



FORMULATION OF DANGE CAKE WITH MORINGA (MORINGA OLEIFERA) LEAF FLOUR SUBSTITUTION AS AN IRON-RICH SNACK FOR THE PREVENTION OF ANEMIA IN ADOLESCENT GIRLS

FORMULASI KUE DANGE DENGAN SUBSTITUSI TEPUNG DAUN KELOR (MORINGA OLEIFERA) SEBAGAI CAMILAN TINGGI ZAT BESI UNTUK PENCEGAHAN ANEMIA PADA REMAJA PUTRI

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Abstract

Iron deficiency anemia remains a nutritional problem among adolescent girls, making the development of acceptable local food products rich in iron important. This study aimed to evaluate the effect of Moringa oleifera leaf flour substitution on the organoleptic characteristics, iron content, and proximate composition of dange cake and to determine the best formulation. An experimental study using a Completely Randomized Design (CRD) was conducted with four formulations: F1 (0 g), F2 (12 g), F3 (25 g), and F4 (37 g) Moringa leaf flour. Organoleptic testing used a 1–5 hedonic scale involving 30 untrained adolescent-girl panelists. Data were analyzed using the Kruskal–Wallis test because the organoleptic data were not normally distributed. The results showed no significant differences in color ($p=0.543$), aroma ($p=0.067$), or texture ($p=0.085$), whereas taste differed significantly ($p<0.001$). F2 had the highest mean rank for color (67.10), aroma (70.73), taste (82.27), and texture (68.70), and was therefore selected as the best formulation. Laboratory analysis of F2 showed protein 5.16%, fat 4.04%, carbohydrate 63.35%, moisture 23.75%, ash 1.70%, crude fiber 4.65%, and iron 17.10 mg/g as reported in the research results. The findings indicate that dange cake with 12 g Moringa leaf flour substitution has good sensory acceptance and potential to be developed as an iron-rich snack to support anemia prevention among adolescent girls.

Keywords : Dange Cake, Moringa Oleifera Leaf Flour, Iron, Anemia, Organoleptic.

Abstrak

Anemia defisiensi besi masih menjadi masalah gizi di kalangan remaja putri, sehingga pengembangan produk pangan lokal kaya zat besi yang dapat diterima menjadi hal yang penting. Penelitian ini bertujuan untuk mengevaluasi pengaruh substitusi tepung daun kelor (*Moringa oleifera*) terhadap



karakteristik organoleptik, kandungan zat besi, dan komposisi proksimat kue dange serta menentukan formulasi terbaik. Penelitian eksperimental menggunakan Rancangan Acak Lengkap (RAL) dilakukan dengan empat formulasi: F1 (0 g), F2 (12 g), F3 (25 g), dan F4 (37 g) tepung daun kelor. Uji organoleptik menggunakan skala hedonik 1–5 yang melibatkan 30 panelis remaja putri yang tidak terlatih. Data dianalisis menggunakan uji Kruskal–Wallis karena data organoleptik tidak terdistribusi normal. Hasil penelitian menunjukkan tidak ada perbedaan signifikan pada warna ($p=0,543$), aroma ($p=0,067$), atau tekstur ($p=0,085$), sedangkan rasa menunjukkan perbedaan signifikan ($p<0,001$). F2 memiliki peringkat rata-rata tertinggi untuk warna (67,10), aroma (70,73), rasa (82,27), dan tekstur (68,70), sehingga dipilih sebagai formulasi terbaik. Analisis laboratorium terhadap F2 menunjukkan kandungan protein 5,16%, lemak 4,04%, karbohidrat 63,35%, kadar air 23,75%, abu 1,70%, serat kasar 4,65%, dan zat besi 17,10 mg/g sebagaimana dilaporkan dalam hasil penelitian. Temuan ini mengindikasikan bahwa kue dange dengan substitusi 12 g tepung daun kelor memiliki penerimaan sensoris yang baik dan berpotensi dikembangkan sebagai camilan kaya zat besi untuk mendukung pencegahan anemia di kalangan remaja putri.

Kata Kunci : Kue Dange, Tepung Daun Moringa Oleifera, Zat Besi, Anemia, Organoleptik.

1. INTRODUCTION

Adolescent girls are a group vulnerable to nutritional problems, including iron deficiency anemia. Their high activity levels and inadequate dietary patterns may reduce the intake of essential nutrients. Iron deficiency can affect oxygen transport and is associated with fatigue, reduced concentration, and impaired learning performance. The research report cites the 2023 Indonesian Health Survey (SKI) and notes that anemia among adolescents remains a health concern, with adolescent girls showing a higher prevalence than adolescent boys. The recommended iron intake for girls aged 13–18 years is 15 mg/day based on the 2019 Indonesian Recommended Dietary Allowance (AKG).

Prevention of iron deficiency anemia can be supported through the development of nutrient-dense foods based on locally available ingredients. Dange is a traditional food associated with Pangkep, South Sulawesi, prepared using ingredients such as grated coconut and glutinous rice flour. The research report notes that dange has a sweet-savory sensory profile and is commonly accepted as a traditional snack. Combining dange with Moringa oleifera leaf flour provides an opportunity to increase the nutritional value of a familiar local food.

Moringa leaves are recognized as a nutrient-rich plant ingredient and contain iron as well as other nutrients. The research report cites Moringa as a potential plant-based iron source, while also noting that its characteristic aroma and bitter taste may reduce consumer acceptance. Previous studies cited in the research report have investigated Moringa flour in products such as cookies, brownies, food bars, and fortified biscuits, showing its potential to increase iron content while maintaining acceptable sensory characteristics at selected substitution levels (Dewi & Aminah, 2020; Putri & Roosita, 2021; Rahmawati et al., 2022; Simbolon et al., 2021).

The sensory acceptability of a Moringa-based traditional snack therefore depends on the amount of substitution used. Excessive substitution may strengthen the characteristic green color, aroma, bitterness, or astringent aftertaste of Moringa leaf flour. For this reason, determining a formulation that balances nutritional potential and sensory acceptance is important.

This study aimed to analyze the effect of Moringa oleifera leaf flour substitution on the organoleptic characteristics of dange cake, determine the best formulation based on panelist acceptance, and describe the iron and proximate composition of the selected formulation. The study was expected to provide scientific information for the development of a local snack with potential as an iron source for adolescent girls.



2. RESEARCH METHOD

This study was an experimental study using a Completely Randomized Design (CRD) with four formulations of dange cake. The formulations differed in the amount of Moringa leaf flour: F1 (0 g, control), F2 (12 g), F3 (25 g), and F4 (37 g). In the formulation, the amount of black glutinous rice flour was adjusted to 250 g, 237 g, 225 g, and 212 g, respectively, while the other main ingredients were kept according to the research formulation.

The dange cake formulation and preparation were conducted at the Nutrition Laboratory of Universitas Negeri Makassar. Nutritional analyses were conducted at Laboratorium Kesehatan Masyarakat Makassar I and the Nutrition Laboratory of Universitas Negeri Makassar. Organoleptic testing was conducted in the environment of SMA IT Showatul Is'ad. The organoleptic panel consisted of 30 untrained adolescent girls aged 13–18 years who met the inclusion criteria stated in the research report.

Organoleptic evaluation used a hedonic test with a 1–5 scale covering color, aroma, taste, and texture. The data were first assessed for normality and homogeneity. Because the data were not normally distributed while the variances were homogeneous, the Kruskal–Wallis non-parametric test was used to assess differences among the four independent formulations. Mean rank values were used to describe the relative acceptance of each formulation.

The best formulation was selected based on the overall organoleptic acceptance, particularly the formulation with the highest mean rank across the sensory attributes. The selected formulation was then analyzed in the laboratory for proximate composition, including protein, fat, carbohydrate, moisture, ash, and crude fiber, as well as iron content. Iron analysis was performed using atomic absorption spectrophotometry (AAS), while carbohydrate was calculated by difference as described in the research report.

Table 1. Dange Cake Formulations

Formulation	Black glutinous rice flour (g)	Moringa leaf flour (g)
F1 (Control)	250	0
F2	237	12
F3	225	25
F4	212	37

Source: Research data, 2026.

3. RESULT AND DISCUSSION

The organoleptic data were not normally distributed, so the Kruskal–Wallis test was used. The results for color, aroma, taste, and texture are summarized in Table 2.

Table 2. Organoleptic Acceptance of Dange Cake

Attribute	F1 Mean Rank	F2 Mean Rank	F3 Mean Rank	F4 Mean Rank	p-value
Color	59.05	67.10	61.10	54.75	0.543
Aroma	60.67	70.73	62.57	48.03	0.067
Taste	76.07	82.27	44.85	38.82	<0.001
Texture	61.00	68.70	64.40	47.90	0.085

Source: Primary data, 2026 (Kruskal–Wallis test).

For color, F2 had the highest mean rank (67.10), followed by F3 (61.10), F1 (59.05), and F4 (54.75). However, the Kruskal–Wallis test produced $p=0.543$, indicating no statistically significant difference in panelists' color acceptance among formulations. The research observations indicated that higher Moringa substitution tended to make the product darker and, in some samples, slightly greenish.

For aroma, F2 again had the highest mean rank (70.73), followed by F3 (62.57), F1 (60.67), and F4 (48.03). The p-value of 0.067 was above 0.05, indicating no statistically significant difference. The research observations suggested that the characteristic Moringa aroma became more noticeable as the



amount of Moringa flour increased, particularly in F4, while the lower level used in F2 could still blend with the characteristic aroma of dange.

Taste was the only sensory attribute showing a statistically significant difference, with $p < 0.001$. F2 had the highest mean rank (82.27), followed by F1 (76.07), F3 (44.85), and F4 (38.82). Panelist comments described F2 as having a pleasant sweet-savory taste, with the Moringa taste and bitterness still acceptable. Increasing the substitution to 25 g and 37 g was associated with stronger bitterness and astringent aftertaste, which corresponded with lower acceptance in F3 and F4.

For texture, F2 had the highest mean rank (68.70), followed by F3 (64.40), F1 (61.00), and F4 (47.90). The p -value of 0.085 indicated no statistically significant difference among formulations. F2 was generally described as soft and crisp, although individual panelists differed in their perception of softness and coarseness. Overall, the texture results indicated that the substitution levels did not produce a statistically significant difference in acceptance.



Figure 1. Preparation of the dange cake formulation.



Figure 2. Organoleptic testing with adolescent-girl panelists.

Table 3. Proximate Composition and Iron Content of the Best Formulation (F2)

Parameter	Unit	Result
Fat	%	4.04
Protein	%	5.16
Carbohydrate	%	63.35
Moisture	%	23.75
Ash	%	1.70
Crude fiber	%	4.65
Iron (Fe)	mg/g	17.10

Source: Laboratory report, 2026.

Based on the sensory results, F2 was selected as the best formulation because it consistently showed the highest mean rank for color, aroma, taste, and texture. This result indicates that the use of



12 g Moringa leaf flour provided a balance between the characteristic sensory properties of Moringa and the established sensory profile of dange. Importantly, the statistical results should be interpreted by attribute: the significant difference was found only for taste, whereas color, aroma, and texture did not differ significantly among formulations.

The taste result is consistent with the sensory observations reported in the research. Moringa leaf flour contains characteristic compounds and pigments that can affect product sensory characteristics. As the substitution level increased, the characteristic bitterness and astringent aftertaste became more noticeable in the panelists' comments. Similar product-development studies cited in the research report have shown that an appropriate level of Moringa substitution can increase the nutritional value of a product while retaining consumer acceptance (Dewi & Aminah, 2020; Rahmawati et al., 2022).

The selected F2 formulation contained 5.16% protein, 4.04% fat, 63.35% carbohydrate, 23.75% moisture, 1.70% ash, and 4.65% crude fiber. The laboratory result also reported an iron content of 17.10 mg/g. The research report relates the presence of iron to the use of Moringa leaf flour as a substitution ingredient and identifies the product as having potential for development as an iron-containing snack.

For adolescent girls, adequate iron intake is important because growth and regular menstrual blood loss increase the need for iron. The research report uses an iron requirement of 15 mg/day for girls aged 13–18 years. The selected formulation therefore has nutritional potential as a snack intended to contribute to dietary iron intake. However, the study evaluated nutrient composition rather than the effect of consuming the product on hemoglobin status; therefore, its potential role in anemia prevention should be understood as a food-based contribution rather than a demonstrated clinical effect.

The findings also show that selecting a formulation solely on the basis of higher Moringa substitution is not appropriate. Although increasing Moringa flour may increase the functional potential of the product, excessive substitution may reduce sensory acceptance, particularly taste. F2, with 12 g substitution, provided the best overall balance in this study and was therefore selected for laboratory nutrient analysis.

DISCUSSION

The main finding of this study was that a moderate Moringa leaf flour substitution level produced the highest overall sensory acceptance. F2 had the highest mean rank for every tested sensory attribute. The absence of significant differences for color, aroma, and texture indicates that the observed mean-rank differences were not strong enough to demonstrate a statistically significant effect at the 5% level. In contrast, the significant taste result demonstrates that substitution level was an important determinant of sensory acceptance for taste.

The color pattern can be explained by the visual contribution of Moringa leaf pigments. F1, which contained no Moringa flour, tended to be lighter, whereas higher substitution levels produced darker products and, in some observations, a greenish appearance. Nevertheless, the color differences did not significantly change panelist acceptance. This suggests that the color variation produced by the tested substitution levels remained within an acceptable sensory range.

A similar pattern occurred for aroma. F2 had the highest mean rank, while F4 had the lowest. The lack of statistical significance indicates that panelists' aroma acceptance remained relatively similar despite the increasing amount of Moringa flour. Nevertheless, the descriptive comments suggest that the characteristic Moringa aroma became more apparent at higher substitution levels. This distinction between descriptive tendency and statistical significance is important in interpreting the sensory findings.

Taste was more sensitive to substitution level than the other attributes. F2 had the highest mean rank and mean score, while F3 and F4 showed substantial declines. The research report describes stronger bitterness and astringent aftertaste at higher substitution levels. This may explain why the Kruskal–Wallis test detected a significant difference in taste. The result supports the selection of F2



as a formulation that can provide Moringa enrichment without excessive deterioration in taste acceptance.

The proximate analysis indicates that the selected product contains carbohydrate as the largest reported macronutrient component, followed by protein and fat, together with moisture, ash, and crude fiber. These values describe the composition of the selected laboratory sample. The reported iron content provides the main nutritional basis for the proposed use of the product as an iron-containing snack. Further research is needed to evaluate iron bioavailability, shelf life, vitamin C content, and the effect of regular consumption on hemoglobin status, as also suggested in the research report.

4. CONCLUSION

Moringa oleifera leaf flour substitution in dange cake did not produce statistically significant differences in panelists' acceptance of color ($p=0.543$), aroma ($p=0.067$), or texture ($p=0.085$), but it produced a significant difference in taste ($p<0.001$). The F2 formulation containing 12 g Moringa leaf flour had the highest mean rank for color, aroma, taste, and texture and was selected as the best formulation. Laboratory analysis of F2 reported protein 5.16%, fat 4.04%, carbohydrate 63.35%, moisture 23.75%, ash 1.70%, crude fiber 4.65%, and iron 17.10 mg/g. The formulation therefore has potential for development as an iron-containing local snack for adolescent girls, although further studies are needed to assess iron bioavailability and its clinical contribution to anemia prevention.

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