

Sensory evaluation and nutritional properties of Gapit Cake substituted with mocaf flour for adolescent

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Abstract

The problem of insufficient fiber and iron intake in adolescents can contribute to increased malnutrition. Providing nutritious food can help prevent malnutrition in adolescents. One of the food components that has the potential to be a source of fiber and iron is Mocaf flour. The purpose of this study was to analyze the sensory properties and nutritional content of gapit cake formulations with mocaf flour substitution. This study employed a completely randomized design with three treatments. The gapit cake formulations with a ratio of mocaf flour and tapioca flour were F1 (85:5), F2 (90:10), and F3 (100:0). The variables analyzed included sensory tests, selected formula, and nutritional content. The results showed that the formulations (F1, F2, and F3) exhibited significant differences in several hedonic test parameters, including color, aroma, taste, texture, and overall ($p < 0.05$). F3 is the selected formula with an estimated nutritional content of 3.62 g water, 1.44 g ash, 2.4 g protein, 16.80 g fat, 71.03 g carbohydrate, 4.72 g fiber, 4.09 mg iron, and 435.74 kcal of energy per 100 grams. This product also meets the nutritional content claims as a source of fiber and iron. A gapit cake with a mocaf flour substitute has the potential to be a healthy snack alternative containing fiber and iron for adolescent.

Keywords

Mocaf flour, Gapit Cake, Adolescent, Food development, Sensory evaluation

Introduction

Adolescents are a demographic susceptible to nutritional deficiencies due to heightened dietary requirements for growth and development. Nevertheless, adolescent diets frequently fail to meet balanced nutritional requirements, especially for fiber and iron [1]. Insufficient fiber intake may lead to gastrointestinal issues, whereas inadequate iron levels may increase the risk of anemia, adversely affecting concentration, scholastic achievement, and immune function [2]–[4]. If this situation

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persists for an extended period, it may lead to increased malnutrition among adolescents.

Strategies to prevent malnutrition among adolescents include offering nutritious, palatable diets that align with their tastes. Utilizing local products to diversify the diet is one viable method. One of the food ingredients that can be used in product development is Mocaf. Mocaf is a product derived from cassava (*Manihot Esculenta Crantz*), processed through the alteration of cassava cells via fermentation, wherein lactic acid bacteria (LAB) predominate during the fermentation process. Microorganisms generate pectinolytic and cellulolytic enzymes that can degrade cassava cell walls and liberate starch granules. Microorganisms produce enzymes that hydrolyze starch into sugars, which are subsequently converted into organic acids, particularly lactic acid. This process will alter the properties of the resultant flour, making the mocaf flavor neutral as it masks the taste of fresh cassava. Mocaf also had higher fiber content and a possible source of iron. Moreover, Mocaf can serve as an alternative to wheat or tapioca flour in a range of processed food items [5].

A potential food product for development is gapit cake. Gapit cake is a local Cirebon delicacy favored by diverse demographics, particularly adolescents. Gapit cake is composed of wheat flour or tapioca flour. Substituting traditional flour with Mocaf flour in gapit cake manufacture is anticipated to enhance the product's nutritional profile, particularly in fiber and iron content, while maintaining customer acceptance levels. This study examines the sensory attributes and nutritional composition of gapit cake formulations incorporating mocaf flour as a substitute, aiming to provide nutritious food to mitigate malnutrition among adolescents

Method

Research design

This study was a laboratory experiment using a completely randomized design with one factor and two replications. The factor used was the addition of Mocaf flour at three levels. Product preparation and sensory evaluation were conducted in the Nutrition Laboratory of the Nutrition Study Program, University Muhammadiyah Cirebon. Nutrient content analysis was performed at the Chem-Mix Pratama Laboratory in Yogyakarta.

Gapit Cake preparation

The ingredients for gapit cake are purchased at traditional markets in Cirebon Regency, West Java. Mocaf is purchased commercially from online stores. The ingredients for gapit cake include mocaf, tapioca flour, coconut dregs, coconut milk, pandan leaves, sugar, eggs, salt, and butter. The formulations with various ratios of Mocaf to tapioca flour were F1 (85:15), F2 (90:10), and F3 (100:0). The formula for making gapit cake is shown in [Table 1](#). Preparation of gapit cake begins by mixing butter, sugar, salt, and eggs using a mixer. Then add tapioca flour, mocaf, coconut dregs, coconut milk, and pandan

leaves to the mixture. The mixture is stirred until a moist dough forms. Heat a special gapit cake mold. Pour the mixture into the mold, press and clamp it, and cook the gapit cake over medium heat until cooked through.

Table 1. Formulation (g) of gapit cake with different ratios of Mocaf and tapioca flour

Ingredient	Formula		
	F1 (85:15)	F2 (90:10)	F3 (100:0)
Mocaf	213	225	250
Tapioca	37	25	0
Coconut dregs	100	100	100
Pandan leaves	10	10	10
Sugar	7	7	7
Eggs	40	40	40
Salt	3	3	3
Coconut milk	100	100	100
Butter	15	15	15

Sensory valuation

The sensory evaluation included hedonic and hedonic quality tests. This test was conducted on 30 semi-panelists. The panelists were nutrition students at Universitas Muhammadiyah Cirebon who met the inclusion criteria. Panelist inclusion criteria included having received a one-hour lecture on sensory evaluation methods, having no allergies, being in good health, not being colorblind, and having no taste or smell deficiencies. Before the sensory test, panelists were asked to sign an informed consent form after an explanation. The sensory evaluation was conducted in a sensory testing room with adequate lighting and free from odors. Panelists were provided with water during the sensory testing to neutralize their taste perception. Gapit cake samples were served to panelists on plastic plates. Each sample was randomly assigned a three-digit code to prevent panelists from identifying each sample. Panelists were asked to provide a sensory assessment of each sample on a sensory testing form, using a scale of 1 to 9, with one being the lowest and nine the highest.

Analysis of selected formula

The selected formula was analyzed using the exponential comparison method. The aspects considered were the hedonic test results, including color, aroma, taste, and texture. The weight value was based on the product considerations, with each component assigned a weight of 0.25. Each element was then ranked according to the hedonic test score obtained in the sensory analysis. The formula with the highest priority in that aspect was ranked lowest. The score is calculated by multiplying the weight value by the ranking. The selected formula was the one with the lowest total score.

Nutritional analysis

The nutrient content analyzed included water, ash, protein, fat, carbohydrates, crude fiber, iron, and energy. Water content was determined by oven drying. Ash content was evaluated by combustion of the sample. Fat content was measured using the Soxhlet extraction method. Protein content was analyzed using the Kjeldahl method. Carbohydrate content was determined by difference calculation. Iron (Fe) content was

assessed using spectrophotometry. Crude fiber analysis used a gravimetric method involving acid-base hydrolysis. Energy content was estimated using a calculation method.

Data analysis

Data were analyzed using Microsoft Excel and SPSS. Sensory evaluation data were analyzed descriptively, with mean values and standard deviations. Furthermore, sensory evaluation data were analyzed using ANOVA with Duncan's exact test, as the data were normally distributed and homogeneous. Significant differences were declared at the 95% confidence level (p -value < 0.05). Nutrient content data were analyzed descriptively, with results presented as mean and standard deviation.

Results

Sensory evaluation results

The sensory evaluation analyzed in this study includes hedonic tests and hedonic quality. The results are shown in Table 2. A hedonic test was conducted to assess panelists' preferences for food products. The results showed significant differences in color, aroma, taste, and texture (p -value < 0.05). Formula 3, with the highest Mocaf proportion (100%), had the highest hedonic test scores for color (6.2 ± 1.4), aroma (6.1 ± 1.4), taste (6.1 ± 1.4), texture (5.4 ± 1.9), and overall (5.8 ± 1.7) compared to the other formulas. The results indicated that F3 was the most preferred by panelists across all hedonic attributes.

Table 2. Sensory evaluation of gapit cake with different ratios of Mocaf and tapioca flour

Sensory attributes	Formula			p-value
	F1 (85:15)	F2 (90:10)	F3 (100:0)	
Hedonic test				
Color	5.6 ± 1.4^{ab}	5.2 ± 1.3^a	6.2 ± 1.4^b	0.021
Aroma	5.2 ± 1.3^a	5.6 ± 1.0^{ab}	6.1 ± 1.4^b	0.019
Taste	4.7 ± 1.4^a	5.3 ± 1.7^{ab}	6.0 ± 1.4^b	0.003
Texture	4.2 ± 1.5^a	4.7 ± 1.9^{ab}	5.4 ± 1.9^b	0.038
Overall	4.9 ± 1.0^a	5.1 ± 1.5^{ab}	5.8 ± 1.7^b	0.040
Hedonic quality				
Color	5.2 ± 1.8^a	5.7 ± 1.8^a	5.9 ± 1.5^a	0.297
Mocaf aroma	5.1 ± 1.6^a	5.5 ± 1.8^{ab}	6.3 ± 2.1^b	0.046
Mocaf taste	4.9 ± 1.4^a	5.9 ± 1.4^b	6.3 ± 2.0^b	0.003
Savory taste	5.2 ± 1.3^a	5.5 ± 1.7^a	6.0 ± 1.7^a	0.102
Texture	6.0 ± 1.8^a	5.7 ± 1.8^a	5.3 ± 1.8^a	0.279

^{a,b} Means with the same letters in the same row indicate no significant difference at $\alpha = 5\%$

Furthermore, a hedonic quality test was conducted to obtain an overview of the Figure 1 of the product characteristics. In terms of hedonic quality, the analysis results showed no significant differences in color, savory taste, and texture (p -value > 0.05). Significant differences were found in the Mocaf aroma ($p = 0.046$) and Mocaf taste ($p = 0.003$). Formula 3 exhibited significant higher levels of Mocaf aroma (6.3 ± 2.1) and taste (6.3 ± 2.1) than F1 and F2. This result suggested that F3 had a stronger Mocaf aroma and taste than the other formulations.

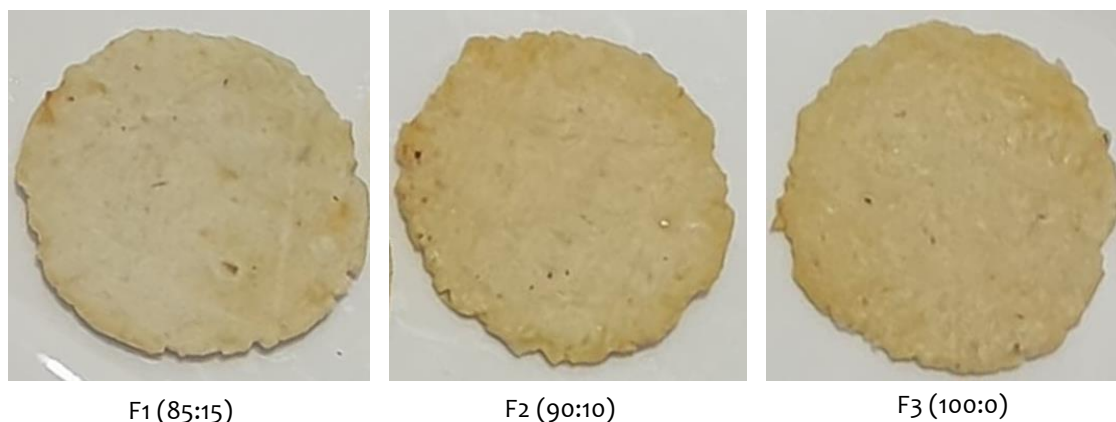


Figure 1. Gapit cake with different ratios of Mocaf and tapioca flour

Selected formula

The selected formula is obtained from calculations using the exponential comparison method, which is presented in Table 3. The analysis results showed that F3 had the lowest total score (1.00) and was prioritized over the other formulas (rank 1). Therefore, in this study, F3 was selected as the best formulation.

Table 3. Selected formula of gapit cake with different ratios of Mocaf and tapioca flour

Parameters	Weight value	F1 (85:15)		F2 (90:10)		F3 (100:0)	
		Rank	Score	Rank	Score	Rank	Score
Color	0.25	2	0.50	3	0.75	1	0.25
Aroma	0.25	3	0.75	2	0.50	1	0.25
Taste	0.25	3	0.75	2	0.50	1	0.25
Texture	0.25	3	0.75	2	0.50	1	0.25
Total Score			2.75		2.25		1.00
Rank			3		2		1

Nutritional content and nutritional contribution for adolescents

The nutritional content analysis of the selected formula (F3) is presented in Table 4. The nutritional content of Gapit cake per 100 grams was calculated as 3.62 g water, 1.44 g ash, 2.4 g protein, 16.80 g fat, 71.03 g carbohydrate, 4.72 g fiber, 4.09 mg iron, and 435.74 kcal of energy (Table 4). The nutritional content analysis also calculated its contribution to the nutrition label guideline (NLG) table for adolescents (the general population). The %NLG for fiber was 15,73% and for iron was 18,59%. The results indicate that this product meets the nutritional content claims as a source of fiber (minimum 3 grams per 100 g) and a source of iron (minimum 15% of the nutrition label reference per 100 g).

The nutritional content of the product was also calculated per serving size, which was 65 grams. This amount per serving was calculated assuming this product is used as a snack that provides 10-15% of the recommended dietary allowance (RDA). The RDA is based on a group of adolescents for both boys and girls aged 13 to 18 years. The result showed that 65 grams of gapit cake meets 10.69%-13.82% of the energy adequacy level, 9.02%-10.59% of the fiber adequacy level, and 17.73%-24.19% of the iron adequacy level.

Table 4. Nutrient content and nutrient contribution to the NLG and RDA

Nutrient	Nutrient content per 100 g	Nutrient content per 65 g	% NLG per 100 g ¹	% RDA per 65 g (serving size)			
				Boys		Girls	
				13-15 y.o	16-18 y.o	13-15 y.o	16-18 y.o
Moisture (g)	3.62±0.07	2.35±0.05	-	-	-	-	-
Ash (g)	1.44±0.04	0.93±0.03	-	-	-	-	-
Protein (g)	2.40±0.07	1.56±0.04	4.00	2.23	2.08	2.40	2.40
Fat (g)	16.80±0.13	10.92±0.08	25.07	13.65	12.85	15.60	15.60
Carbohydrate (g)	71.03±0.20	46.17±0.13	21.86	13.19	11.54	15.39	15.39
Fiber (g)	4.72 ± 0.05	3.07±0.03	15.73	9.02	8.29	10.59	10.59
Iron (mg)	4.09±0.05	2.66±0.03	18.59	24.19	24.19	17.73 ²	17.73 ²
Energy (kcal)	435.74±0.6	283.23±0.42	20.27	10.69	10.9	13.82	13.48

¹NLG = nutritional label guidelines, ²RDA = recommended dietary allowance

Discussion

Gapit cake is a local culinary specialty from Cirebon that remains a favored snack, particularly among the youth. The incorporation of Mocaf flour as the primary ingredient in gapit cake is expected to improve the product's sensory attributes and nutritional profile. The findings of this study demonstrate that F3, which contains the highest proportion of Mocaf (100%), received the highest level of preference from panelists across all hedonic parameters compared to the other formulas. The findings suggest that products with a higher proportion of Mocaf are deemed acceptable. This observation is consistent with the research by Yuniartini and Nugrahani, which found that the cookie formulation with 0% chickpea flour and 100% mocaf was the most favored option [6]. In similar lines, additional research indicated that incorporating 100% Mocaf into cheese cookies yielded the highest preference levels when compared to alternative formulations [7]. Mocaf exhibits a relatively neutral flavor profile and lacks the intensity of fresh cassava flavour, making it a versatile alternative to wheat flour for a range of flour-based food products [8]. The Mocaf processing method involves multiple stages. The fermentation process is a vital phase in the production of Mocaf flour. Cassava fermentation can occur via microbial agents, such as *Lactobacillus plantarum*, or through methods that do not involve microbes. The fermentation process effectively reduces cassava bitterness, thereby enhancing the acceptability of Mocaf [5].

This study also found that adding Mocaf to the product had no significant impact on the hedonic quality of color, savory taste, and texture. However, it did impact the Mocaf aroma and taste. Increasing mocaf levels makes a stronger mocaf aroma and taste in the product sample. Several studies confirm that increasing the proportion of mocaf in food products enhances their distinctive aroma and flavor. This finding is due to the natural sensory characteristics of mocaf, which can impact the unique flavor and aroma of cassava-derived products even after fermentation and processing [9]. The hedonic quality of this Mocaf gapit cake may be enhanced by incorporating mixed flour, flavorings, or other ingredients, primarily to refine texture, color, and taste. Previous research has identified several examples of mixed flours, including arrowroot flour, corn flour, breadfruit or pumpkin flour, and rice or sago flour [10], [11]. The incorporation of

various flavoring agents may also effectively mask the remaining cassava flavor while simultaneously enhancing the overall flavor profile. Fruit and ginger extract are examples of natural flavoring agents that can enhance food products [12].

Analysis of the selected formulas showed that F3 was the best Gapit cake formulation. Nutritional analysis per 100 grams showed that this Gapit cake contains 4.72 g of fiber and 4.09 mg of iron. Furthermore, this product meets the requirements for claims as a source of fiber and a source of iron. Mocaf is known to have several nutritional benefits, including fiber and iron. Mocaf does contain dietary fiber, which is beneficial for digestion. The fiber content of Mocaf is known to be higher (3.4%) than wheat flour (2-2.5%) [13]. Furthermore, one serving (65 g) of this product is also known to meet 10-15% of the energy requirement for a snack. However, adolescents should still obtain nutritional intake from other main foods. These findings can provide important insights for further research on mocaf in the development of food products as a source of fiber and iron for functional foods, especially for adolescents.

Conclusion

This study has developed a gapit cake formula utilizing Mocaf flour. The results indicated that the formulations (F1, F2, and F3) showed significant differences across multiple hedonic test parameters, including color, aroma, taste, texture, and overall assessment ($p < 0.05$). The chosen formula, F3, presents an estimated nutritional profile comprising 3.62 g of water, 1.44 g of ash, 2.4 g of protein, 16.80 g of fat, 71.03 g of carbohydrate, 4.72 g of fiber, 4.09 mg of iron, and 435.74 kcal of energy per 100 grams. This product fulfills the nutritional content claims, serving as a source of fiber and iron. A gapit cake made with a mocaf flour substitute is a viable option for a nutritious snack, providing beneficial fiber and iron for adolescents. Further similar research could analyze the product's shelf life as a potential application. Furthermore, human clinical trials are needed to determine its effectiveness in improving nutritional status in adolescents.

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