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Sensory Acceptability and Characterizationof Durian Rind Tart

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Abstract: *This study explored the development and evaluation of an alternative flour derived from durian (Durio zibethinus) rind, with the goal of using it as a primary ingredient in tart formulations. Specifically, it assessed the phytochemical composition of durian rind and its incorporation into three tart formulations evaluated for sensory acceptability in terms of appearance, aroma, taste, texture, and overall appeal. The research also analyzed the nutritional and physicochemical properties of the most preferred formulation. The study employed a descriptive and mixed-methods design, with laboratory and sensory evaluation conducted at Surigao del Norte State University's Food Technology Innovation Center. Data were gathered from 120 respondents, including food experts and consumers, and were analyzed using frequency counts, percentages, means, standard deviations, MANOVA for repeated measures, Bonferroni tests, and ANOVA with Scheffé's post hoc analysis. Results revealed that durian rind contains beneficial phytochemicals, and among the three formulations, Formulation B consistently received the highest ratings across all sensory attributes. Significant differences were observed among formulations. Nutritional and physicochemical analyses further supported the viability of Formulation B as a moderately healthy and stable tart product, highlighting its potential for commercial and sustainable food applications.*

Keywords: *Durian rind flour, sensory evaluation, tart formulation, phytochemical analysis, sustainable food product*

I. INTRODUCTION

Durian, a tropical fruit with a spiky exterior and a distinctive, potent odor, is native to Southeast Asia, including Thailand. It is rich in carbohydrates, primarily in the form of starch and sugar. Additionally, durian contains hemicellulose, a type of indigestible fiber. Countries like Thailand, Malaysia, Indonesia, Philippines, Vietnam, Cambodia, and Myanmar are major producers of this fruit. While less common, durian is also grown in other tropical regions, such as Hawaii. Thailand and Malaysia dominate global durian production, contributing nearly 90% of the world's supply. Philippine durian production varies, peaking at 91,210 metric tons in 2013. Mindanao Island is a major producer, contributing around 54,700 metric tons annually. In 2021, the country produced over 73,000 metric tons of fresh durian.Durian fruit consists of flesh (20-35%), seeds (5-15%), and husk (55-66%). The husk, often discarded, is a significant source of agricultural waste. The Philippines generates about 22,000 metric tons of durian waste annually, much of which ends up in landfills or is discarded along roadsides.

The durian fruit is rich in several essential nutrients, including carbohydrates, proteins, vitamins, and minerals, which contribute to its health benefits. Notably, durian is a good source of vitamin C, B vitamins (such as thiamine and riboflavin), calcium, potassium, iron, and magnesium, among others (Chua et al., 2020). The high carbohydrate content, primarily in the form of sugars and starches, provides a significant energy source, making durian an energy-dense fruit (Sangpong et al., 2021). The nutritional profile of durian varies with its ripeness. Ripe durian is particularly noted for its higher levels of bioactive compounds, including polyphenols, flavonoids, and carotenoids, which are associated with antioxidant and anti-inflammatory properties (Ketsa et al., 2023). For instance, studies have shown that durian extracts exhibit anti-proliferative effects in vitro, suggesting potential benefits for cancer prevention (Sinulingga et al., 2020).Furthermore, the fruit's antioxidant capacity is significant, with various studies highlighting its ability to scavenge free radicals, which can contribute to oxidative stress and various health issues (Wiangsamut et al., 2023).

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The presence of carotenoids, particularly β-carotene and α-carotene, enhances the fruit's nutraceutical value, providing additional health benefits (Ketsa et al., 2023). In addition to its nutritional benefits, durian seeds also possess health-promoting properties. They are rich in starch and have been explored as a potential substitute for wheat flour in various food products, thereby contributing to food innovation and waste reduction. The seeds and other non-edible parts of the fruit, often discarded, can be utilized in various applications, promoting sustainability within the durian industry (Cui et al., 2021).Given the significant amount of durian waste generated annually, researchers have explored its potential for various applications, including food and non-food products. While studies have focused on specific aspects of durian waste utilization, a comprehensive review specifically addressing the potential of durian rind flour, particularly in the context of bakery products like tarts, macaroons, and cookies, is still needed. This review aims to fill this gap by examining the value, benefits, and potential applications of durian rind flour in these specific food products.

II. LITERATURE REVIEW

Durian, often referred to as the "King of Fruits," is a tropical fruit native to Southeast Asia with the Philippines being a notable player in its cultivation and exportation. The country, especially Davao City, has emerged as one of the top exporters of durian, contributing significantly to the global market, which is currently estimated at 1.4 million tons (Gallawan et al., 2023). While the Philippines primarily focuses on domestic consumption, it is also involved in the export market, although it lags behind countries like Thailand and Malaysia, which dominate the global durian trade. It is celebrated for its distinctive aroma, creamy texture, and rich flavor, though its smell can be polarizing. The fruit comprises three main components: pulp (edible), seeds, and rind, with the latter two often discarded as waste. Rich in carbohydrates, dietary fiber, and essential vitamins, durian pulp is a popular ingredient in desserts and beverages (Misman et al., 2022).The rind, which constitutes a substantial portion of the fruit, is typically tough and fibrous. While traditionally regarded as waste, recent studies have shown its potential as a source of dietary fiber and bioactive compounds, making it suitable for various applications in the food and pharmaceutical industries (Tan et al., 2023).

Attributes

The fruit typically exhibits a large, ovoid to nearly round shape, with an average weight ranging from 2 kg to 4 kg, depending on the cultivar (Teo et al., 2024). The exterior of the durian is notable for its thick, spiky husk, which serves as a protective layer for the soft, creamy flesh inside. This spiky exocarp not only contributes to the fruit's formidable appearance but also plays a crucial role in its mechanical properties, allowing it to withstand significant impacts without damage (Islam, 2023).The aroma of durian, often described as polarizing, is primarily attributed to its complex composition of volatile compounds. Research indicates that durian's distinctive scent arises from a combination of esters and sulfur-containing compounds. Esters, such as ethyl acetate and ethyl α-methyl butyrate, contribute fruity notes, while sulfur compounds, including thiols and disulfides, impart the characteristic pungent odor associated with the fruit (Yang, 2024).

Durian Rind as Waste

Durian rind, a by-product of durian fruit consumption, is often discarded as waste, leading to significant environmental concerns globally, particularly in countries like the Philippines where durian is widely cultivated. The durian fruit, known for its strong odor and unique taste, has a substantial rind that constitutes approximately 60-75% of the whole fruit (Sangkhonkhet et al., 2023). This high percentage of waste presents both an environmental challenge and an opportunity for resource recovery. In the Philippines, particularly in regions like Davao City, durian is a major agricultural product, and the disposal of its rind contributes to pollution and waste management issues (Gallawan et al., 2023).

Nutritional and Functional Properties of Durian Rind Flour

Durian rind is rich in dietary fiber, particularly crude fiber, which makes it a suitable replacement for wheat flour in food formulations. For instance, (Bhoosem et al., 2021) revealed that incorporating durian rind powder into butter cakes,

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replacing wheat flour, significantly increased dietary fiber. Notably, consumer acceptance remained high for formulations with up to 5% durian rind powder substitution, demonstrating the potential of this ingredient to enhance the nutritional profile of baked goods while maintaining consumer appeal.

Health Benefits of Durian Rind

Durian rind, frequently discarded as waste, has attracted considerable interest due to its potential health benefits and its applicability in various fields. This interest is primarily attributed to its rich phytochemical composition, particularly the presence of phenolic acids and flavonoids. Research findings indicate that the rind of Durio zibethinus contains significant levels of these compounds, such as caffeic acid, quercetin, and myricetin, which are known to exhibit strong antioxidant properties (Tran, 2023). This antioxidant activity is crucial as it helps mitigate oxidative stress, which is linked to various chronic diseases, including cancer and cardiovascular disorders (Charoenphun et al., 2022).Moreover, the anti-inflammatory properties of durian rind have been substantiated through various studies. The rind has been shown to inhibit the production of pro-inflammatory mediators, suggesting its potential use in managing inflammatory conditions (Nguyen, 2024). The presence of bioactive compounds in the rind may also contribute to its use as a natural preservative, as evidenced by its efficacy in preserving food products through its antimicrobial properties (Kamaruzzaman, 2024).

The nutritional value of durian rind extends beyond its bioactive compounds. It is rich in cellulose, hemicellulose, and lignin, making it a valuable resource for producing biodegradable materials and food additives, such as pectin (Lestari, 2024). The cellulose content, which ranges from 31% to 35%, positions durian rind as a sustainable alternative for hydrogel fabrication and other industrial applications (Xing et al., 2022). Furthermore, the extraction of pectin from durian rind has been explored for its potential in creating biopolymers, which could be utilized in various food and pharmaceutical applications (Lestari, 2024).In terms of metabolic health, durian rind extracts have demonstrated antidiabetic effects, with studies showing a significant reduction in blood glucose and cholesterol levels in experimental models (Na & Jalil, 2019). This suggests that incorporating durian rind into diets may offer protective benefits against metabolic disorders, enhancing its appeal as a functional food ingredient.

Processing and Applications

Processing techniques are pivotal in transforming durian rind into flour. (Hasem et al., 2019) emphasized the potential of extracting pectin from durian rinds, highlighting its multifunctionality in food as a stabilizer and texturizer. These insights underline the broader applicability of durian rind derivatives beyond flour, supporting its valorization as a valuable resource in food processing.Durian rind flour has been successfully utilized in developing various bakery products. Similarly, (Kwanhian's 2023) work with butter cakes confirmed its potential to substitute conventional flours while improving nutritional profiles. Furthermore, (Tran, 2023) demonstrated the antioxidant properties of durian rind, as highlighted by Tran, suggest that its inclusion could also impart health benefits, such as reducing oxidative stress in consumers. The exploration of durian rind flour as an alternative flour source has gained traction due to its unique nutritional profile and functional properties. Durian rind flour, derived from the outer skin of the durian fruit, presents a promising alternative to traditional flours such as wheat and corn, particularly in terms of dietary fiber content and potential health benefits.

A key characteristic of durian rind flour is its high carbohydrate content, which can reach as much as 70% in certain formulations (Grasielda, 2022). The carbohydrate composition of durian rind flour is comparable to that of wheat flour, typically ranging from 70% to 75%. However, the functional properties of these two flours differ markedly. Durian rind flour exhibits lower crystallinity and distinct amylopectin characteristics, which may consequently influence its behavior in baking and cooking applications(Huga et al., 2022). Given its fiber content, durian rind flour may offer potential benefits for digestive health and blood sugar management. However, further research specifically on durian rind flour is needed to confirm these potential effects (Isnaini, 2021). The use of durian rind flour in food products has been shown to significantly enhance their nutritional value without compromising their sensory appeal, presenting a compelling option for food manufacturers (Grasielda, 2022).

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Durian rind flour has been successfully utilized in various products, including ice cream and baked goods, where it serves as a thickening agent or a substitute for cornstarch. The incorporation of durian rind flour into these products not only enhances their nutritional profile but also contributes to a unique flavor and texture that can differentiate them in the market. This versatility is a significant advantage over other alternative flours, such as those derived from legumes or nuts, which may have more pronounced flavors that can limit their application in certain recipes (Isnaini, 2023). Moreover, the environmental aspect of utilizing durian rind flour is noteworthy. The durian fruit is widely consumed, particularly in Southeast Asia, leading to substantial waste from the rind. By converting this waste into flour, there is potential for reducing food waste and promoting sustainability in food production (Sembor, 2023). This aligns with global trends towards more sustainable food systems, where the valorization of food by-products is increasingly prioritized.

III. METHODOLOGY

The study utilized the descriptive research design method to analyze the acceptability of durian rind flour tart. This approach aimed to assess how well the durian rind flour received in comparison to traditional flour. Mixed methods research design is determining the sensory attributes of the flour and analyzed for analytical and chemical analysis, which includes moisture content, fiber, fat and total ash. While the sensory acceptability of the food products that utilize the durian rind flour as the main ingredient in making tart will be measured in terms of appearance, aroma, taste and texture.The developmental research study on Durian Rind Flour will be conducted at the Food Technology Innovation Center within Surigao del Norte State University, located in Surigao City, Caraga Region, Philippines. To determine the level of acceptability of the product, an adaptive-made questionnaire will be utilized, the potential products will be then evaluated using a 9-point Hedonic Scale especially in ascertaining the acceptability of the product in terms of appearance, aroma taste and texture by the panel of experts, consumers that were picked through a purposive random sampling. Multiple trials will be conduct to achieve a desired product.Mean and Standard Deviationwere used to determine the acceptability of the durian rind tart as to appearance, aroma, flavor/taste, and texture.Multivariate Analysis of Variance (MANOVA) for Repeated Measures and Bonferroni's Test were used to compare the three formulations of durian rind tart in terms of the four sensory attributes: appearance, aroma, taste, and texture.

IV. RESULTS AND DISCUSSION

Table 1 presents the acceptability of the appearance of the three different Durian Rind Tart formulations as evaluated by the panel of raters.

TABLE 1: ACCEPTABILITY OF APPEARANCE OF DURIAN RIND TART

Statement	Formulation A			Formulation B			Formulation C		
	M	**SD**	***D***	**M**	**SD**	***D***	**M**	**SD**	***D***
1. The tart looks visually appealing.	7.30	0.92	***LM***	8.43	0.72	***LVM***	7.58	0.91	***LVM***
2. The crust has an even color and bake.	7.18	1.10	***LM***	8.36	0.79	***LVM***	7.42	0.88	***LM***
3. The tart appears fresh and well-presented.	7.44	1.07	***LM***	8.33	0.89	***LVM***	7.50	0.89	***LVM***
4. The color of the product is suitable for its type.	7.28	1.22	***LM***	8.30	0.87	***LVM***	7.50	1.01	***LM***
5. The overall appearance matches my expectations.	7.25	1.24	***LM***	8.18	0.88	***LVM***	7.42	0.98	***LM***
Average	**7.29**	**0.92**	***LM***	**8.32**	**0.68**	***LVM***	**7.48**	**0.79**	***LM***

For Formulation A, the average mean score was 7.29 with a descriptive rating of "Like moderately" (LM). Among the statements, the highest rating was given to the statement "The tart appears fresh and well-presented" with a mean of

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7.44 (LM), while the lowest was for "The crust has an even color and bake," which received a mean of 7.18, still falling under the "Like moderately" category. This indicates that while the overall appearance of Formulation A was favorably accepted, there is slightly less visual appreciation for its crust uniformity.In Formulation B, the appearance was rated highest among the three formulations with an average mean of 8.32, interpreted as "Like very much" (LVM). The highest mean score of 8.43 was recorded for the statement "The tart looks visually appealing," suggesting that this formulation was the most attractive in terms of general appearance. The lowest mean, although still high, was 8.18 for "The overall appearance matches my expectations," which remained in the LVM category. These results demonstrate a strong positive reception for Formulation B's visual qualities, indicating it may have the most appealing presentation.Formulation C had an overall average mean of 7.48, also falling under the "Like moderately" (LM) description. The highest-rated statement was "The tart looks visually appealing" with a mean of 7.58, interpreted as "Like very much" (LVM), showing that it was generally attractive to the raters. The lowest score was 7.42 for both "The crust has an even color and bake" and "The overall appearance matches my expectations," both receiving LM ratings. This reflects a generally favorable visual response to Formulation C, though it did not perform as highly as Formulation B.

Table 2 highlights the acceptability of aroma of the three Durian Rind Tart formulations based on specific descriptive statements evaluated by the raters.

TABLE 2: ACCEPTABILITY OF AROMAOF DURIAN RIND TART

Statement	Formulation A			Formulation B			Formulation C		
	M	**SD**	***D***	**M**	**SD**	***D***	**M**	**SD**	***D***
1. The aroma of the tart is pleasant.	7.43	1.10	***LM***	8.43	0.80	***LVM***	7.48	1.00	***LM***
2. The smell of durian is noticeable but not overpowering.	7.38	1.28	***LM***	8.34	0.77	***LVM***	7.48	0.91	***LM***
3. The aroma enhances my appetite.	7.28	1.27	***LM***	8.24	0.84	***LVM***	7.28	1.08	***LM***
4. The tart smells fresh and inviting.	7.23	1.35	***LM***	8.33	0.78	***LVM***	7.40	1.13	***LM***
5. The aroma is suitable for a dessert.	7.27	1.43	***LM***	8.25	0.82	***LVM***	7.26	1.19	***LM***
Average	**7.31**	**1.10**	***LM***	**8.32**	**0.64**	***LVM***	**7.38**	**0.87**	***LM***

Beginning with Formulation A, the raters gave it an overall average mean of 7.31, which falls under the category of “Like moderately” (LM). Among the individual statements, the highest-rated aspect was “The aroma of the tart is pleasant,” with a mean score of 7.43, indicating a generally positive perception of its scent. The lowest rating was given to “The tart smells fresh and inviting,” which received a score of 7.23, though this still remained in the “Like moderately” range. These scores suggest that Formulation A was moderately well-received in terms of aroma, though not outstanding.Turning to Formulation B, it achieved the highest overall aroma acceptability rating among the three, with an average mean of 8.32. This corresponds to the description “Like very much” (LVM), indicating a strong favorable impression of the tart’s smell. The highest score, 8.43, was again for “The aroma of the tart is pleasant,” which shows that this formulation had a strong appeal at first scent. The lowest, albeit still very favorable, was 8.24 for “The aroma enhances my appetite.” These ratings consistently place Formulation B in the upper tier of acceptability, making it the most aromatic and appealing version of the tart among the formulations tested.In the case of Formulation C, the tart earned an average aroma rating of 7.38, which like Formulation A, falls under “Like moderately” (LM). The highest mean score of 7.48 was observed for both “The aroma of the tart is pleasant” and “The smell of durian is noticeable but not overpowering.” Meanwhile, the lowest mean was 7.26 for “The aroma is suitable for a dessert.” These results suggest that while the aroma of Formulation C was positively rated, it lacked the standout appeal shown by Formulation B.

Table 3 details the acceptability of taste for the three Durian Rind Tart formulations, assessing how well the flavor of each variant was received by the panel of raters.

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TABLE 3: THE ACCEPTABILITY OF TASTEOF DURIAN RIND TART

Statement	Formulation A			Formulation B			Formulation C		
	M	SD	D	M	SD	D	M	SD	D
1. The tart tastes delicious overall.	7.58	0.87	*LVM*	8.58	0.60	*LE*	7.61	0.85	*LVM*
2. The sweetness level is just right.	7.46	0.86	*LM*	8.49	0.58	*LVM*	7.48	0.86	*LM*
3. The durian flavor is pleasant and balanced.	7.52	0.93	*LVM*	8.44	0.59	*LVM*	7.42	0.86	*LM*
4. The tart does not leave an unpleasant aftertaste.	7.50	1.08	*LM*	8.40	0.64	*LVM*	7.46	0.82	*LM*
5. The taste encourages me to eat more.	7.51	0.95	*LVM*	8.48	0.66	*LVM*	7.35	1.02	*LM*
Average	**7.51**	**0.71**	*LVM*	**8.48**	**0.45**	*LVM*	**7.46**	**0.69**	*LM*

For Formulation A, the overall average mean score was 7.51, which falls under the category “Like very much” (LVM). This indicates a favorable impression of the tart's taste. The highest individual score was 7.58 for the statement “The tart tastes delicious overall,” suggesting that the general flavor was well accepted by the raters. The lowest rating was 7.46 for “The sweetness level is just right,” which, while slightly lower, still reflects a good balance of taste components and falls within the “Like moderately” (LM) range. Overall, Formulation A demonstrated a strong yet modest appeal in terms of taste.Formulation B received the highest ratings across all taste-related criteria, earning an outstanding overall average of 8.48, interpreted as “Like very much” (LVM), nearing the upper end of the scale. Notably, the highest individual mean of 8.58 was given to “The tart tastes delicious overall,” which even surpassed the LVM threshold and entered the “Like extremely” (LE) category. The lowest, though still highly rated, was 8.40 for “The tart does not leave an unpleasant aftertaste.” These consistently high scores across statements affirm that Formulation B was the most flavorful and satisfying option among the three.Formulation C obtained an overall average mean of 7.46, falling under the “Like moderately” (LM) category. The highest rating of 7.61 was for “The tart tastes delicious overall,” reflecting a generally positive perception of its flavor. Conversely, the lowest score was 7.35 for the statement “The taste encourages me to eat more,” suggesting a relatively less compelling flavor that may not be as stimulating to the appetite as the other formulations. While Formulation C was still acceptable, its scores suggest it lacked the stronger taste appeal found in Formulation B.

Table 4 presents the acceptability of texture of the Durian Rind Tart formulations, focusing on how the physical characteristics of the tart contributed to the overall sensory experience.

TABLE 4: ACCEPTABILITY OF TEXTURE OF DURIAN RIND TART

Statement	Formulation A			Formulation B			Formulation C		
	M	SD	D	M	SD	D	M	SD	D
1. The tart crust is crisp and not soggy.	7.38	0.92	*LM*	8.59	0.54	*LE*	7.54	0.85	*LVM*
2. The tart is not too dry or too moist.	7.35	0.99	*LM*	8.53	0.61	*LE*	7.43	0.86	*LM*
3. The tart is smooth and creamy, making it easy to incorporate into dessert.	7.43	0.93	*LM*	8.54	0.55	*LE*	7.51	0.82	*LVM*
4. The texture is consistent throughout the product.	7.34	0.90	*LM*	8.52	0.55	*LE*	7.45	0.78	*LM*
5. The texture makes the tart enjoyable to eat.	7.37	0.92	*LM*	8.50	0.62	*LE*	7.43	0.83	*LM*
Average	**7.37**	**0.76**	*LM*	**8.54**	**0.43**	*LE*	**7.47**	**0.68**	*LM*

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For Formulation A, the average texture score was 7.37, which corresponds to the description "Like moderately" (LM). The highest rating among the statements was 7.43 for "The tart is smooth and creamy, making it easy to incorporate into dessert," reflecting appreciation for the tart's mouthfeel. The lowest score was 7.34 for "The texture is consistent throughout the product," although still within the LM category. These results indicate that the texture of Formulation A was considered satisfactory by the raters, but not outstanding. In contrast, Formulation B received the highest ratings across all texture-related statements, with an impressive overall average of 8.54—falling under the "Like extremely" (LE) category. This result signifies exceptional texture acceptability. The statement "The tart crust is crisp and not soggy" earned the highest individual score of 8.59, suggesting that the raters particularly appreciated the quality of the crust. The lowest score, though still high at 8.50, was for "The texture makes the tart enjoyable to eat," reaffirming that every aspect of the tart's texture in Formulation B was very well received. These scores confirm that Formulation B provided the most favorable texture experience among all three versions. As for Formulation C, the tart had an average texture rating of 7.47, which remains in the "Like moderately" (LM) category. The highest score of 7.54 was given to "The tart crust is crisp and not soggy," indicating a relatively favorable response to the tart's structural integrity. The lowest mean, 7.43, was shared by the statements "The tart is not too dry or too moist" and "The texture makes the tart enjoyable to eat." While the ratings for Formulation C were generally positive, they did not quite reach the higher level of acceptability seen in Formulation B.

The results presented in Tables 5 and 6 summarize the statistical analysis on the sensory attributes of the developed Durian Rind Tart formulations. To determine whether significant differences existed among the three formulations in terms of appearance, aroma, taste, and texture, a Multivariate Analysis of Variance (MANOVA) for repeated measures was conducted using Wilks' Lambda, followed by univariate ANOVA tests for each individual attribute. Pairwise comparisons using Bonferroni correction were then performed to identify where the specific differences occurred.

TABLE 5: SIGNIFICANT DIFFERENCE ON THE ACCEPTABILITY OF THE SENSORY ATTRIBUTES OF THE THREE FORMULATIONS OF DURIAN RIND TART

Attribute	F	p	Decision on Ho	Interpretation
Appearance	110.82	<0.01	Rejected	Significant
Aroma	94.65	<0.01	Rejected	Significant
Taste	116.11	<0.01	Rejected	Significant
Texture	166.37	<0.01	Rejected	Significant

Wilks' Lambda $\Lambda = 0.256$, $F = 57.30$, $p < 0.01$

As shown in Table 5, the MANOVA test revealed a significant multivariate effect of formulation on the combined sensory attributes, with Wilks' Lambda (Λ) = 0.256, F = 57.30, and $p < 0.01$. This indicates that, overall, the raters perceived the three formulations as significantly different in terms of their sensory profiles. The follow-up univariate ANOVA for each attribute also showed significant differences across the formulations. Specifically, appearance ($F = 110.82$, $p < 0.01$), aroma ($F = 94.65$, $p < 0.01$), taste ($F = 116.11$, $p < 0.01$), and texture ($F = 166.37$, $p < 0.01$) all had p-values less than 0.01, leading to the rejection of the null hypothesis for each attribute. These findings confirm that the sensory characteristics varied significantly depending on the formulation.

Table 6 presents the results of the pairwise comparisons using the Bonferroni adjustment. In terms of appearance, all three formulations differed significantly from one another. Formulation B (M = 8.32) was rated significantly higher than both Formulation A (M = 7.29, $p < 0.01$) and Formulation C (M = 7.48, $p < 0.01$), while Formulation C was also rated slightly but significantly higher than Formulation A ($p = .027$).For aroma, significant differences were found between Formulation B (M = 8.32) and both Formulation A (M = 7.31, $p < 0.01$) and Formulation C (M = 7.38, $p < 0.01$). However, no significant difference was observed between Formulations A and C ($p = 1.000$), indicating similar perception of aroma between the two.

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TABLE 6: PAIRWISE COMPARISON ON THE SENSORY ATTRIBUTES OF DURIAN RIND TART IN THREE FORMULATIONS

Attribute	Formulation (Mean)		p	Decision on Ho	Interpretation
Appearance	A (M=7.29)	B (M=8.32)	<0.01	Rejected	Significant
	A (M=7.29)	C (M=7.48)	.027	Rejected	Significant
	B (M=8.32)	C (M=7.48)	<0.01	Rejected	Significant
Aroma	A (M=7.31)	B (M=8.32)	<0.01	Rejected	Significant
	A (M=7.31)	C (M=7.38)	1.000	Not Rejected	Not Significant
	B (M=8.32)	C (M=7.38)	<0.01	Rejected	Significant
Taste	A (M=7.51)	B (M=8.48)	<0.01	Rejected	Significant
	A (M=7.51)	C (M=7.46)	1.000	Not Rejected	Not Significant
	B (M=8.48)	C (M=7.46)	<0.01	Rejected	Significant
Texture	A (M=7.37)	B (M=8.54)	<0.01	Rejected	Significant
	A (M=7.37)	C (M=7.47)	.602	Not Rejected	Not Significant
	B (M=8.54)	C (M=7.47)	<0.01	Rejected	Significant

Regarding taste, Formulation B (M = 8.48) again outperformed the others, with significantly higher scores than both Formulation A (M = 7.51, $p < 0.01$) and Formulation C (M = 7.46, $p < 0.01$). No significant difference in taste was detected between Formulation A and C ($p = 1.000$), suggesting that both had a comparable flavor profile in the eyes of the panel.In terms of texture, Formulation B (M = 8.54) was rated significantly higher than both Formulation A (M = 7.37, $p < 0.01$) and Formulation C (M = 7.47, $p < 0.01$). However, no significant difference was found between Formulations A and C ($p = .602$), again implying a similar texture experience between these two formulations.The statistical analyses strongly support the conclusion that Formulation B was significantly more acceptable than Formulations A and C across all four sensory attributes. The consistent significant differences between Formulation B and the others affirm its superiority in terms of appearance, aroma, taste, and texture, making it the most preferred formulation among the three versions of the Durian Rind Tart.

Table 7 presents the nutritional components of Durian Rind Tart Formulation B, as determined through chemical analysis per 100 grams, with corresponding values per serving size and their contributions to daily nutritional needs.

A 100-gram portion of Formulation B contains 302.03 calories, with approximately 86.31 calories coming from fat. When converted to a serving size (rounded to 150 calories), this accounts for 6% of the recommended daily caloric intake based on a 2,000-calorie diet. This places the tart within a moderate calorie range for a dessert portion.serving, which contributes 6% of the daily value. This amount falls within acceptable limits for occasional consumption, especially for a dessert item. The sodium content is relatively low at 99.08 milligrams per 100 grams, or approximately 50 milligrams per serving, equating to only 2% of the daily recommended value, making it a heart-friendly choice for those monitoring salt intake.The tart is relatively high in carbohydrates, providing 51.73 grams per 100 grams, or about 26 grams per serving, which contributes 9% of the daily value. This reflects its nature as a starchy, sweet product. Meanwhile, the protein content is modest, with 2.2 grams per 100 grams, approximately 1 gram per serving, which represents 2% of the daily value and less than 2% of the Recommended Energy and Nutrient Intake (RENI) for Filipino males aged 19–29, as per the Food and Nutrition Research Institute (FNRI) standards.

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TABLE 7: NUTRITIONAL CONTENTS OF FORMULATION "B" OF DURIAN RIND TART

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	302.03	150		6
Calories from Fat	86.31	45		
Total Fat (g)	9.59	5	6	
Sodium (mg)	99.08	50	2	
Total Carbohydrates (g)	51.73	26	9	
Protein (g)	2.2	1	2	<2

*Based on the Report of Chemical Analysis
% Daily Value is based on the New Nutrition Facts Label finalized May 20, 2016

Table 8 outlines the physicochemical components of the Durian Rind Tart Formulation, highlighting its moisture content, ash content, protein, fat, and sodium levels per 100 grams of the product.

TABLE 8: PHYSICO-CHEMICAL PROPERTIES OF FORMULATION "B"OF DURIAN RIND TART

Parameter	Result
Moisture	34.73 g/100g
Ash Content	1.75 g/100g
Crude Protein	2.20 g/100g
Total Fat	9.59 g/100g
Sodium	99.08 mg/100g

The moisture content of the tart is 34.73 grams per 100 grams, indicating that approximately one-third of the product's weight consists of water. This relatively high moisture level is typical for soft-baked products and plays a significant role in the tart's texture, palatability, and shelf life. Products with higher moisture tend to have a shorter shelf life unless preserved properly.

The ash content, which measures the total mineral content in food, is 1.75 grams per 100 grams. This value reflects the presence of essential inorganic nutrients and gives insight into the tart's mineral richness. While modest, this amount suggests that the tart contains trace minerals beneficial to the diet.The crude protein content is 2.20 grams per 100 grams, reaffirming that the tart provides a small amount of protein. Although not a high-protein product, the presence of protein still contributes to its overall nutritional value and supports its classification as a balanced dessert item.The total fat content is measured at 9.59 grams per 100 grams, consistent with values seen in the earlier nutritional table. This amount contributes to the tart's flavor and mouthfeel while remaining within moderate fat levels for a typical serving. It reflects the likely use of shortening or butter in the crust and durian-based ingredients in the filling.The sodium content is 99.08 milligrams per 100 grams, confirming its relatively low salt profile. This is particularly advantageous for individuals managing their sodium intake, as it allows the tart to be a flavorful yet heart-friendlier dessert option.

V. CONCLUSION

Formulation B was the most favorably accepted among the three tart formulations, demonstrating superior sensory characteristics. Its consistently high ratings in appearance, aroma, taste, texture, and composite appeal validate its formulation as the optimal version for consumer preference.The significant differences among the three formulations confirm that Formulation B is most preferred by the participants.Nutritional analysis affirms that the durian rind tart is a moderately healthy dessert option. With acceptable levels of fat, carbohydrates, and sodium, it fits within dietary guidelines for occasional consumption while offering a novel and eco-friendly alternative.The physicochemical

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properties of Formulation B demonstrate that it is both nutritionally stable and structurally suitable for tart production. Its moisture, fat, and protein content support its practicality for commercial-scale preparation and storage.

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