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SENSORY EVALUATION OF *PUKIS* ENRICHED WITH DIFFERENT LEVELS OF CARROT PUREE (*DAUCUS CAROTA L*)

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Abstract
This study investigates the effects of incorporating varying concentrations of carrot puree (0%, 25%, 50%, and 75%) into pukis*, a traditional Indonesian snack, on its organoleptic properties. The objective is to enhance the nutritional value of* pukis *without compromising its sensory attributes, such as color, aroma, texture, taste, and overall acceptability. A hedonic test was conducted to assess consumer preferences for the different formulations. The results indicated that the addition of carrot puree significantly influenced the color, with higher concentrations resulting in a more vibrant orange hue. Aroma and taste were also affected, with the 25% carrot puree formulation being most preferred for maintaining the traditional flavor while offering enhanced sweetness. Texture analysis showed that the 50% carrot puree formulation provided a desirable balance between moisture retention and the light, spongy texture typical of* pukis*. Overall, the study found that a moderate level of carrot puree (25% to 50%) successfully enhanced the nutritional profile of* pukis *while preserving its sensory qualities. These findings suggest that carrot puree can be a viable ingredient for fortifying traditional snacks, offering a healthier alternative without compromising consumer acceptance.*
Keywords: *Carrot puree, Organoleptic evaluation, Pukis, Sensory attribute*

INTRODUCTION

Indonesia is known for its rich culinary heritage, which includes a variety of traditional snacks enjoyed by different generations across diverse regions. One such popular traditional snack is *pukis*, a half-moon shaped, soft textured cake commonly found in local markets and roadside stalls. Traditionally made from flour, eggs, coconut milk, sugar, and yeast, pukis has long been a part of Indonesian food culture due to its unique flavor, affordable price, and ease of preparation (Wijaya, 2019). However, as consumer awareness regarding nutrition and food quality increases, there is a growing demand for healthier versions of traditional foods without compromising taste and texture.

The integration of functional ingredients into traditional food products has garnered significant attention in recent years due to the increasing demand for healthier alternatives in everyday diets (Vignesh et al., 2024). One such ingredient is carrot puree, which is recognized for its nutritional benefits, particularly its high content of beta-carotene, a precursor of vitamin A. This study explores the impact of incorporating varying levels of carrot puree into a traditional Indonesian snack, *pukis*. Known for its soft, spongy texture and mildly sweet flavor, *pukis* is typically made from a batter consisting of flour, sugar, coconut milk, and margarine. The addition of carrot puree offers an opportunity to enhance the

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nutritional profile of this popular snack without compromising its sensory attributes, such as color, aroma, texture, and taste (Richards et al., 2024).

The potential benefits of fortifying traditional foods with vegetables have been recognized in numerous studies, which highlight the advantages of increasing the consumption of micronutrient-rich ingredients like vegetables (Olson et al., 2021). However, the challenge lies in ensuring that the nutritional improvements do not detract from the sensory qualities that consumers have come to expect. In the case of *pukis*, this means maintaining the traditional taste, texture, and appearance while enhancing the nutritional content. This balance is critical, as consumer acceptance is heavily influenced by sensory appeal.

This research investigates how different concentrations of carrot puree (0%, 25%, 50%, and 75%) affect the organoleptic properties of *pukis*, focusing on color, aroma, texture, taste, and overall acceptability. By using a hedonic test, the study evaluates consumer preferences and identifies the optimal level of carrot puree that maintains the sensory appeal of *pukis* while improving its nutritional value. The importance of visual appeal in food products cannot be overstated, as color is one of the first attributes consumers assess when evaluating a product. The addition of carrot puree, known for its vibrant orange color due to beta-carotene, is expected to influence the appearance of *pukis*. Previous studies have shown that vegetable-based fortifications can significantly improve the visual appeal of baked goods, with consumers associating vibrant colors with freshness and quality (Hoppu et al., 2021). However, the degree of color enhancement needs to be balanced, as excessive color change may deviate too far from traditional expectations, potentially affecting consumer preference (Vermeir & Roose, 2020).

Aroma, another key sensory attribute, plays a significant role in the overall acceptance of food. The incorporation of carrot puree is likely to alter the aroma of *pukis*, introducing the characteristic scent of carrots, which is generally perceived as fresh and slightly sweet (Prerana & Anupama, 2020). While this enhancement may improve the product's olfactory appeal, there is also a possibility that strong carrot aromas could overpower the traditional smell of *pukis*, potentially altering consumer expectations and acceptability. Texture is a critical factor in determining the consumer's overall experience with a baked product (Guiné, 2022). The addition of carrot puree introduces moisture to the batter, which may influence the texture of *pukis*, potentially making it denser or less airy. Since *pukis* is traditionally valued for its light, spongy texture, any changes in texture could significantly affect consumer preference. The study aims to determine whether the moisture from carrot puree enhances or detracts from the desired texture of *pukis*.

Taste is perhaps the most crucial sensory attribute when it comes to food acceptance. Carrots are naturally sweet, but this sweetness may not fully compensate for the reduction in added sugar required when increasing the proportion of carrot puree (van Stokkom et al., 2018). As a result, the sweetness and flavor balance of *pukis* may be altered, with higher levels of carrot puree introducing earthy or slightly bitter notes that may be less desirable to consumers . This study seeks to assess whether the addition of carrot puree enhances the flavor profile of *pukis* or whether it detracts from the familiar taste that consumers enjoy.Overall, this research addresses the critical question of how to balance the nutritional benefits of carrot puree with the preservation of the traditional sensory

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appeal of *pukis*. By exploring the effects of varying levels of carrot puree on the color, aroma, texture, and taste of *pukis*, this study aims to identify an optimal formulation that enhances both the nutritional value and sensory qualities of the product. The findings will provide valuable insights into the potential for vegetable fortification in traditional snacks, contributing to the broader field of food fortification and consumer acceptance.

METHODS

Design, Time, and Location

This study employed a quantitative experimental research design, focusing on the formulation and evaluation of *pukis* with the addition of carrot puree. The experimental component involved varying levels of carrot puree incorporated into the *pukis* batter to observe its effects on the sensory properties of the final product. The main objective was to identify the most acceptable formulation based on panelist responses, thereby establishing a standard recipe for a nutritionally enhanced yet palatable *pukis*.

The research was conducted over a four-month period, from December 2023 to March 2024. All formulation trials and organoleptic evaluations were carried out at the Food Preparation Laboratory, Department of Family Welfare Education, Faculty of Engineering, Universitas Negeri Makassar. This facility provided the necessary tools and controlled environment required for the consistent preparation and assessment of food samples.

Participants

The participants in this study were 30 semi-trained panelists consisting of culinary students and lecturers from the Faculty of Engineering, Universitas Negeri Makassar. The age range of the panelists was between 20 to 50 years, with varied culinary exposure. All panelists volunteered to participate and provided verbal informed consent prior to testing. Ethical approval was granted by the institutional committee for educational research ethics.

Materials

The main materials used in this study were fresh carrots, wheat flour (medium protein), eggs, granulated sugar, coconut milk, margarine, salt, yeast, and water. Carrot puree was prepared from cleaned, peeled, and grated carrots, which were then processed using a chopper with coconut milk. All ingredients were food-grade and sourced from local markets in Makassar.

Tools and Equipment

Key tools included digital scales, graters, chopper blenders, mixing bowls, stainless whisks, stainless steel spoons, a pukis mold, gas stove, and measuring cups. The tools were sanitized before each use to maintain food safety standards.

Procedure

The experiment was conducted in three stages: (1) preparation of carrot puree, (2) formulation and preparation of pukis batter with different percentages of carrot puree (0%, 25%, 50%, 75%), and (3) baking the batter in standardized pukis molds. Each formulation was produced in duplicate to ensure consistency.

Carrot Puree Preparation

Fresh carrots were washed thoroughly, peeled, grated, and then chopped finely using a chopper with a ratio of 1:0.3 coconut milk. The puree was prepared fresh daily to avoid oxidation and microbial growth.

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Formulation of Pukis Batter

Four batter formulations were prepared:

1. F0: Control (0% carrot puree)
2. F1: 25% carrot puree, 75% base ingredients
3. F2: 50% carrot puree, 50% base ingredients
4. F3: 75% carrot puree, 25% base ingredients

Each batter included biang (starter mix), made from wheat flour, yeast, and water, fermented for 5 minutes until bubbly. The main batter was made by mixing eggs, sugar, coconut milk, flour, salt, and carrot puree, then combined with biang and margarine, left to rest for 10 minutes before baking.

Organoleptic Testing

Organoleptic evaluation was conducted using a 9-point hedonic scale to assess color, aroma, texture, taste, and overall acceptance. The score sheet included both hedonic preference and hedonic quality (mutu hedonik) criteria. Each participant tasted samples from all four formulations under identical lighting and serving conditions.

Data Collection and Analysis

Data were recorded manually using score sheets. Statistical analysis was performed using SPSS version 29.0. One-way ANOVA was used to identify significant differences among formulations ($p < 0.05$), followed by Duncan's multiple range test to detect differences between groups. Descriptive statistics were also used to analyze mean scores and trends.

RESULTS AND DISCUSSIONS

Color Evaluation

The visual appearance of food is a primary factor influencing consumer preference and acceptability. In this study, figure 1, the addition of carrot puree significantly affected the color of pukis. The results showed a consistent increase in mean hedonic scores for color across formulations, from F0 (control) to F3 (75% puree). Specifically, F0 received the lowest score (2.11 ± 1.09), indicating a pale or dull appearance, while F3 achieved the highest score (6.61 ± 0.69), reflecting a vibrant orange hue. Statistical analysis using one-way ANOVA revealed a highly significant difference among the four formulations ($p < 0.01$). Further analysis with Duncan's post-hoc test confirmed that each formulation differed significantly from the others in terms of color perception. This strong statistical distinction supports the observation that increasing the proportion of carrot puree contributes to a more visually appealing product.

The enhancement in color can be attributed to the natural pigments present in carrots, particularly beta-carotene, which intensifies the orange coloration (Ikram et al., 2024). As the concentration of carrot puree increases, so does the beta-carotene content, leading to a stronger and more appealing visual presentation of the pukis. These findings are in line with Ranasinghe *et al*. (2022), who noted similar improvements in appearance when vegetable-based ingredients were added to bakery products. However, while the deeper color was generally perceived positively, anecdotal feedback from panelists indicated that extremely intense orange coloration (as in F3) may deviate too far from the traditional appearance of pukis, potentially affecting consumer expectations. Thus, although

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F3 scored highest for color, a balance must be struck between nutritional enhancement and traditional product identity.

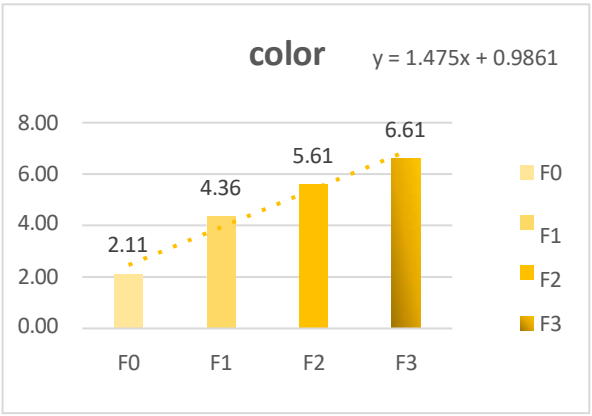

Figure 1. Analysis of Organoleptic Test Data for Carrot Puree Pukis Color Aroma Evaluation

Aroma is a key factor that influences the overall sensory appeal of food and is often associated with freshness and ingredient quality. In this study, the addition of carrot puree showed a clear impact on the aroma of the pukis. The hedonic aroma (figure 2) scores increased consistently across the four formulations, with F0 (control) scoring the lowest at 2.56 ± 1.49 and F3 (75% puree) scoring the highest at 5.56 ± 1.43. This trend suggests that the incorporation of carrot puree enhanced the aromatic profile of the product. Statistical analysis using one-way ANOVA indicated a significant difference among all formulations ($p < 0.01$). Further evaluation with Duncan's multiple range test confirmed that the differences in aroma perception between formulations were statistically significant. These findings indicate that as the percentage of carrot puree increases, the aroma becomes more intense and is generally well-received by panelists.

The improved aroma can be attributed to the volatile compounds naturally present in carrots, which are released more prominently as the puree content increases. These include terpenes and other aromatic compounds that contribute to the fresh and slightly sweet scent characteristic of carrots. Previous studies, such as those by Gómez & Martinez (2018), have similarly reported that vegetable-based additions enhance the aroma of bakery products by introducing fresh, natural notes. Despite the improvement in aroma, some panelists noted that the scent of the pukis with 75% carrot puree (F3) slightly overpowered the traditional aroma of the original product. While not necessarily unpleasant, this shift in aromatic profile may affect the expectations of consumers accustomed to the conventional version of pukis.

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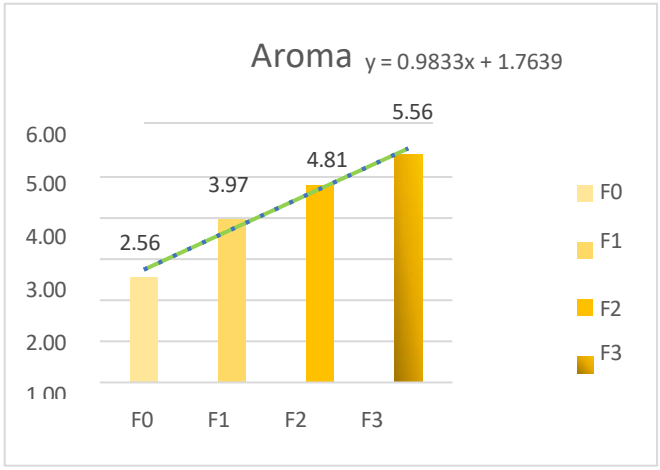

Figure 2. Analysis of Organoleptic Test Data for Carrot Puree Pukis Aroma

Texture Evaluation

Texture is a critical sensory attribute in baked products as it directly affects mouthfeel and consumer satisfaction. In this study, the texture of pukis was evaluated to determine how varying levels of carrot puree influenced softness, moistness, and overall tactile impression. The hedonic scores (figure 3) for texture decreased as the proportion of carrot puree increased. The control sample (F0) recorded a texture score of 4.39 ± 1.65, while F1 (25% puree) achieved the highest score at 5.11 ± 0.92, indicating a favorable balance of softness and structure. However, F2 (50%) dropped to 4.14 ± 1.69 and F3 (75%) recorded the lowest score at 3.25 ± 2.36, reflecting a noticeably denser and less desirable texture (figure 3). Statistical analysis via one-way ANOVA revealed a significant difference in texture ratings among all formulations ($p < 0.01$). Duncan's test further confirmed that F1 differed significantly from F3, emphasizing that high levels of carrot puree negatively impacted the product's textural quality.

The decline in texture quality at higher concentrations of carrot puree can be attributed to the high water content of carrots (approximately 89%). Excess moisture disrupts gluten network
formation in the batter, leading to a weaker structure and a soggier mouthfeel. This finding aligns with prior research by Purkiewicz *et al*. (2024), which demonstrated that vegetable fortification, while nutritionally beneficial, can compromise structural integrity in baked products if not carefully balanced . Additionally, the fiber content of carrots may have interfered with the aeration process during mixing and baking, resulting in a heavier and less airy product. Panelist feedback corroborated these findings, with many describing the texture of F3 as "too moist" or "less fluffy" compared to F0 and F1. While moderate carrot puree addition (F1) enhances texture slightly by adding moisture and softness, excessive addition (F3) compromises the desirable textural qualities of pukis. These findings suggest that 25% puree is the optimal level for maintaining consumer-preferred texture while still incorporating the nutritional benefits of carrots.

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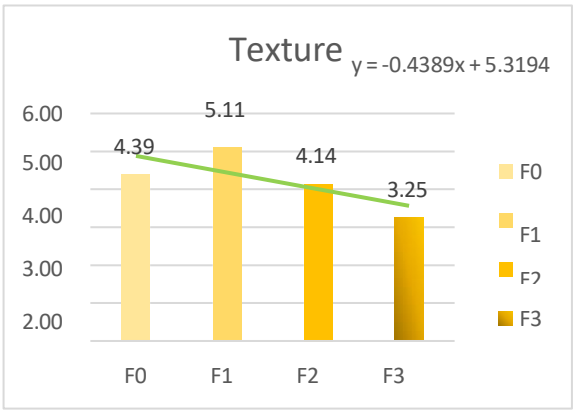

Figure 3. Analysis of Organoleptic Test Data for Carrot Puree Pukis texture

Taste evaluation

Taste plays a central role in determining the overall acceptability of food products. In this study, the addition of carrot puree influenced the sweetness and flavor complexity of the pukis across different formulations. The hedonic scores for taste (figure 4) showed a downward trend with increased levels of carrot puree. The control formulation (F0) received the highest score of 5.25 ± 1.13, followed closely by F1 at 5.19 ± 0.89. Meanwhile, F2 and F3 scored lower at 5.00 ± 1.07 and 4.03 ± 1.63, respectively. One-way ANOVA revealed that these differences were statistically significant ($p < 0.01$), and Duncan's multiple range test confirmed significant distinctions among certain formulations. The decline in taste scores for F2 and F3 can be attributed to a reduction in added sugar, which was proportionally decreased as the amount of carrot puree increased. Although carrots possess natural sweetness, it was insufficient to fully compensate for the reduction in granulated sugar, particularly in higher concentrations such as F3.

Furthermore, the earthy and mildly bitter undertones of carrot became more noticeable at higher puree levels. This shift altered the traditional flavor profile of pukis, which is typically sweet and creamy with a hint of richness from coconut milk and margarine. Panelist feedback indicated that F1 preserved the closest resemblance to traditional pukis in terms of taste, while F3 introduced unfamiliar flavors that some found less enjoyable. These results are consistent with previous studies Karki *et al.* (2024) that noted excessive vegetable fortification may compromise taste due to changes in flavor balance and ingredient interactions. In this context, the carrot puree functioned as both a nutritional and flavor-modifying agent. While moderate levels of carrot puree (25%) maintain a satisfactory taste profile, higher levels (50% and 75%) diminish the familiar sweetness and introduce off-flavors. Therefore, maintaining sugar balance is crucial when fortifying traditional snacks to ensure consumer preference is upheld.

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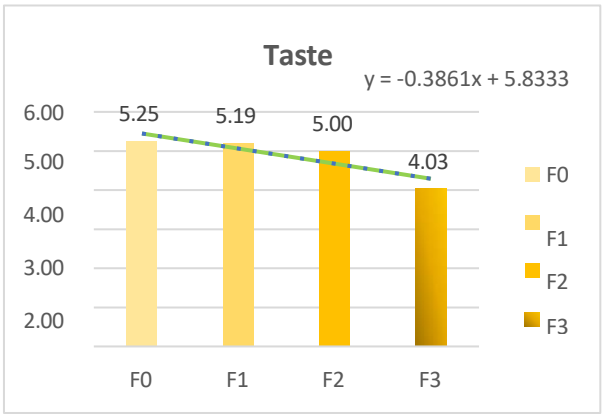

Figure 4. Analysis of Organoleptic Test Data for Carrot Puree Pukis taste

Overall Evaluation

The overall evaluation of pukis with carrot puree was assessed through a comprehensive organoleptic test, figure 5, which showed significant differences across the four formulations ($p < 0.05$). The highest mean score for overall quality was recorded in F3 (3.70 ± 1.166), indicating that this formulation, despite containing the highest level of carrot puree, was perceived as the most acceptable. However, as the percentage of carrot puree increased in the formulations, a negative trend in overall acceptability emerged, with the trend value reaching -0.0894. This result suggests that as more carrot puree was added, the overall quality of the pukis deteriorated in the eyes of the panelists.

This negative trend can be attributed to several factors. First, while carrot puree contributes some level of natural sweetness, it was not sufficient to fully replace the sweetness of granulated sugar, particularly in higher concentrations such as F3. This change in sweetness, along with the earthy, slightly bitter aftertaste that becomes more noticeable with higher carrot puree content, likely altered the traditional flavor profile of pukis. The control formulation (F0), with no carrot puree, maintained the traditional sweetness and flavor profile that the panelists found more familiar and palatable. As more puree was incorporated, the flavor profile shifted, and the panelists found the product increasingly less acceptable.

These findings align with prior studies that have explored the impact of vegetable fortification on traditional snacks. For instance, research by Pedersen *et al* (2023) observed similar effects, where the addition of vegetables to sweet products led to a decrease in overall acceptability due to alterations in flavor balance and ingredient interactions. The fortification of sweet treats with vegetables such as carrots can disrupt the delicate balance between sweetness, flavor, and texture, often resulting in a product that is less favorable to consumers. Furthermore, studies like those by Fiorentini *et al.* (2020) support the idea that the sensory characteristics of food products are highly sensitive to the ratio of natural ingredients used, particularly when vegetables with strong flavors are involved.

Additionally, the reduction in sugar content associated with the addition of carrot puree may also contribute to the perceived decrease in overall quality. While sugar is known for enhancing sweetness and balancing other flavors, it also plays a role in the texture and mouthfeel of baked goods like pukis. The decrease in sugar content, especially in higher carrot puree formulations, may have led to a less desirable texture, contributing to the lower acceptance of F2 and F3.

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These results underscore the importance of maintaining a balance between fortification and the preservation of traditional flavor profiles. As the addition of carrot puree increases, the sensory appeal of the product diminishes, leading to lower overall acceptability. This finding suggests that moderate levels of fortification may be more successful in retaining the familiar taste and texture that consumers prefer, a perspective supported by previous research on food fortification (Martorell & de Romaña, 2017). In this study, formulation F1, which contained a moderate level of carrot puree, was the most preferred by the panelists, highlighting the potential for achieving a balance between nutrition and consumer preference.

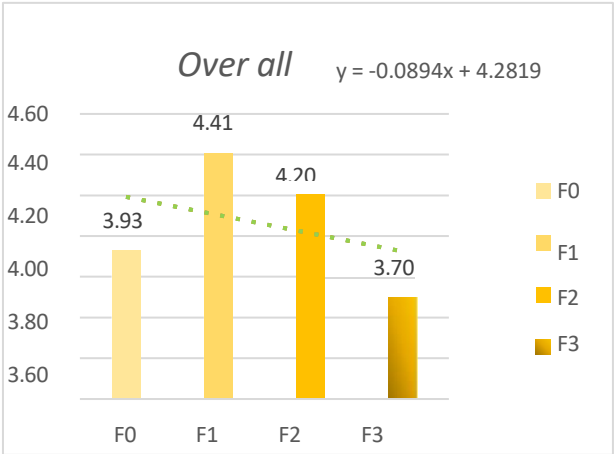

Figure 5. Analysis of Organoleptic Test Data for Carrot Puree Pukis Color over all

Hedonic Test Results

The hedonic test, which measured the panelists' preferences for aroma, texture, taste, and overall acceptability of the pukis formulations with carrot puree, revealed significant differences among the four formulations. The ANOVA results at a 95% confidence level indicated that the formulations differed substantially ($p < 0.01$), with formulation F3 exhibiting the highest mean score for aroma (4.53 ± 1.890). Despite this, the addition of carrot puree negatively impacted the overall hedonic acceptability of the pukis, as evidenced by a downward trend with a value of -1.1. This trend suggested that as the concentration of carrot puree increased, panelists found the product less enjoyable, with their preference decreasing accordingly.

The trend analysis from the data (Figure 6) showed that formulations with higher carrot puree concentrations, particularly F2 and F3, led to a decline in sensory attributes, most notably in aroma, taste, and texture. This finding is in line with previous studies on food fortification, where excessive vegetable additions were found to alter the traditional flavor profile, leading to reduced consumer acceptance. For instance, Harling (2017) observed that high levels of vegetable incorporation, such as carrots, in baked products can introduce off-flavors and bitterness, which negatively affect consumer preference.

In this study, formulation F1 (with the lowest carrot puree content) performed the best in terms of hedonic acceptance, with the panelists reporting the most favorable scores compared to F2 and F3. Panelist feedback indicated that while F1 retained a recognizable taste and aroma similar to the traditional pukis,

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F3, with its highest carrot puree concentration, introduced earthy and slightly bitter flavors that some panelists found unappealing. This result further supports the notion that moderate fortification is essential for maintaining the balance of sensory characteristics that consumers expect in familiar products like pukis. Additionally, while carrots provide some natural sweetness, this sweetness was not sufficient to compensate for the reduction in sugar that accompanied the increased carrot puree content in higher formulations.

The study findings align with the work of (Peris *et al*. (2019), who demonstrated that the introduction of higher amounts of vegetable puree in bakery products can significantly alter the sensory properties, leading to a decline in overall acceptability. This suggests that while vegetable fortification can provide nutritional benefits, it must be carefully balanced to ensure that the sensory characteristics align with consumer preferences. In conclusion, the hedonic test results clearly show that moderate levels of carrot puree, as seen in formulation F1, are more acceptable to consumers, preserving the traditional taste and sensory appeal of the pukis. However, as the concentration of carrot puree increases, the sensory qualities of the product begin to diverge from those of the traditional pukis, leading to a decline in overall acceptability

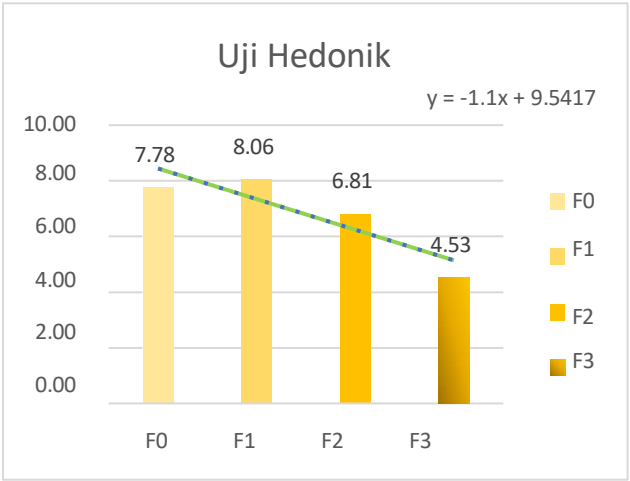

Figure 6. Hedonic Test Data Analysis of Carrot Puree Pukis

Hedonic Quality

The hedonic quality of carrot puree-enriched pukis was evaluated across several sensory attributes including color, aroma, texture, taste, overall acceptability, and preference. As shown in Table XX, the incorporation of carrot puree significantly affected the organoleptic properties of the product, with statistical significance observed across all parameters ($p < 0.01$). Color scores increased consistently with higher levels of carrot puree, from 2.11 ± 1.09 in F0 (control) to 6.61 ± 0.69 in F3. This trend (1.48×) indicates that panelists perceived the products as more orange and visually appealing with increased puree levels. This is in line with findings from Saini *et al.* (2025), which showed that carrot fortification enhanced the visual appeal of bakery products due to the natural pigmentation of β-carotene.

Aroma followed a similar trend, with scores rising from 2.56 ± 1.49 in F0 to 5.56 ± 1.43 in F3 (trend: 0.99×), suggesting that the addition of carrot puree contributed to a more pleasant and fragrant aroma. Carrot's natural aroma may

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have synergized with other ingredients like coconut milk and margarine, enhancing the product's olfactory appeal. Previous studies, such as those by Petka & Topolska (2025), also reported improved aroma in baked goods enriched with vegetable or fruit purees.

Table 1 Results of Anova test analysis from organoleptic test of carrot puree pukis

Indicators	F0	F1	F2	F3	p-value	Trend	Results
Colors	(2,11±1,09)^{a}	(4,36±1,22)^{b}	(5,61±0,84)^{c}	(6,61±0,69)^{d}	0,000**	1,48x	More orange
Aroma	(2,56±1,49)^{a}	(3,97±1,26)^{b}	(4,81±1,33)^{c}	(5,56±1,43)^{d}	0,000**	0,99x	Very fragrant
Texture	(4,39±1,65)^{c}	(5,11±0,92)^{c}	(4,14±1,69)^{bc}	(3,25±2,36)^{a}	0,000**	-0,44x	Less tender
Taste	(5,25±1,13)^{b}	(5,19±0,89)^{b}	(5,00±1,07)^{b}	(4,03±1,630)^{a}	0,000**	-0,38x	Less sweet
Overall	(3,93±0,99)^{ab}	(4,41±0,59)^{c}	(4,20±0,89)^{bc}	(3,70±1,17)^{a}	0,007**	-0,08x	Less good
Acceptance	(7,78±1,75)^{c}	(8,06±1,16)^{c}	(6,81±1,91)^{b}	(4,53±1,89)^{a}	0,000**	-1,1x	Less dislike

Description : - F0(0%),F1(25%), F2(50%),F3(75%);- **p.V=<0,01 = significantly different -* p.V=<0,05 = different ; ^{abcd} : subscript letters indicate different data positions.

However, the influence of carrot puree on texture and taste showed a contrasting pattern. Texture scores declined with increasing puree levels, with F3 (3.25 ± 2.36) scoring significantly lower than F1 and F0 (trend: -0.44×). The addition of more carrot puree possibly introduced excess moisture and disrupted the structure, resulting in a softer, less cohesive crumb. Similar texture degradation was noted by Fadillah *et al*. (2024), who found that high puree concentrations can weaken the structural integrity of baked products.

Taste scores also declined as puree levels increased, from 5.25 ± 1.13 in F0 to 4.03 ± 1.63 in F3 (trend: -0.38×). Although carrots contain natural sugars, they could not fully compensate for the reduced granulated sugar in higher formulations. Furthermore, the earthy and slightly bitter undertones of carrot became more prominent in F2 and F3, which may have contributed to the decrease in palatability. These results are consistent with those of Akesowan & Chareonkul (2024), who observed a reduction in taste acceptance when traditional sweet products were fortified with high levels of vegetable puree.

The overall acceptability scores showed a slight decline with higher carrot content, decreasing from 3.93 ± 0.99 in F0 to 3.70 ± 1.17 in F3 (trend: -0.08×), indicating that panelists perceived the product as less favorable when fortified excessively. The decline, though modest, reinforces the need for careful formulation to preserve traditional sensory appeal. Finally, the preference scores presented the most dramatic decline, dropping from 8.06 ± 1.16 in F1 to 4.53 ± 1.89 in F3 (trend: -1.1×). These findings reflect a significant reduction in overall liking as the concentration of carrot puree increased. F1 was most preferred among the fortified samples, suggesting that a 25% addition is optimal for enhancing nutritional content while maintaining consumer appeal. The sharp decrease in F3's score implies that excessive fortification risks alienating consumers due to off-flavors and textural compromise.

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While the addition of carrot puree positively influenced color and aroma, its impact on texture, taste, and overall preference was more complex. Moderate inclusion (25%) appears optimal, as it offers nutritional benefits without compromising sensory quality. These findings contribute to a growing body of literature emphasizing the importance of sensory balance in the development of fortified traditional foods (Ali et al., 2025). Over-fortification, though nutritionally advantageous, must be approached with caution to avoid diminishing product acceptance.

CONCLUSIONS & RECOMMENDATIONS

In conclusion, the results of the acceptance test underscore the importance of balancing the benefits of vegetable fortification with the preservation of traditional sensory attributes. While moderate levels of carrot puree (as seen in F1) were acceptable to most panelists, higher concentrations led to a marked decline in acceptability, highlighting the need for careful formulation when introducing novel ingredients into traditional recipes. This study contributes to the growing body of literature on food fortification, suggesting that consumer acceptance should be considered alongside nutritional enhancements to ensure the successful incorporation of functional ingredients like carrot puree into traditional food products.

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