysis of the developed Guyabano (Annona muricata) macaron reveals a product with moderate caloric content, providing 388.16 calories per 100g or approximately 190 calories per serving. This represents about 8% of the RENI (Recommended Energy and Nutrient Intake) for males aged 19-29 years. The macaron derives roughly 27% of its calories from fat (106.56 calories from fat per 100g), containing 11.84g of total fat per 100g or 6g per serving, which accounts for 8% of the daily value based on a 2000-calorie diet. Carbohydrates constitute the majority of the macaron's nutritional composition at 63.17g per 100g (32g per serving), contributing 12% to the daily recommended intake. The product contains a modest amount of protein at 6.73g per 100g (3g per serving), fulfilling 6% of daily value requirements and 5% of RENI standards for young adult males. Notably, the sodium content is relatively low at 91.37mg per 100g (45mg per serving), accounting for only 2% of the daily value, suggesting the macaron could be suitable for those monitoring sodium intake. Overall, this Guyabano macaron represents a primarily carbohydrate-based confection with moderate fat content and minimal protein contribution to the diet.

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TABLE 6: NUTRITIONAL CONTENTS OF FORMULATION "A" OFFRENCH MACARONS ENRICHED WITH GUYABANO (*Annona Muricata*) FRUIT POWDER

Food Nutrient	Result of Chemical Analysis(per 100g)	Amount of food nutrient per serving size (rounded value)	% Daily value (based on 2000 Calorie Diet,Rounded value)	%RENI(based on FNRI reference adult requirement of males 19-29 years old)
Calories	388.16	190		8
Calories from Fat	106.56	50		
Total Fat(g)	11.84	6	8	
Sodium(mg)	91.37	45	2	
Total Carbohydrates(g)	63.17	32	12	
Protein(g)	6.73	3	6	5

The physico-chemical analysis of Guyabano (Annona muricata) provides valuable insights into its nutritional composition. The moisture content was determined to be 17.08 g/100g, indicating that the fruit contains a moderate amount of water compared to many other fresh fruits, which typically have higher moisture levels. This relatively lower moisture content may contribute to the fruit's suitability for processing into purees and other food applications. The analysis revealed a surprisingly high total fat content of 11.84 g/100g, which is notable for a fruit, as most fruits typically contain significantly lower fat levels. This elevated fat content may contribute to the creamy texture and mouthfeel that Guyabano is known for, and could be beneficial when incorporating the fruit into products like macarons where fat content influences texture and flavor retention.

TABLE 7: PHYSICO-CHEMICAL PROPERTIES OF FORMULATION "A" OFFRENCH MACARONS ENRICHED WITH GUYABANO (*Annona Muricata*) FRUIT POWDER

Parameters	**Unit**	**Result**	**Method**
Moisture	%	17.08 g/100g	AOAC No. 925.10 AOAC International 2023, 22nd ed., vol 2
Total Fat	%	11.84 g/100g	AOAC No.935.39 D International 2023, 22nd ed., vol 2
Ash Content	%	1.18 g/100g	AOAC No. 923.03, International 2023, 22nd ed., vol 2
Crude Protein	%	6.73 g/100g	AOAC No.935.39 C International 2023, 22nd ed., vol 2
Sodium	%	91.37 mg/100g	AOAC No.973.54 AOAC International 2023, 22nd ed., vol 1

The ash content was measured at 1.18 g/100g, representing the total mineral content of the fruit. This moderate ash content suggests that Guyabano contains a reasonable amount of inorganic nutrients and minerals that contribute to its nutritional value.Crude protein was determined to be 6.73 g/100g, which is relatively high for a fruit. This protein content enhances the nutritional profile of Guyabano and may contribute to its potential health benefits and satiety value when consumed. The sodium content was measured at 91.37 mg/100g, which is somewhat high compared to many other fruits. This sodium level could be a consideration when developing food products for individuals on sodium-restricted diets.All measurements were conducted using official AOAC International methods (2023, 22nd edition), ensuring the reliability and reproducibility of the results. This comprehensive nutritional profile helps explain why Guyabano is valued not only for its unique flavor but also for its nutritional attributes when incorporated into food products like the macarons evaluated in the sensory studies.

V. CONCLUSION

The respondents rated Formulation A as "like very much" in terms of appearance, aroma, taste, texture, and composite appeal of the French Macarons enriched with Guyabano powder. Formulation B was rated "like slightly" for appearance and "like moderately" for aroma, taste, texture, and composite appeal. Formulation C received a rating of

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"dislike slightly" for appearance, aroma, texture, and composite appeal, and "neither like nor dislike" for taste. Formulation A of the French Macarons enriched with Guyabano powder is most preferred by the respondents.

Formulation A of the French Macarons enriched with Guyabano powder is a moderately energy-dense snack that offers a balanced mix of macronutrients, particularly carbohydrates and moderate amounts of fat and protein. It contributes modestly to the daily nutritional requirements, making it a potentially appealing functional food item. The presence of Guyabano powder may enhance its nutritional and phytochemical profile, aligning the product with consumer preferences for health-conscious and value-added food choices.The physico-chemical profile of Formulation A of the French Macarons enriched with Guyabano powder demonstrates a nutritionally balanced and shelf-stable product with low moisture and moderate fat and protein levels. The measured values reflect good processing and ingredient integration, highlighting the formulation's potential as a functional and market-ready snack. The incorporation of Guyabano powder not only contributes to the nutritional value but may also enhance the product's appeal due to its known health benefits.

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