Journal of Applied Nutrition and Dietetic
Volume 5, Number 1, June 2025
P-ISSN: 2797-7412
DOI : 10.30867/jand.v5i1.363

Effect of Adding Moringa Leaf Flour on the Sensory Acceptance of Moringa Biscuits

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Submitted : 05/07/2023 *Accepted: 24/06/2025* *Published: 30/06/2025*

ABSTRACT

The Recovery Food Supplement (PMT) program is a government initiative aimed at improving the nutritional status of toddlers by providing food supplements in addition to their daily intake, particularly for undernourished children. One form of PMT is the toddler biscuit, formulated to contain a minimum of 160 kcal, 3.2–4.8 g of protein, and 4–7.2 g of fat per 40 g serving. According to technical guidelines, PMT targets children aged 6–59 months who are categorized as underweight (weight-for-height < –2 SD) and is administered for 90 days. To determine the effect of adding Moringa leaf flour on the acceptability of Moringa-based biscuit snacks. This study employed a non-factorial Completely Randomized Design (CRD) with three treatments: Y1 (40 g cornstarch + 10 g Moringa leaf flour), Y2 (40 g cornstarch + 15 g Moringa leaf flour), and Y3 (40 g cornstarch + 25 g Moringa leaf flour). Organoleptic tests assessed color, taste, aroma, and texture parameters. Data were analyzed using ANOVA. ANOVA results showed no significant effect on color ($p = 0.216$), aroma ($p = 0.753$), or texture ($p = 0.877$). However, a significant difference was found in the taste parameter ($p = 0.034$), indicating that the addition of Moringa leaf flour influenced the flavor of the biscuits. The addition of Moringa leaf flour significantly affected the taste of Moringa biscuit snacks but had no significant effect on color, aroma, or texture. Future research should consider using a standardized baking temperature across all treatments and explore higher concentrations of Moringa leaf flour to enhance the nutritional content of the product.
Keyword : acceptability, biscuits, moringa leaf, supplementary food, toddler nutrition

Introduction

The **Recovery Food Supplement Program** (*Pemberian Makanan Tambahan Pemulihan*, PMT) is a government initiative aimed at improving the nutritional status of toddlers by providing additional food supplements to support their daily intake, especially for undernourished children. The PMT Recovery program is specifically designed to meet the nutritional needs of toddlers categorized as underweight, and includes products such as toddler biscuits formulated with enhanced nutrient profiles. PMT Recovery Biscuits are developed to contain at least 160 kcal, 3.2–4.8 grams of protein, and 4–7.2 grams of fat per 40-gram serving.

According to the technical guidelines for supplementary feeding, the primary target of PMT is children aged 6–59 months who are classified as underweight, based on weight-for-length/height (WFL/H) measurements below minus two standard deviations (< –2 SD). PMT Recovery is intended as a **supplement** rather than a **replacement** for toddlers' main daily meals. This intervention serves as a form of nutritional supplementation, fortified with essential vitamins and minerals, and is aimed at restoring optimal nutritional status. According to the Ministry of Health,

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PMT targets children below the red line (BGM) in growth charts and those from low-income families.

Distribution of PMT-P (Recovery PMT for undernourished toddlers) in Indonesia has reached 62.8%. In 2015, the Ministry of Health distributed 2,014.1 tons of PMT to 186,481 toddlers. This increased to 5,554.7 tons for 514,320 toddlers in 2016, and by the end of the first semester of 2017, 2,225.1 tons had been distributed to 206,033 toddlers across the country (Putri, 2018).

Currently, the use of **Moringa (Moringa oleifera)** in food products in Indonesia remains limited. With changes in lifestyle and the availability of various modern food options, traditional ingredients such as Moringa leaves are increasingly overlooked. Given their multifunctional benefits—for food, health, and the environment—public awareness of Moringa's nutritional value must be enhanced. According to Sugianto (2016), young Moringa leaves contain high nutritional value, with proximate analysis showing 13.19% moisture, 16.77% ash, 8.42% fat, and up to 39% protein content.

Globally, malnutrition remains a major unresolved issue. According to WHO data (2018), approximately 150.8 million children under five suffer from stunting, 50.5 million from wasting, and 38.3 million are overweight. Asia ranks highest in global malnutrition rates, with 83.6 million stunted children, 35 million wasted, and 17.5 million overweight. Among Asian subregions, South Asia has the highest rate of malnutrition at 33.3%, followed by Southeast Asia at 25.7%, and West Asia at 15.5%.

Further, WHO data from 2020 show that globally, 149.2 million (22.0%) children under five were stunted, 45.4 million were wasted, and 38.9 million (5.7%) were overweight. Stunting cases increased from 21.3% in 2019 to 22.0% in 2020 (WHO, 2020). In Indonesia, the 2018 Basic Health Research (*Riskesdas*) reported an obesity rate of 8%, wasting at 10.2%, and stunting at 30.8% among children under five. The 2021 *Study on Nutritional Status of Toddlers in Indonesia (SSGBI)* across 34 provinces recorded a national stunting prevalence of 24.4%.

In Aceh Province, the 2021 SSGBI reported a stunting rate of 33.2% among toddlers. Within Aceh Besar District, the 2017 data revealed a malnutrition rate of 5.4% and undernutrition rate of 16.7% in toddlers, with the Montasik Public Health Center recording a stunting prevalence of 25.6% (Aceh Besar Health Office, 2021).

Research Methods

This study employed an experimental design using a Completely Randomized Design (CRD) with three treatment groups and three replications each. The research was conducted on November 18, 2022. The organoleptic test was carried out at the Organoleptic Laboratory, Department of Nutrition, Aceh Polytechnic of the Ministry of Health, to assess panelists' preferences regarding the taste, aroma, color, and texture of Moringa leaf biscuits. Data were analyzed using a Completely Randomized Design (CRD) with three treatments and three replications. Statistical analysis was performed using SPSS software, employing Analysis of Variance (ANOVA) to determine the effect of treatment on sensory parameters. If significant differences were found ($p < 0.05$), the analysis was followed by Duncan's Multiple Range Test (DMRT) to compare differences between treatment groups at a 95% confidence level ($\alpha = 0.05$).

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Results

Test results of organoleptic properties

*Moringa Leaf Biscuits*with the addition of Moringa leaf flour treated with 10 grams of Moringa Leaf Powder, 15 grams of Moringa Leaf Powder, and 25 grams of Moringa Leaf Powder to determine the acceptability was carried out through organoleptic tests using the hedonic scale method including taste, color, aroma and texture carried out by the panelists trained in the Organoleptic Laboratory of the Nutrition Department of the Aceh Ministry of Health Polytechnic.

Color of Moringa Leaf Biscuits

The color of the Moringa leaf biscuits in this study varied across treatments. Biscuits in the Y1 group (with 10 grams of Moringa leaf flour) exhibited a slightly light green color, those in Y2 (15 grams) had a bright green color, while biscuits in Y3 (25 grams) appeared slightly darker green. The average results of the organoleptic test for color preference across treatments are presented in Table 1.

Table 1. Average Organoleptic Scores for Color of Moringa Leaf Biscuits

Treatment	Average Score
Y1 (10 g Moringa)	3.033[a]
Y2 (15 g Moringa)	3.333[a]
Y3 (25 g Moringa)	3.167[a]

Note: Scores with the same superscript letter indicate no significant difference (p > 0.05).

As shown in Table 1, the average organoleptic scores for color ranged from **3.033 to 3.333**, which falls into the **"rather like"** category on the hedonic scale. Among the three formulations, the Y2 treatment (with 15 grams of Moringa leaf flour) was the most preferred by panelists in terms of color. The results of the **ANOVA** analysis indicated that the addition of Moringa leaf flour at different levels did **not significantly affect** the color of the biscuits (**p > 0.05**). Therefore, it can be concluded that variations in the amount of Moringa leaf flour did not produce statistically significant differences in the visual color appeal of the biscuits.

Flavor (Taste)

The taste of Moringa leaf biscuits varied across treatments depending on the amount of Moringa leaf flour added. The Y1 biscuits (with 10 grams of Moringa leaf flour) had a **slightly bitter taste**, Y2 (15 grams) were described as **bitter**, and Y3 (25 grams) had a **predominantly bitter taste**. The average organoleptic scores for taste across the three treatments are shown in Table 2.

Table 2. Average Organoleptic Scores for Taste of Moringa Leaf Biscuits

Treatment	Average Score
Y1 (10 g Moringa)	2.867[a]
Y2 (15 g Moringa)	3.267[b]
Y3 (25 g Moringa)	2.967[ab]

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Note: Scores with different superscript letters indicate significant differences ($p < 0.05$).

The scores ranged from **2.867 to 3.267**, which fall within the **"neutral to slightly like"** category on the hedonic scale. The highest taste acceptability was found in treatment **Y2** (15 grams), which received a significantly higher score than Y1 ($p < 0.05$), indicating better acceptance despite its bitter profile. The results suggest that although increasing the amount of Moringa leaf flour intensifies bitterness, the 15-gram formulation (Y2) struck a more favorable balance between flavor and nutritional enhancement.

Based on Table 2, the average organoleptic scores for taste differed across treatments, ranging from **2.867 to 3.267**, which falls under the **"rather like"** category on the hedonic scale. The most preferred formulation was **Y2** (with 15 grams of Moringa leaf flour), which received the highest score. The results of **ANOVA analysis** showed that the addition of Moringa leaf flour had a **significant effect on taste** ($p < 0.05$). Further analysis using **Duncan's Multiple Range Test (DMRT)** indicated that the taste of biscuits with 15 grams of Moringa leaf flour (Y2) was significantly better than that of the biscuits with 10 grams (Y1) and 25 grams (Y3). These findings suggest that 15 grams of Moringa leaf flour offers the most favorable balance between taste and nutritional enrichment.

Aroma

Moringa leaf biscuits from all three treatments—Y1 (10 g), Y2 (15 g), and Y3 (25 g)—shared a similar **distinctive Moringa aroma**. Table 3 presents the average aroma scores:

Table 3. Average Organoleptic Scores for Aroma of Moringa Leaf Biscuits

Treatment	Average Score
Y1 (10 g)	3.133[a]
Y2 (15 g)	3.100[a]
Y3 (25 g)	3.000[a]

The average scores ranged from **3.000 to 3.133**, categorized as **"rather like"**. Although Y1 received the highest score, the differences were not statistically significant. The **ANOVA analysis** revealed that the addition of Moringa leaf flour had **no significant effect on aroma** ($p > 0.05$). Therefore, it can be concluded that variations in the amount of Moringa leaf flour did not affect the perceived aroma of the biscuits.

Texture

The average organoleptic scores for texture are shown in Table 4:

Table 4. Average Organoleptic Scores for Texture of Moringa Leaf Biscuits

Treatment	Average Score
Y1 (10 g)	3.133[a]
Y2 (15 g)	3.167[a]
Y3 (25 g)	3.067[a]

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The scores ranged from **3.067 to 3.167**, which fall within the **"rather like"** category. The **Y2 formulation** (15 g) was the most preferred in terms of texture. However, **ANOVA results** showed **no significant difference** among treatments ($p > 0.05$), indicating that the addition of Moringa leaf flour did not significantly influence the texture of the biscuits.

Discussion

The results of this study showed that the addition of Moringa leaf flour significantly affected the taste of Moringa leaf biscuits but did not significantly influence the color, aroma, or texture. The significant change in taste is likely due to the characteristic bitter flavor of Moringa leaves, which intensifies with higher concentrations. This is consistent with findings by Rahayu et al. (2018), who reported that although Moringa leaves are highly nutritious, their taste may affect acceptability if used in excessive amounts.

In the current study, the formulation with 15 grams of Moringa leaf flour (Y2) was the most preferred in terms of taste, suggesting an optimal balance between flavor intensity and nutritional value. This aligns with research by Indriasari, Basrin, and Salam (2019)**,** which emphasized that product formulations using Moringa flour must consider both sensory and nutritional aspects to ensure consumer acceptability.

While the aroma and texture were not significantly affected by the addition of Moringa leaf flour, all biscuit formulations were rated in the "rather like" category. This finding supports Irwan et al. (2020)**,** who developed Moringa-based cookies and reported that moderate incorporation of Moringa leaves did not negatively affect the aroma and texture, especially when balanced with other ingredients like margarine and eggs.

In terms of nutritional justification, Krisnadi (2015) and Winarno (2004) highlight the high protein, mineral, and antioxidant content of Moringa leaves, making them an excellent functional food ingredient. Although taste can be a limiting factor in product development, it can be adjusted through formulation strategies to ensure nutritional benefits without compromising acceptability.

Furthermore, the need for affordable and nutrient-rich snacks such as Moringa leaf biscuits is aligned with government programs like the Supplementary Feeding Program (PMT)**.** According to the Ministry of Health (2017a, 2017b)**,** these programs aim to improve the nutritional status of undernourished children using locally sourced and fortified foods. Incorporating Moringa leaf flour into PMT biscuit formulations may offer a practical alternative to increase protein and micronutrient intake among vulnerable groups.

Additionally, studies such as those by Aprilianti (2010) and Nofaliana (2013) support the role of ingredient selection and proportion in determining the sensory attributes of functional food products. A similar pattern was observed in this study, where moderate inclusion levels of functional ingredients provided better organoleptic outcomes compared to higher concentrations.

Taken together, the findings suggest that Moringa leaf biscuits, particularly with the addition of 15 grams of Moringa flour, can serve as a potential supplementary snack for nutritional programs. However, product development should continue to consider flavor masking techniques and community preference assessments to improve overall acceptability.

Conclusions

Based on the results of this study, it can be concluded that the addition of Moringa leaf flour to biscuit formulations significantly affected panelists' preference for taste but had no significant

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impact on color, aroma, or texture. The ANOVA test results showed a significant difference in taste acceptability (p = 0.034), with the 15-gram Moringa leaf flour formulation (Y2) being the most preferred. In contrast, no significant differences were observed in preferences for color (p = 0.216), aroma (p = 0.753), or texture (p = 0.877) across the three treatments. These findings suggest that while Moringa leaf flour can enhance the nutritional value of biscuits, its concentration must be carefully balanced to maintain sensory acceptability, particularly in terms of taste.

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