Development of Green Banana Cake (Pisang ijo) Products using Kelor Leaf (*Moringa oleifera* Lam) as a Food Dye and Flour Substitute

Nahriana*, Muhammad Yahya, Ratnawati Tawani
Faculty of Engineering, Universitas Negeri Makassar, South Sulawesi, Indonesia

*Corresponding author: nahriana@unm.ac.id

**Abstract.** Pisang ijo is one of the traditional cakes in South Sulawesi which is very popular within the community. Pisang ijo is made from *Moringa oleifera* leaf flour and extract, wheat flour, plantain, sugar, and salt which is processed using steaming methods. Pisang ijo was served with vanilla sauce. The purpose of the study was to describe the process of making moringa leaf flour and extract, knowing how to process it and find out the results of organoleptic tests of green banana cake by using the substitution of moringa leaf extract (F1) and moringa leaf flour (F2). The research method used was an organoleptic test method using 30 investigators divided into three groups: 10 expert examiners, 10 trained investigators, and 10 untrained investigators. Laboratory tests using spectrophotometric were carried out to determine the nutritional content of moringa leaf flour and extract. The organoleptic test results show that from the aspect of color, the most preferred product by the panelists is the F1 product which produces a lighter green color. The F2 product is less bright. The hedonic test results of aroma, texture, and sense show that the product most preferred by the panelists is the F2 product. Proximate test results indicate a better nutritional content in F2 products, i.e., the protein and vitamin C content are higher, which are 3.38% and 153.2 µg g⁻¹, respectively than the F1 product.

**Keywords:** green banana cake, moringa leaf, substitution, food dye, organoleptic tests

1. Introduction

*Moringa oleifera* Lam or moringa plants are plants that easy to grow and develop, so their availability is sufficient. Moringa plants have long been cultivated because moringa leaves are one of the food ingredients that can be processed into vegetables as a daily menu [1]. Moringa plants have a characteristic that is the size of the leaf as big as the tip of the little finger, green pinnate and has a round leaf shape like an egg. The stem can reach a height of approximately 7 meters. At a certain age, the moringa plant will flower white, and the flower will turn into fruit extending about 25-40 cm [2].

The development of science and technology has caused many scientists to process moringa leaves into new products that have good quality to meet the nutritional needs of consumers [3]. The main content in moringa leaves is iron which is needed by the body. According to Rudianto [1], moringa leaves contain Beta Carotene, Thiamin (B1), Riboflavin (B2), Niacin (B3), calcium, iron, phosphorus, magnesium, zinc, and vitamin C, so they can be an alternative to improve nutritional status. In addition
to the high nutritional content, moringa leaf can also be used as a coloring agent for food because it contains chlorophyll which can produce natural green color, so it is safe for consumption.

The high content of nutrients and chlorophyll substances in moringa leaves is one of its advantages compared to other food crops. Therefore, food processing based on moringa leaves must be more varied so that it attracts consumer tastes [4][5]. Moringa leaves can be processed with simple technology and can be used as additives to food products. One method of processing moringa leaves is using a simple drying method then it is carried out by laying so that it is easy to use and more durable. Zakaria [6] stated that moringa leaf flour contains rich nutrients such as protein 28.25%, vitamin A in the form of β-carotene 11.92 mg, calcium 2241.19 mg, and magnesium 28.03 mg.

In general, foods that have an attractive appearance can invite consumers to taste, so a sense of enjoyment arises. One of the most interesting things is the color of food, especially in traditional cakes which have their own characteristics, both from raw materials, processing and presentation. However, the government's concern is the discovery of producers who process food using hazardous ingredients such as the use of textile dyes in food [7]. Therefore, the processing of banana green cake can be developed by utilizing moringa leaves which was processed into the flour so as to provided a natural green color and produce bananas which have better quality and high nutritional content.

2. Material and method

2.1. Materials and tools
The materials used in this study are:
Wheat flour 200 g, moringa leaf flour 40 g, dark green moringa leaf for extract 20 g, plantain, sugar 30 g, coconut milk/water 300 cc, margarine 20 g, salt 5 g, vanilla 3 g, and DHT syrup sufficiently.
While the equipment needed is a set of laboratory equipment such as scales, basins, blenders, steamer pans, wooden spoons, rolling pins, knives, sieves, trays, spoons, and others.

2.2. Research procedure

2.2.1 The process of making moringa leaf flour
The process of making moringa leaf flour started from the sorting of moringa leaves to obtain moringa leaves that were suitable for use. Moringa leaves were dried to reduce the water content. After that, the moringa leaves were smoothed and sifted.

2.2.2 The process of making moringa leaf extract
Moringa leaves were sorted first to get the desired leaves. Furthermore, moringa leaves were blended with water and filtered to produce moringa leaf extract.

2.2.3 The process of making a green banana cake
The plantain was steamed until cooked and then peeled. The wrapping of green banana was made from a mixture of wheat flour, moringa leaf extract, salt and water (F1). For F2 product code, moringa leaf extract was not used and replaced with moringa leaf flour. The mixture was steamed until cooked. After that, the mixture was kneaded until smooth. Then, the flaked skin mixture was filled with plantain and rolled up to form like a raw. After that, it was served with DHT syrup and vanilla sauce made from coconut milk stew, sugar, water, wheat flour, and vanilla.

2.3. Organoleptic tests
Organoleptic tests were carried out to test the acceptance of panelists against green bananas; then a sensory test was conducted to assess the color, aroma, texture, and taste described in the prepared sheet score [8]. Organoleptic testing was a way of testing by using the human senses as the main tool for measuring the acceptance of the product. In this test, 30 competent panelists were used and divided into three groups: 10 expert investigators, 10 trained investigators and 10 untrained investigators who
came from the lecturers and students Tata Boga Concentration, Department of PKK, Faculty of Engineering, Universitas Negeri Makassar.

3. Description of sensory test data

3.1. Hedonic test of color aspects
The results of the evaluation of the organoleptic test of color was carried out by the panelists, and the results of descriptive analysis related to the frequency and percentage can be seen in Table 1.

| Category               | Number of Panelists | Frequency | Percentage (%) |
|------------------------|---------------------|-----------|----------------|
| Very like              | 30                  | 0         | 0              |
| Like                   | 30                  | 17        | 56.7           |
| Slightly like          | 30                  | 7         | 23.3           |
| Slightly dislike       | 30                  | 6         | 20             |
| Almost dislike         | 30                  | 0         | 3.3            |
| Total                  | 30                  | 30        | 100            |

Table 1 shows that in the F1 product the panelists did not choose for the category of very like and almost dislike (0%). Like categories were chosen by 17 panelists (56.7%), slightly like category was chosen by 7 panelists (23.3%), and slightly dislike category was chosen by 6 panelists (20%). In the F2 product for the category of very like and like not chosen by the panelists (0%), the slightly like category was chosen 8 panelists (26.7%), the slightly dislike category was chosen 21 panelists (70%), and the almost dislike category was selected 1 panelist (3.3%). Based on the hedonic test, the most preferred product by the panelists is the F1 product which produces a lighter green color. The F2 product is less bright.

3.2. Hedonic test of aroma aspects
The results of the evaluation of the organoleptic test of aroma carried out by the panelists and the results of descriptive analysis related to the frequency and percentage can be seen in Table 2.

| Category             | Number of Panelists | Frequency | Percentage (%) |
|----------------------|---------------------|-----------|----------------|
| Extremely strong     | 30                  | 0         | 0              |
| Very strong          | 30                  | 0         | 63.3           |
| Moderately strong    | 30                  | 0         | 36.7           |
| Slightly strong      | 30                  | 17        | 56.7           |
| Off flavor           | 30                  | 13        | 43.3           |
| Total                | 30                  | 30        | 100            |

Table 2 indicates that F1 products in the category of extremely strong, very strong and moderately strong are not selected by the panelists (0%). The slightly strong category was chosen by 17 panelists (56.7%), and off-flavor category selected 13 panelists (43.3%). In F2 products, the category is
extremely strong, slightly strong and off flavor is not selected by the panelists (0%). The very strong
category was chosen by 19 panelists (63.3%), and the moderately strong category selected 11 panelists
(36.7%). The hedonic test results show that the product most preferred by the panelists is the F2
product. In F1 products the aroma of moringa leaves is stronger while in F2 products the aroma of
moringa leaves is more integrated with the mixture, so the aroma is not too strong.

3.3 Hedonic test of texture aspects
The results of the evaluation of the organoleptic test of texture carried out by the panelists and the
results of descriptive analysis related to the frequency and percentage can be seen in Table 3.

| Category   | Number of Panelists | F1 Frequency | F2 Frequency | Percentage (%) |
|------------|---------------------|--------------|--------------|----------------|
| Very soft  | 30                  | 0            | 0            | 0              |
| Soft       | 30                  | 0            | 0            | 0              |
| Slightly soft | 30            | 14           | 20           | 46.7           |
| Hard       | 30                  | 16           | 10           | 53.3           |
| Very hard  | 30                  | 0            | 0            | 0              |

The data in Table 3 describe that in the F1 product in the category of very soft, soft and hard are
not selected by the panelists (0%), a slightly soft category was chosen by 14 panelists (46.7%), and the
hard category was selected 16 panelists (53.3 %). The same thing happens with F2 products, but with a
different percentage of panelists. In a slightly soft category, 20 panelists were chosen (66.7%), and the
hard category was selected 10 panelists (33.3%). The hedonic test results show that the best texture by
panelists is F2 products with a slightly soft texture.

3.4 Hedonic test of sense aspects
The results of the evaluation of the organoleptic test of sense carried out by the panelists, and the
results of descriptive analysis related to the frequency and percentage can be seen in Table 4.

| Category | Number of Panelists | F1 Frequency | F2 Frequency | Percentage (%) |
|----------|---------------------|--------------|--------------|----------------|
| Excellent| 30                  | 0            | 16           | 0 53.3         |
| Very good| 30                  | 9            | 10           | 30 33.3        |
| Good     | 30                  | 14           | 4            | 46.7 13.4      |
| Fair     | 30                  | 7            | 0            | 23.3 0         |
| Dislike  | 30                  | 0            | 0            | 0              |

Table 4 shows that the F1 products in the excellent and dislike category were not selected by the
panelists (0%), very good category was chosen by 9 panelists (30%), the good category was chosen by
14 panelists (46.7%) and the fair category was chosen by 7 panelists (23.3%). In F2 products, 16
panelists (53.3%) selected excellent categories, 10 panelists were selected for the very good category
(33.3%), 4 panelists were selected for the good category (13.3%). Whereas for the fair and dislike
category, panelists were not chosen (0%). The hedonic test results show that F2 products taste better than F1 products.

3.5 Proximate test results
Proximate test results of F1 and F2 products can be seen in Table 5. F1 products use moringa leaf extract while F2 products use moringa leaf flour.

Table 5. Proximate test results for F1 and F2 products

| Lab. Number | Sample Code | Parameters       | Carbohydrate (%) | Protein (%) | Vitamin A (µg g⁻¹) | Vitamin C (µg g⁻¹) |
|-------------|-------------|------------------|------------------|-------------|---------------------|-------------------|
| 18011653    | F1          |                  | 10.89            | 3.31        | 0.187               | 127.72            |
| 18011654    | F2          |                  | 2.54             | 3.38        | 0.057               | 153.2             |

Based on Table 5 it is known that carbohydrate and vitamin A content is higher in F1 products, which are 10.89% and 0.187 µg g⁻¹, respectively; whereas in F2 products the protein and vitamin C content is higher, namely 3.38% and 153.2 µg g⁻¹.

Overall, the results of this study indicate that F2 products are preferred, i.e., aspects of aroma, texture, and taste. But the color produced by the F2 product is not too bright. Proximate test results indicate a better nutrient content in F2 products.

4. Conclusion
The organoleptic test results show that from the aspect of color, the most preferred product by the panelists is the F1 product which produces a lighter green color. The F2 product is less bright. The hedonic test results of aroma, texture, and sense show that the product most preferred by the panelists is the F2 product. Proximate test results indicate a better nutrient content in F2 products, i.e., the protein and vitamin C content are higher, which are 3.38% and 153.2 µg g⁻¹, respectively than the F1 product.

References
[1] A. S. Rudianto and S. Alharini, “Studi Pembuatan Dan Analisis Zat Gizi Pada Produk Biskuit Moringa Oleifera Dengan Subtitusi Tepung Daun Kelor.” Program Studi Ilmu Gizi Fakultas Kesehatan Masyarakat Universitas Hasanuddin Makasar, 2013.
[2] A. D. Tilong, “Ternyata, Kelor Penakluk Diabetes.” Jogjakarta: DIVA Press, 2012.
[3] S. Aminah, T. Ramdhan, and M. Yanis, “Kandungan nutrisi dan sifat fungsional tanaman kelor (Moringa oleifera),” Bul. Pertan. Perkota., vol. 5, no. 2, pp. 35–44, 2015.
[4] A. Diantoro, M. Rohman, R. Budiarti, and H. T. Palupi, “Pengaruh Penambahan Ekstrak Daun Kelor (Moringa Oleifera L.) Terhadap Kualitas Yoghurt,” Teknol. PANGAN, vol. 6, no. 2, 2015.
[5] O. S. Adeyemi and T. C. Elebiyo, “Moringa oleifera supplemented diets prevented nickel-induced nephrotoxicity in wistar rats,” J. Nutr. Metab., vol. 2014, 2014.
[6] A. T. Zakaria and R. H. Sirajuddin, “Penambahan Tepung Daun Kelor Pada Menu Makanan Sehari-hari Dalam Upaya Penanggulangan Gizi Kurang Pada Anak Balita,” J. Media Gizi Pangan, vol. 13, 2012.
[7] M. Pritchard, T. Craven, T. Mkandawire, A. S. Edmondson, and J. G. O’Neill, “A comparison between Moringa oleifera and chemical coagulants in the purification of drinking water—An alternative sustainable solution for developing countries,” Phys. Chem. Earth, Parts A/B/C, vol. 35, no. 13, pp. 798–805, 2010.
[8] D. Shiriki, M. A. Igyor, and D. I. Gernah, “Nutritional evaluation of complementary food formulations from maize, soybean, and peanut fortified with Moringa oleifera leaf powder,” Food Nutr. Sci., vol. 6, no. 05, p. 494, 2015.