HEDONIC AND PROXIMATE EVALUATION OF AVOCADO-BANANA ULI PUREE IN NUTRITION PROGRAM MANAGEMENT

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Abstract
Local food innovation plays a significant role in improving community nutrition by providing nutrient-rich, culturally acceptable products. Avocado (Persea americana) and Banana Uli (Musa x paradisiaca L. AAB) are potential local ingredients that can be developed into functional food for nutrition programs. This study aimed to evaluate the hedonic acceptance and proximate composition of dry sponge cake fortified with avocado flour and banana uli puree to support nutrition program management. A completely randomized design with three formulations was applied: F1 (10 g avocado flour + 15 g banana uli puree), F2 (15 g + 10 g), and F3 (20 g + 5 g). Hedonic tests on color, aroma, taste, and texture were conducted by trained panelists, and proximate analysis included carbohydrate, protein, fat, potassium, moisture, and ash content. Results indicated that formulation F1 achieved the highest hedonic scores for taste (4.08 ± 0.12) and texture (4.36 ± 0.15), with neutral brown color and neutral avocado aroma. Proximate analysis of F1 showed 71.2 g carbohydrates, 10.5 g protein, 1.8 g fat, 159.9 mg potassium, 7.26% moisture, and 0.69% ash per 100 g. F1 was identified as the optimal formulation due to its sensory acceptance and nutritional quality. This study demonstrates that developing dry sponge cake using local ingredients can enhance community nutrition while supporting the implementation of nutrition program management through functional and culturally appropriate foods.
Keywords: avocado, banana, sensory, proximate, functional

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INTRODUCTION

Indonesia is known for its diverse culinary heritage, including a wide range of traditional foods and snacks with distinctive flavors and appearances. One popular product is kue bolu (sponge cake), which is generally classified into two types: baked bolu and steamed bolu (1). Sponge cake is made from wheat flour, eggs, sugar, and leavening agents, whipped and baked for a soft texture. Indonesia still relies on wheat imports, which totaled 9,350.4 tons in 2022, down from 11,172.0 tons in 2021 (2). This decline suggests a gradual shift toward food self-sufficiency by substituting imported materials with locally sourced ingredients. From a nutrition program management perspective, the use of local food resources represents a sustainable strategy to strengthen national food security while improving efficiency in food distribution (3).

Avocado (Persea americana) is an important horticultural commodity with high economic value and potential for food diversification. This commodity is cultivated for both domestic consumption and export markets (4). Data from BPS indicate that national avocado production increased from 669,260 tons in 2021 to 865,780 tons in 2022, while production in North Sumatra Province also rose from 35,378 tons to 50,511 tons during the same period (5). Increasing utilization of local food resources is considered an important strategy to support sustainable food systems and strengthen community-based nutrition interventions (6).

Avocado contains various nutrients and bioactive compounds that support its use in food product development, including protein, carbohydrates, healthy fats, and essential micronutrients such as vitamins C and E (7). Its favorable lipid profile and functional components provide potential benefits in improving the nutritional quality of processed food products (8). However, avocado has a relatively short shelf life, which limits its utilization and highlights the need for appropriate processing methods to maintain quality and extend storage stability (9). Application of food processing technology therefore becomes important in increasing product value and promoting the development of nutrient-dense local foods (10).

Banana (Musa x paradisiaca L. AAB) is another widely available local fruit in Indonesia that has important nutritional value and supports food diversification efforts (11). According to BPS data, national banana production increased from 8,741,147 tons in 2021 to 9,245,427 tons in 2022, while production in North Sumatra rose from 121,364 tons to 164,533 tons during the same period (5). Utilization of local fruits is relevant in supporting food-based nutrition programs and the development of locally sourced food products (12).

Banana, particularly banana uli, contains potassium of approximately 650.3 mg per 100 g of edible portion and has relatively low fat content (13). Potassium plays a role in maintaining blood pressure balance and cardiovascular health through the natriuresis mechanism that promotes sodium excretion through urine (14). Therefore, the development of food products using avocado and banana as local ingredients has potential to enhance nutritional value while supporting the utilization of local agricultural commodities and community nutrition programs (6,15).

The development of dry sponge cake fortified with avocado flour and banana uli puree aims to produce a local food product with improved nutrition and consumer acceptability. Experimental research supports evidence-based nutrition interventions by providing data on nutrient retention and product acceptance (16). Previous studies have examined avocado and banana as food ingredients, but research on their combined use—particularly avocado flour and banana uli puree—remains limited. Evidence on consumer acceptance and proximate composition is also still scarce. Therefore, this study evaluates the hedonic characteristics and proximate composition of avocado–banana uli puree products as a local food innovation.

METHODS

The study used a Completely Randomized Design (CRD) with three treatments and two replications, resulting in six experimental units. The formulations combined avocado flour and banana uli puree: F1 (10 g:15 g), F2 (15 g:10 g), and F3 (20 g:5 g), with each treatment prepared and baked twice as separate batches. This design was used to evaluate the effect of formulation proportions on the organoleptic characteristics and chemical quality of the dry sponge cake, while standardized laboratory methods ensured reliable research results (17).

Flour production was conducted on May 20–21, 2024, at the Food Technology Laboratory of Helvetia Institute of Health. The organoleptic test was carried out on June 5, 2024, and chemical quality analysis on June 12, 2024, at laboratories selected for their equipment capacity and analytical reliability.

The study used basic kitchen equipment such as measuring spoons, a mixer, bowls, scales, a stove, an oven, baking pans, and spatulas to ensure consistent preparation. The

fortified dry sponge cake with avocado flour and banana uli puree was developed following SOP principles to maintain reproducibility and quality control.

Organoleptic and hedonic data were analyzed with SPSS. Normality tests determined the analysis method: $P > 0.05$ indicated normal distribution, analyzed with ANOVA; $P < 0.05$ indicated non-normal distribution, analyzed with the Kruskal–Wallis test. Significant differences between treatments were further evaluated using the Bonferroni test.

Table 1. Formulation of Dry Sponge Cake with Avocado Flour and Banana Uli Puree

Materials	F1	F2	F3
Wheat Flour	75 gr	75 gr	75 gr
Avocado Flour	10 gr	15 gr	20 gr
Banana Uli Puree	15 gr	10 gr	5 gr
Chicken Eggs	2 eggs	2 eggs	2 eggs
Palm Sugar	100 gr	100 gr	100 gr
Margarine	20 gr	20 gr	20 gr
SP (Cake Emulsifier)	½ teaspoon	½ teaspoon	½ teaspoon
Vanilla Powder	½ teaspoon	½ teaspoon	½ teaspoon
Baking Powder	½ teaspoon	½ teaspoon	½ teaspoon

Research Implementation

Procedure for Making Avocado Flour

The production of avocado flour began with sorting fruits based on ripeness and physical condition. The peel was removed using a sterile knife, and the pulp was sliced thinly to speed up drying. The slices were dried in an oven at 65 °C for 24 hours until the moisture content decreased. After drying, the material was ground into flour, sieved using a 60-mesh filter to obtain uniform particle size, and stored in an airtight container.

Procedure for Making Banana Uli Puree

The preparation of banana uli puree began by setting up the necessary equipment and ingredients. Ripe banana uli puree were selected for their optimal natural sugar content and soft texture. The bananas were sliced into ±1 cm pieces and blended at high speed for one minute to obtain a homogeneous puree.

Procedure for Making Dry Sponge Cake

The dry sponge cake was prepared by first weighing ingredients according to each treatment. Eggs, SP, and palm sugar were whipped until light and fluffy. Wheat flour, avocado flour, baking powder, and banana uli puree were added gradually at low speed to preserve texture. Melted margarine was incorporated last to enhance softness. The batter was poured into a greased tray and baked at 170°C for 30 minutes, producing a fortified dry sponge cake with characteristic color and aroma from avocado flour and banana uli puree.

Research Parameters

The study evaluated two main parameters: organoleptic and chemical tests. Organoleptic evaluation included color, aroma, taste, and texture, assessed using a 5-point hedonic scale by 25 trained panelists selected based on willingness, good health, and ability to assess sensory attributes. Samples were coded and presented randomly under controlled conditions to minimize bias. Chemical analysis measured carbohydrate, protein, fat, potassium, moisture, and ash contents to determine the nutritional quality and consumer acceptance of the product.

RESULTS

Hedonic Test Results

The hedonic evaluation used a five-point scale (1 = strongly dislike to 5 = strongly like) to assess color, aroma, taste, and texture of the dry sponge cake formulated with avocado flour and banana uli puree. Scores from 25 panelists were averaged and analyzed statistically to identify significant differences and determine the most acceptable formulation.

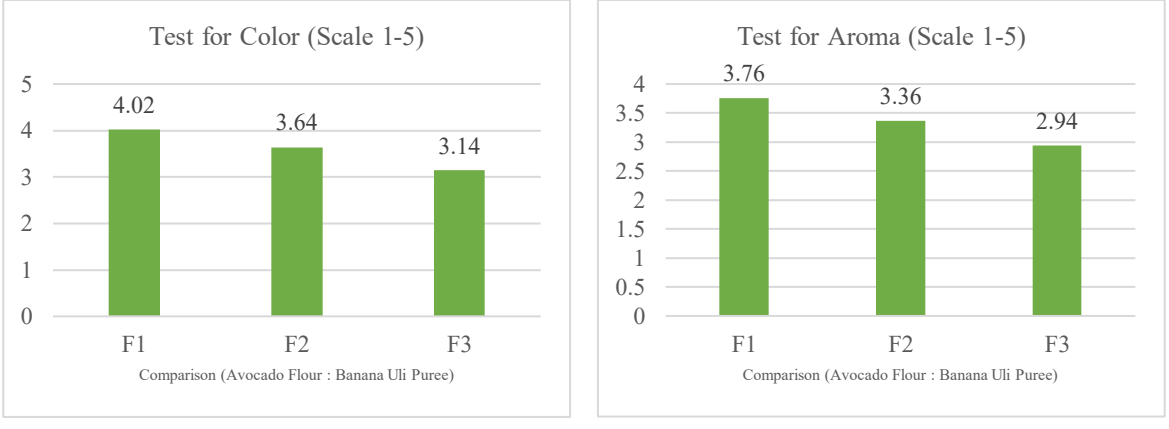

Figure 1. Results of Hedonic Quality Test for Color and Quality Test for Aroma

Hedonic color test showed F1 (10 g avocado flour + 15 g banana uli puree) had the highest score of 4.02 (liked), F2 scored 3.64 (liked), and F3 scored 3.14 (slightly liked). Kruskal–Wallis's test was significant (p = 0.000), with Bonferroni indicating a difference between F1 and F3, suggesting that higher avocado flour produced a darker brown color, while more banana uli puree resulted in a lighter brown color.

Hedonic aroma test showed F1 (10 g avocado flour + 15 g banana uli puree) had the highest score of 3.76 (liked), F2 scored 3.36, and F3 scored 2.94 (both slightly liked). Kruskal–Wallis's test was significant (p = 0.006), with Bonferroni showing a difference between F3 and F1, indicating that higher avocado flour with less banana uli puree increased aroma intensity.

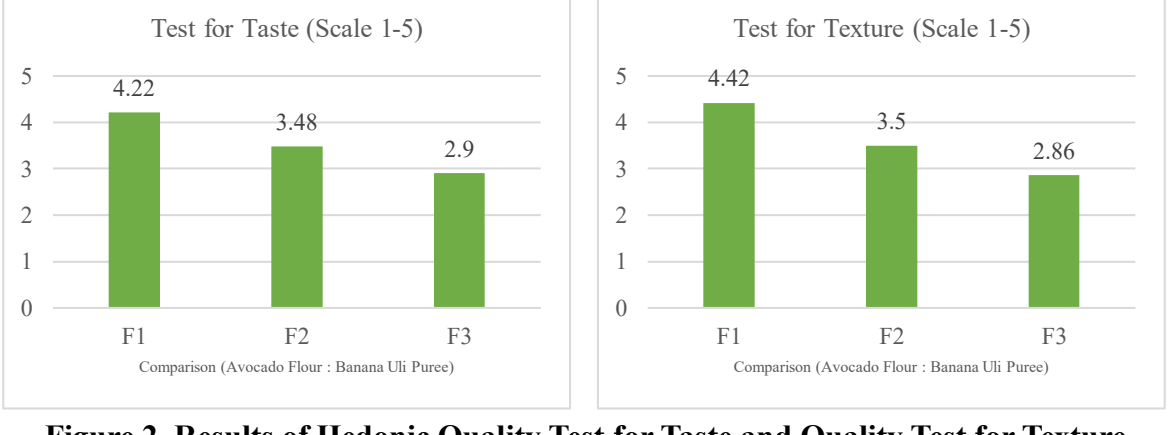

Figure 2. Results of Hedonic Quality Test for Taste and Quality Test for Texture

Hedonic taste test showed F1 (10 g avocado flour + 15 g banana uli puree) had the highest score of 4.22 (liked), F2 scored 3.48 (liked), and F3 scored 2.9 (slightly liked). Kruskal–Wallis's test was significant (p = 0.000), with Bonferroni showing differences between F1 vs F2 and F1 vs F3, indicating that higher avocado flour with less banana uli puree reduced sweetness, while lower avocado flour with more banana uli puree increased sweetness.

Hedonic texture test showed F1 (10 g avocado flour + 15 g banana uli puree) had the highest score of 4.42 (liked), F2 scored 3.5 (liked), and F3 scored 2.86 (slightly liked). Kruskal–Wallis test was significant (p = 0.000), with Bonferroni showing differences between F1 vs F2 and F1 vs F3, indicating that higher avocado flour with less banana uli puree produced a softer texture, while lower avocado flour with more banana uli puree resulted in a harder dry sponge cake.

Results of Hedonic Quality Test

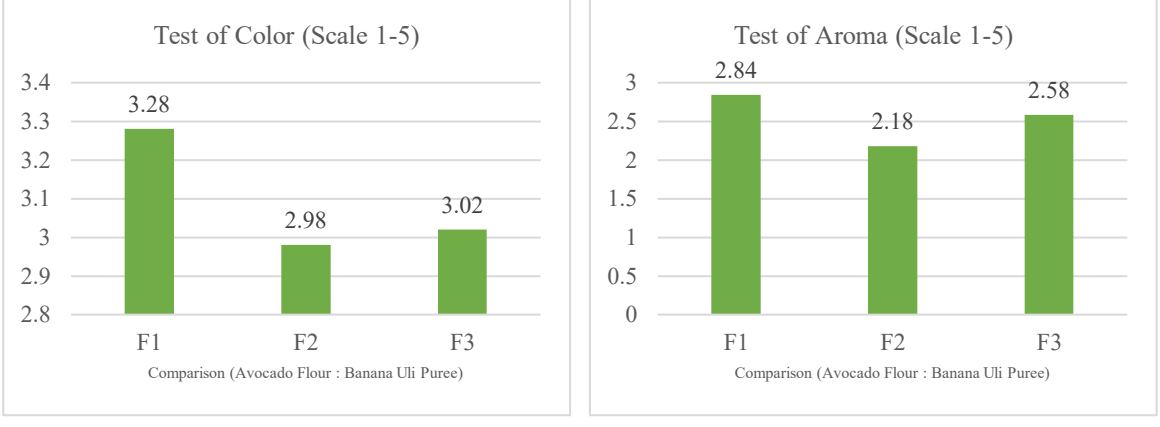

Figure 3. Results of Hedonic Quality Test of Color and Quality Test of Aroma

Hedonic test for color showed F1 (10 g avocado flour + 15 g banana uli puree) had the highest score of 3.28 (neutral brown), while F2 and F3 scored 2.98 and 3.02, respectively. Kruskal–Wallis's test was not significant (p = 0.244), indicating ingredient proportions did not significantly affect color.

Hedonic test showed F1 (10 g avocado flour + 15 g banana uli puree) had the highest aroma score of 2.84 (neutral avocado aroma). F2 scored lowest (2.18, weak aroma) and F3 scored 2.58 (neutral aroma). Kruskal–Wallis test was significant (p = 0.000), with Bonferroni showing F2 differed from F1 and F3. Higher avocado flour increased aroma intensity, while more banana puree softened it.

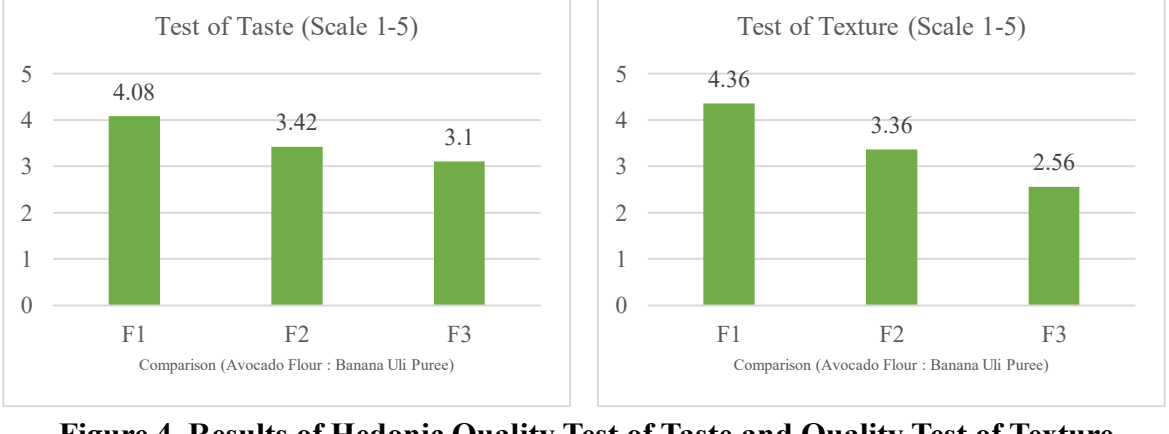

Figure 4. Results of Hedonic Quality Test of Taste and Quality Test of Texture

Hedonic test showed F1 (10 g avocado flour + 15 g banana uli puree) was most preferred with a sweet taste score of 4.08. F2 and F3 scored lower (3.42 and 3.1, slightly sweet). Kruskal–Wallis's test indicated significant differences (p = 0.000), with Bonferroni showing F1

differed significantly from F2 and F3. Higher avocado flour and less banana puree reduced sweetness, while the opposite increased it.

Figure 8 shows that F1 had the highest texture acceptance (4.36, soft), followed by F2 (3.36, slightly soft) and F3 (2.56, slightly soft). Kruskal-Wallis's test indicated a significant effect (P = 0.000), and Bonferroni test showed differences between F1 vs F2 and F1 vs F3. Higher avocado flour with less banana uli puree produced a softer cake, while lower avocado flour with more puree resulted in a firmer texture.

Best Formulation

Based on the results of both the hedonic test and the hedonic quality test, the average values of the organoleptic evaluation were reanalyzed to determine the best formulation of the dry sponge cake, as presented in Table 2.

Table 2. Average Scores of Organoleptic Tests for Color, Aroma, Taste, and Texture of Dry Sponge Cake

Treatment	Average Hedonic Score	Average Hedonic Quality Score	Organoleptic Test Score
F1 (10g : 15g)	4,36	3,64	4,00
F2 (15g : 10g)	3,50	2,99	3,25
F3 (20g : 5g)	2,96	2,82	2,89

Based on the organoleptic test results of the dry sponge cake fortified with avocado flour and banana uli puree, the best formulation was F1 with a score of 4.00. The best formulation identified from the organoleptic test will then proceed to chemical analysis, including measurements of carbohydrate, protein, fat, potassium, moisture, and ash content.

Analysis of Nutrient Content

The nutrient content analysis conducted on the dry sponge cake fortified with avocado flour and banana uli puree included measurements of carbohydrate, protein, fat, potassium, moisture, and ash content. The results of the nutrient content analysis for the dry sponge cake with the best formulation can be seen in Table 3.

Table 3. Nutrient Content of Dry Sponge Cake Fortified with Avocado Flour and Banana Uli Puree

Chemical Test	Nutrient Content (per 100 g)	SNI	Description
Carbohydrate	71,2 g	-	-
Protein	10,5 g	Minimum 6%	Compliant
Fat	1,8 g	Maximum 3%	Compliant
Potassium	159,9 mg	-	-
Moisture Content	7,26 %	Maximum 5 %	Non-compliant
Ash Content	0,69 %	Minimum 1,5 %	Compliant

Production Cost Analysis of Dry Cake

The weight of the dough for one formulation of dried cake fortified with avocado flour and uli banana puree is 690 grams. Each piece of dried cake requires 45 grams, so one recipe yields 15 pieces. Compared to the market price of Rp 1,000 per piece, the production cost of the dried cake fortified with avocado flour and uli banana uli puree puree in this study is lower than the existing market products.

Table 4. Production Cost of Dry Cake Fortified with Avocado Flour and Banana Uli Puree

No	Food Ingredient	Base Price (IDR)	Required Amount F1	Cost for F1 (IDR)
1	Wheat Flour	Rp 16.000/kg	75 g	Rp 1.200
2	Avocado Flour	Rp 20.000/kg	10 g	Rp 578
3	Banana Uli Puree	Rp 10.000/bunch	15 g	Rp 417
4	Chicken Eggs	Rp 2.000/egg	2 btr	Rp 4.000
5	Palm Sugar	Rp 7.000/pack	100 g	Rp 3.500
6	Margarine	Rp 5.000/pack	20 g	Rp 500
7	SP (Cake Emulsifier)	Rp 5.000/pack	½ teaspoon	Rp 417
8	Vanilla Powder	Rp 500/pack	½ teaspoon	Rp 250
9	Baking Powder	Rp 7.000/pack	½ teaspoon	Rp 388
Total Production Cost				Rp 11.250
Price Per Piece = Rp 11.250: 15 piece				Rp 750

DISCUSSION

Color Acceptance

Food color is a key sensory attribute that strongly influences consumer preference and appetite, often becoming the first parameter evaluated when assessing food products. The findings of this study indicated that formulation F1 showed the highest acceptance in terms of color, with an average hedonic score of 3.28 categorized as neutral brown. This result is likely associated with the proportion of banana uli puree used in the formulation, which contributed to a more appealing brown appearance compared to other treatments. The browning reaction in banana-based products generally occurs due to enzymatic oxidation when fruit tissue is processed, affecting the visual quality of the final product. Previous studies on fruit-based bakery products also report that the addition of fruit-derived ingredients can influence sensory attributes, including color and overall acceptability, particularly when applied in appropriate proportions within the formulation (18). These findings support the results of the present study, where the balanced composition of avocado flour and banana uli puree in formulation F1 contributed to a color that was more acceptable to panelists compared with other formulations.

From the perspective of nutrition program management, the color quality observed in this study indicates that visual appearance plays an important role in the acceptance of local food–based products. Sensory acceptance, including color, taste, aroma, and texture, determines whether a product can be effectively introduced in community nutrition programs (19). The relatively acceptable color characteristics found in the selected formulation may increase consumer interest in consuming nutritionally improved foods, thereby supporting food diversification strategies and community-based nutrition interventions (20). Moreover, the use of local fruits such as banana and avocado in this product demonstrates the potential of local resources in developing nutritious foods and strengthening sustainable food systems within nutrition programs (21).

Aroma Acceptance

Aroma is an important sensory attribute that influences palatability and the initial acceptance of food products. The results of this study showed that formulation F1 had the

highest aroma acceptance with an average hedonic score of 2.84, categorized as a neutral avocado aroma. This finding suggests that the proportion of avocado flour and banana uli puree in F1 produced a more balanced aroma compared with other formulations, while higher levels of avocado flour tended to intensify the characteristic aroma and potentially reduce acceptance when too strong. Previous studies report that the aroma of avocado is influenced by volatile compounds such as esters, alcohols, aldehydes, ketones, and terpenoids that form the characteristic aroma profile of avocado-based products (22).

The composition of these compounds can vary depending on fruit maturity, processing, and storage conditions, which may affect aroma intensity and consumer perception (23). In addition, baking processes can modify aroma development in fruit-based bakery products through heat-induced chemical reactions that alter volatile compounds and influence the sensory characteristics of the final product (24). From a nutrition program management perspective, acceptable aroma characteristics are important for supporting the adoption of innovative foods made from local ingredients, as organoleptic properties such as aroma, color, taste, and texture influence consumer willingness to accept products introduced through community-based nutrition programs (25).

Taste Acceptance

Taste is a key factor influencing consumer acceptance of food products. The results of this study showed that formulation F1 was the most preferred dry cake formulation with a hedonic score of 4.08 (sweet), indicating that the combination of avocado flour and banana uli puree produced a taste that was more acceptable to panelists. The sweetness of the product is mainly associated with ripe bananas, which contain higher levels of sugars such as sucrose, glucose, and fructose formed during the ripening process through starch hydrolysis. Previous studies report that the conversion of starch into simpler sugars during banana ripening increases sweetness and improves flavor acceptance (26). On the other hand, avocado flour may contribute a slightly bitter taste due to phenolic compounds, which can reduce perceived sweetness when used in higher proportions. Therefore, balancing sweetness with the subtle flavor of avocado becomes important in improving product acceptability and supporting the development of food innovations for community nutrition programs (27). Taste evaluation also provides important information for planning product distribution, promotion strategies, and household preparation practices in community-based nutrition programs to ensure that the products are aligned with local food preferences (28).

Texture Acceptance

Texture is an important factor in sensory acceptance because it reflects the physical characteristics of a product (29,30). The results of this study showed that formulation F1 had the highest texture acceptance with a hedonic score of 4.36 (soft), indicating better batter stability and gas retention during baking, which contributed to a softer cake texture. Previous studies report that cake texture is influenced by batter structure and the ability to retain gas bubbles during baking, affecting crumb softness and uniformity (31). Research also shows that partial substitution of wheat flour with other ingredients can affect volume expansion and the texture of bakery products (32). In addition, fruit puree with higher moisture content can support starch gelatinization and contribute to softer textures (33).

From a nutrition program perspective, texture is an important determinant of food acceptability. Matching softness and mouthfeel with local preferences can increase consumption and support the success of community nutrition programs (19). Maintaining texture quality also ensures that innovative foods remain acceptable and sustainable within community interventions (21,34).

Macronutrient and Micronutrient Content

Fortified products using local ingredients such as avocado flour and banana puree can support functional food development and provide nutritional benefits for community programs. In this study, formulation F1 contained 71.2 g/100 g carbohydrates, 10.5 g/100 g protein, 1.8 g/100 g fat, 159.9 mg/100 g potassium, 7.26% moisture, and 0.69% ash (12,27). These findings indicate that the selected formulation not only achieved better sensory acceptance but also maintained a favorable nutritional composition.

Previous studies report that ingredient substitution in fruit-based bakery products can influence carbohydrate composition, sweetness perception, and overall acceptance of fortified foods (35,36). The nutritional quality of formulated products is also affected by ingredient interactions and processing methods, particularly in optimizing protein content and nutrient density for target populations (37,38). In addition, potassium-rich ingredients such as bananas contribute to dietary potassium intake and support cardiovascular health, strengthening the functional value of local food innovations (6).

Moisture and ash content are important quality indicators because they influence product stability, shelf life, and mineral retention in fortified foods (39,40). Therefore, integrating laboratory findings with national food quality standards can support evidence-based nutrition program interventions and promote the development of nutrient-dense local foods that are acceptable for community implementation (17).

CONCLUSION AND RECOMMENDATION

Formulation F1 (10 g avocado flour and 15 g uli banana puree) was identified as the best product based on organoleptic and chemical analyses. The product showed neutral brown color, neutral avocado aroma, sweet taste, soft texture, and nutritional content per 100 g of 71.2 g carbohydrates, 10.5 g protein, 1.8 g fat, 159.9 mg potassium, 7.26% moisture, and 0.69% ash. These results indicate that the product has potential as a functional food, particularly for individuals with hypertension due to its potassium content. The development of local food–based products such as this cake can support food diversification and community nutrition programs. Further studies are recommended to evaluate shelf life, wider consumer acceptance, and the application of this product in community-based nutrition interventions.

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