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Iron-Enriched Dim Sum with Moringa and Tempeh Flour: A Dietary Approach to Preventing Anemia in Pregnant Women

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Abstract

Anemia in pregnant women is a public health problem with a high prevalence in Indonesia, one of the main causes of which is low iron intake. This study aimed to analyze the iron content of dim sum formulated with moringa leaf and tempeh flour substitution as a food product to prevent anemia in pregnant women. This was an experimental study with a completely randomized design (CRD) consisting of a single factor and three ratio variations of moringa leaf to tempeh flours such as F0 (control, without substitution), F1 (ratio 1:2), F2 (ratio 1:1), and F3 (ratio 2:1). The iron content was analyzed using the visible spectrophotometer. The results showed significant differences in iron content among the treatments ($p \leq 0.001$). F0, F1, F2, and F3 had an iron content of 2.54±0.21; 3.37±0.37; 3.81±0.06; and 4.63±0.26 mg 100 g^{-1}, respectively. The F3 treatment had the highest iron content and significantly differed from the F0 control formula. Based on the results, moringa leaf flour contains iron, which plays a role in hemoglobin formation. At the same time, tempeh, rich in protein, helps support the production of red blood cells and prevents anemia. This modified dim sum can potentially be a source of iron-rich food that can help prevent anemia, especially in pregnant women.

Keywords: iron; modified dim sum; moringa leaf; substitution; tempeh

INTRODUCTION

Anemia remains a global health issue, especially during pregnancy. The World Health Organization (WHO) states that the prevalence of anemia during pregnancy in developing countries is still relatively high at 45%, compared to 13% in developed countries (Pemiliana et al., 2019). According to the 2023 Indonesian Health Survey, the prevalence of anemia during pregnancy in Indonesia is still relatively high, reaching 27.7%, particularly among women aged 25 to 34 (Ministry of Health, 2024). One of the leading causes of anemia during pregnancy is the insufficient intake of nutrients, particularly iron and protein. Anemia in pregnancy poses serious health risks for both the mother and fetus. In mothers, it is associated with increased risks of preterm delivery, postpartum hemorrhage, and susceptibility to infections. For the fetus, maternal anemia may contribute to low birth weight, impaired developmental outcomes, and elevated risk of stillbirth (Aji et al., 2020; Gibore et al., 2020). Therefore, alternative solutions are needed through the development of local food products rich in iron and protein, such as dim sum with moringa leaf and tempeh flour substitution, to help address anemia among pregnant women more practically and support sustainable nutritional fulfillment (Nabilla et al., 2022).

Iron is a mineral required to form red blood cells (hemoglobin), which carry oxygen and

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carbon dioxide in the body. Iron deficiency in pregnant women can lead to anemia and have adverse effects, increasing the risk of preterm birth, low birth weight (LBW), neonatal death, and hindering mental development (Fauzia et al., 2024). The government has implemented a supplementation program to prevent anemia during pregnancy, providing 90 iron tablets; however, only 44.2% of pregnant women consume them. This is due to the lack of monitoring and knowledge about the benefits of the supplementation provided (Kody et al., 2021). This indicates the need for alternative options that are more acceptable and easier to consume, such as the development of iron-rich food products made from local ingredients. Studies analyzing the iron content of dim sum with the substitution of moringa leaf flour and tempeh are still minimal, even though these two ingredients have great potential to increase iron intake to prevent anemia in pregnant women.

Anemia prevention in pregnant women requires alternative strategies, not only through iron tablet supplementation but also through developing food products using local food substitutes (Sari, 2023). Food product development is a systematic process to create or improve food products to meet specific nutritional needs. In this case, the development of food products aims to fulfill dietary needs, particularly to ensure adequate iron and protein intake to prevent anemia during pregnancy (Arohman et al., 2019). Substituting nutrient-rich ingredients such as moringa leaf and tempeh flours, which have been shown to increase blood hemoglobin levels, can potentially reduce the risk of anemia in pregnant women. The developed product is a healthy snack based on dim sum, which can be consumed as a nutritious snack to help meet the iron needs of pregnant women (Ariani et al., 2022).

The moringa plant (*Moringa oleifera*) is one of the versatile local plants that is rich in nutrients and has various health benefits (Makkulawu and Amalia, 2022). Moringa leaves contain high levels of iron, 20.49 mg 100 g^{-1}, as well as protein, vitamin A, and vitamin B, which aid in forming red blood cells and increase hemoglobin levels in the blood (Hastuty and Nitia, 2022). The high iron content in moringa leaf flour is beneficial for improving blood hemoglobin levels and enhancing red blood cell production, helping to prevent anemia during pregnancy and maintain normal blood hemoglobin levels (Sailendra et al., 2024). In addition to iron, protein is essential in addressing anemia during pregnancy, as iron and protein play a role in red blood cell production. Hemoglobin is a protein in red blood cells that functions to carry oxygen and carbon dioxide (Rizal et al., 2023). Tempeh is a high plant-based protein source that contains non-heme iron (Rahmania et al., 2023). The protein content in tempeh is beneficial for the formation of red blood cells, thus preventing anemia (Pinasti et al., 2020). Tempeh's widespread consumption in Indonesia and the common cultivation of moringa leaves in home gardens highlight their strong potential as accessible and culturally accepted ingredients for iron-fortified food products, such as enriched dim sum. Their availability and familiarity support their practicality for broader utilization and scalable food processing.

Dim sum is a traditional snack originating from the Canton Region (Guangdong) that is highly nutritious because it is made from base ingredients such as chicken, fish, and shrimp, which are rich in protein and widely loved by the Indonesian community (Ardhanareswari, 2019). Dim sum comes in various flavors such as salty, savory, and sweet, and it has an appealing shape. Therefore, developing a food product in dim sum is necessary, specifically to increase nutritional needs during pregnancy, using local food ingredients that can enhance iron content, such as moringa leaf and tempeh flour substitution (Rohmah et al., 2023). Dim sum was chosen in this study because it is a versatile food preparation that can be modified in terms of ingredients, easily combined with both plant-based and animal protein sources, and has the potential to address anemia through the substitution of moringa leaves, which are rich in iron (28.2 mg 100 g^{-1}), and tempeh, which contains isoflavones and phytase that support iron absorption. This could help meet the daily iron needs of pregnant women as an alternative to iron tablet supplementation (Teoh et al., 2024).

Research on the development of dim sum products made from local ingredients, particularly with the substitution of moringa leaf flour and tempeh as sources of iron, remains very limited. Yet, these two ingredients have great potential in increasing iron intake to prevent anemia in pregnant women. Therefore, this study aimed to analyze the iron content of dim sum products formulated with the substitution of moringa leaf

flour and tempeh to provide an alternative nutrient-rich food to prevent anemia. This modified dim sum product is expected to increase iron content and contribute to meeting the iron needs during pregnancy for women experiencing anemia, serving as a practical alternative iron source.

MATERIALS AND METHOD

Materials and study design

The main ingredients used in this study were moringa leaf and tempeh flours as substitutes, wheat flours, and supporting ingredients for making dim sum, such as chicken meat, granulated sugar, table salt, pepper, garlic, ground pepper, ginger, and dumpling wrappers. The supporting ingredients were obtained from Prawirotaman Market, while the moringa leaf and tempeh flours were purchased through the Shopee e-commerce platform from the store "*Ielts Organic Food*". The instrument used included a scale, cutting board, knife, spatula, plates, bowls, spoons, sieve, food processor, steamer, mixing basin, stove, pot, and spectrophotometer to analyze the iron content.

This study was an experimental research with a completely randomized design (CRD). The treatments were F0 as a control formulation with 100% wheat flour weighing 15 g, and F1, F2, and F3 were groups of treatments with ratio variations of moringa leaf flour to tempeh flour 1:2, 1:1, and 2:1, respectively. Each treatment used a substitute flour with a total weight of 15 g, with different ratio compositions for each treatment that were designed to evaluate differences in iron content among the formulas. The study was conducted at the Food Laboratory of Universitas Alma Ata for product formulation, which obtained ethical clearance from the Ethics Committee of Universitas Alma Ata (No: KE/AA/XII/10112168/EC/2024). The research was carried out from December 2024 to February 2025. Each treatment was performed in two replications to ensure accuracy and data validity. Running each treatment in duplicate provides a practical means to verify measurement precision and ensure experimental reliability. Using two replicates balances statistical reliability with resource efficiency, enabling error detection without excessive time or cost. This method was suitable when technical variability and replication capacity are minimal.

Dim sum formulation

The dim sum formulation with flour substitution in this study used the same ingredient composition for all treatments, except for the type of flour used. The product formulation was based on preliminary research involving three trials to determine the optimal formulation. The control formula (F0) uses 100% wheat flour, while treatments F1, F2, and F3 are substitutions with moringa leaf and tempeh flour combinations in different ratios that can be seen in Table 1.

Dim sum (DimsTelor) sample preparation

The preparation of dim sum with flour substitution began with determining the formula based on the ratio of moringa leaf to tempeh flours, which was coded as F0, F1, F2, and F3, followed by weighing the raw materials for

Table 1. Dim sum formulation with moringa leaf and tempeh flour substitution

Ingredients	Treatments			
	F0	F1	F2	F3
Chicken (g)	100	100	100	100
Cassava flour (g)	10	10	10	10
Wheat flour (g)	15	0	0	0
Moringa and tempeh flour (g)	0	15	15	15
Sugar (g)	3	3	3	3
Pepper (g)	2	2	2	2
Egg (g)	20	20	20	20
Salt (g)	3	3	3	3
Onion (g)	7	7	7	7
Oyster sauce (g)	5	5	5	5
Sesame oil (g)	3	3	3	3
Dumpling skin (g)	24	24	24	24

Note: This dim sum formulation was adopted from a previous study by Ardhanareswari (2019)

approximately ±15 minutes. The next step was preparing the ingredients and equipment, including washing bowls, weighing tools, and preparing seasonings, which required ±10 minutes. Moringa leaf flour was then dry-roasted over low heat for ±3 minutes to remove any raw odor, cooled, and sieved for ±5 minutes. The chicken meat was washed under running water, separated from the bones, cut into small pieces for easy grinding, and weighed according to the formulation. For the dim sum filling, the chicken meat was mixed with moringa leaf flour, tempeh flour, and additional ingredients such as tapioca flour, wheat flour, eggs, pepper, oyster sauce, sugar, salt, sesame oil, garlic, and ginger. All ingredients were blended in a food processor until smooth and well combined (±25 minutes). The prepared filling was wrapped with dim sum skin, each weighing 15 g, and shaped according to the desired dim sum model (±25 minutes). The final step was steaming, which involved preheating the steamer until the water boiled for ±5 minutes, steaming the dim sum for ±10 minutes, and then cooling them for ±5 minutes before packaging or analysis. The total time required to prepare one batch of dim sum was approximately ±1 hour and 48 minutes. The preparation of dim sum with flour substitution is illustrated in Figure 1.

Iron content measurement

Iron content analysis was conducted at the Chem-Mix Pratama Laboratory, Bantul. The procedure for analyzing iron content using the visible spectrophotometry method is as follows. The samples, ground into a fine powder in a porcelain crucible, were weighed at 5 g and ashed in a muffle furnace until they turned ash. Afterward, the ashes were dissolved using 50 ml of HNO_3 1:3 while grinding them in a porcelain mortar. The solution was filtered using filter paper, and the filtrate was transferred to a 100 ml erlenmeyer flask. One milliliter of clear filtrate was taken, and 2 ml of 1.5 M ammonium thiocyanate (NH_4SCN) was added. The solution will turn red if the sample contains iron. Then, aquades was added to bring the volume to 10 ml, and the absorbance was measured using a spectrophotometer with a wavelength of 510 nm. The obtained data and the iron content were recorded using a standard iron curve (Nabilla et al., 2022). The iron content analysis

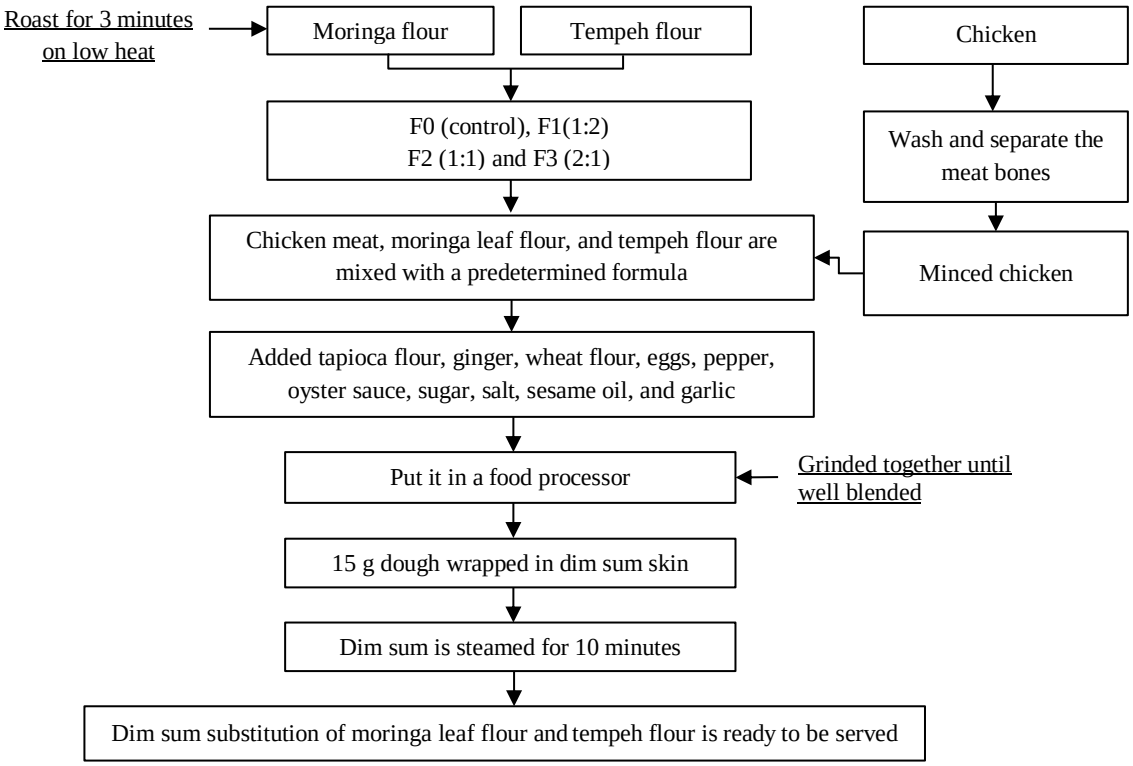

Figure 1. Flow chart of moringa leaf and tempeh flour substitution

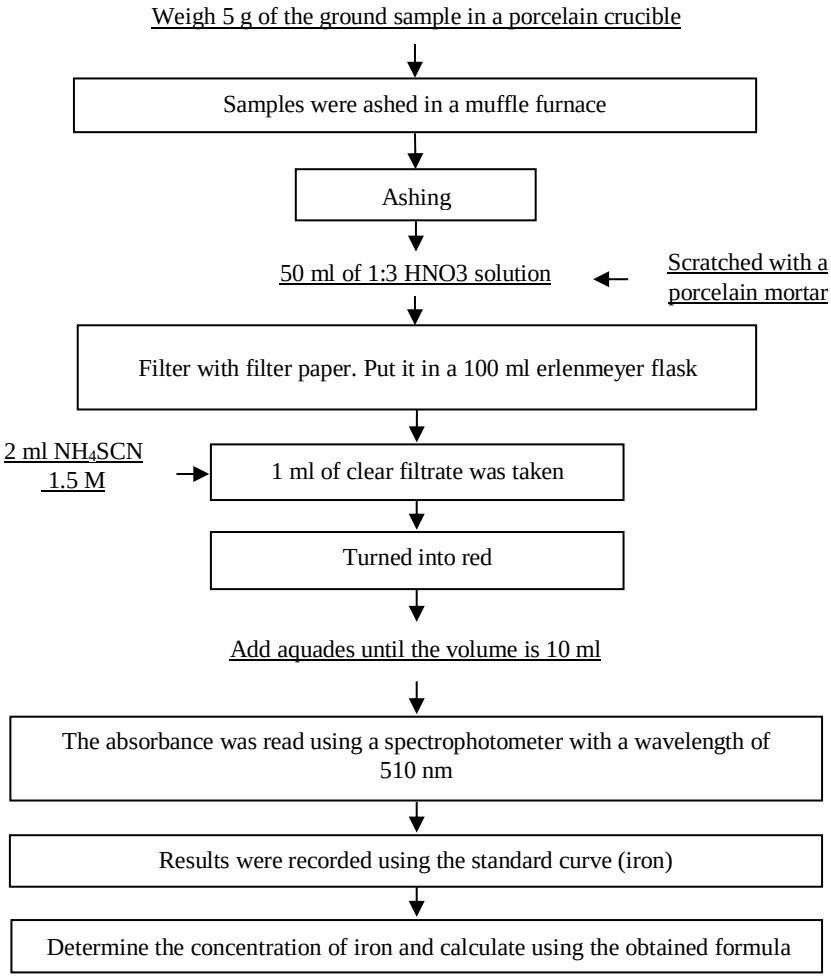

Figure 2. Flowchart of iron analysis using the visible spectrophotometry method

of the dim sum with flour substitution using the visible spectrophotometry method is presented in Figure 2.

Statistical analysis

The statistical analysis was created using descriptive quantitative analysis with a One-Way ANOVA test, utilizing SPSS 25.0 version, to examine the differences in iron content among the treatments. A Duncan multiple range test was performed to determine the differences between the treatments. A significance level was determined by $p \leq 0.05$.

RESULTS AND DISCUSSION

Development of DimsTelor product

This study aimed to develop dim sum products substituting moringa leaf and tempeh flours to prevent anemia in pregnant women. The results showed that the F3 formula (10 g moringa leaf flour + 5 g tempeh flour) provided the best chewier texture, reduced beany odor, and higher iron content than the control formula. Blanching and dry-roasting of moringa leaf flour for ±3 minutes effectively reduced the characteristic beany odor of moringa leaves. However, increasing the proportion of moringa leaf and tempeh flours also affected changes in the dough texture. The development of the dim sum product for each formulation can be seen in Figure 3.

Experiment and formula modification

In the first trial, 15 g of moringa leaf flour and 15 g of tempeh flour were added directly into the dough without pre-processing, such as dry-roasting. The results showed that the dim sum had a hard texture and a distinctive beany odor from the moringa leaves, which was caused by the activity of lipoxygenase enzymes (Angelina et al., 2021). These enzymes play a role in the hydrolysis of polyunsaturated fatty acids, producing compounds that contribute to the beany

F0 F1

F2 F3

Figure 3. Product of DimsTelor with flour substitution in each treatment (F0, F1, F2, and F3)

odor (Daud et al., 2023). The beany odor in the dough can be reduced through heat treatments such as dry-roasting (Lestiarini and Rindiani, 2023).

In the second trial, 10 g of moringa leaf flour and 10 g of tempeh flour were used. The results showed that the dim sum still had a hard texture due to the high proportion of flour. This is consistent with the findings of Sinaga et al. (2022) who reported that adding moringa leaf flour to dough results in a denser texture because of its fiber content, which affects elasticity. Similarly, Selawati et al. (2024) stated that increasing the proportion of tempeh flour can lead to a harder dough texture. The fiber content of moringa leaf flour contributes to a denser and chewier texture in siomay, and increasing the amount of this flour is directly proportional to the texture enhancement (Arni et al., 2024). Therefore, a reformulated ratio was applied, using 15 g of combined moringa leaf and tempeh flour.

According to Adha et al. (2021), adding moringa leaf flour to onion sticks produced the best quality products regarding color, taste, and crispiness. Likewise, adding 10% tempeh flour to fudgy brownies resulted in products most preferred by panelists, particularly regarding texture (Hidayat et al., 2024). Rahmayanti et al. (2020) also reported that adding 10% moringa leaf flour per 100 g of tempeh sausage increased its iron content to 11.50 mg 100 g^{-1}. In the third trial, 15 g of moringa leaf flour was used, and the beany odor of moringa leaves was reduced after blanching and dry-roasting treatments for 3 minutes. The dim sum texture improved compared to the previous trials, becoming less demanding while maintaining the desired chewiness (Medho and Muhamad, 2019).

However, a slight fishy odor from the chicken meat was still noticeable, prompting the addition of ginger as an ingredient. According to Wediasari et al. (2022), ginger is an effective natural ingredient to reduce fishy odors in various foods, particularly in products made from fish and chicken, as its active compound, zingerone, can neutralize unwanted odors and provide a fresh aroma. This series of trials found that blanching, dry-roasting, and adjusting the proportion of moringa leaf and tempeh flours are essential in producing dim sum with improved texture and aroma.

Iron content analysis in DimsTelor products

The average iron content analysis results in dim sum with flour substitution can be seen in Figure 4. The study shows that the iron content in the dim sum increased with each treatment. The control treatment (F0) had the lowest iron content at 2.54 mg 100 g^{-1}, while treatment F1 increased to 3.37 mg 100 g^{-1}. In treatment F2, the iron content increased to 3.82 mg 100 g^{-1}; treatment F3 had the highest iron content at 4.63 mg 100 g^{-1}. This indicates that substituting ingredients increased iron content, with the best formula containing 4.63 mg 100 g^{-1} per serving (Putri et al., 2023).

Moringa leaves are a source of plant-based iron and protein (Rahmayanti et al., 2020). According to previous research, moringa leaf flour has an iron content of up to 28.2 mg 100 g^{-1} (Oktafiani and Aprilia, 2023). The highest increase in iron content in treatment F3 is due to the higher iron in moringa leaf flour compared to tempeh flour, leading to a significant increase in iron content. Moringa leaves are rich in iron; however, anti-nutritional compounds such as tannins, phytates, and oxalates that can inhibit the absorption of minerals, including iron, are also found in the moringa leaf. The bioavailability of iron becomes low due to its high phytic acid concentration (Gallaher et al., 2017; Wahyuningsih et al., 2023). To address this issue, this study applied three-minute processing treatments such as blanching and dry-roasting, which were proven to reduce the levels of anti-nutrient compounds without significantly decreasing the iron content. This method is consistent with the findings of Mawouma et al. (2016) who reported that mild heating can reduce the raw odor of moringa leaves while decreasing anti-nutritional compounds, especially phytic acid, that may affect iron bioavailability. Although increasing the use of moringa leaf flour can improve the iron content, which is beneficial for health, especially in preventing anemia, excessive amounts may affect the sensory characteristics and decrease product acceptability (Fitriarni et al., 2024).

This study is in line with the findings of Rahmayanti et al. (2020) which show that substituting moringa leaf and tempeh flours increases iron content, especially with a higher proportion of moringa leaf flour, which is rich in iron. However, tempeh flour contains 3 to 5 mg of iron per 100 g. Although its contribution is minor, its isoflavone and phenolic compound content can help improve iron absorption in the body (Suprihartini et al., 2020).

According to Teoh et al. (2024), tempeh flour improves iron bioavailability because fermentation produces phytase, which reduces phytic acid, an inhibitor of iron absorption. This is consistent with research by Rohmah et al. (2023) which also showed that the combination of moringa leaves and tempeh significantly increased iron content in processed products. Thus, both can be effective alternatives to meet the iron needs of pregnant women with anemia. Dim sum is a versatile food that can be easily modified both in terms of filling and dough. Its convenient serving size makes it an ideal functional food option to be developed, particularly with the substitution of moringa leaf and tempeh flours to meet nutritional needs, mainly to ensure adequate iron and protein intake to prevent anemia during pregnancy.

Effectiveness of the DimsTelor formula considering capital and production costs

The effectiveness of the dim sum formula with flour substitution was calculated based on iron content and production costs. This analysis considered capital, expenses, and the increased percentage of iron needed by pregnant women.

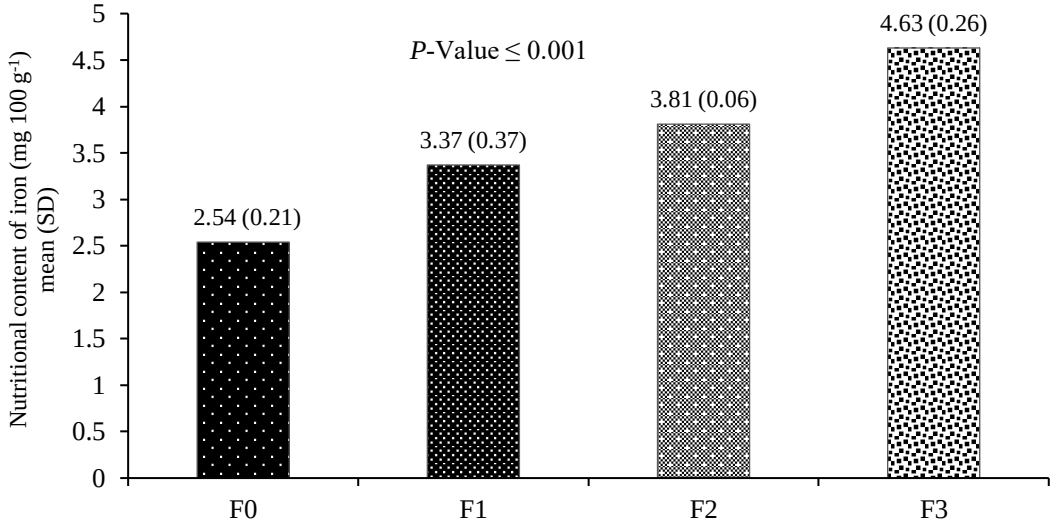

Figure 4. Mean of iron content in DimsTelor product

The production costs were calculated based on the raw material prices at Prawirotaman Market in December 2024.

Table 2 shows that substitute flour increased the iron content in dim sum as the substitution ratio increased. The control formula (F0) had the lowest iron content, 2.54 mg per serving, with a production cost of 4,689 IDR. After substituting moringa leaf and tempeh flours, the iron content increased with varying percentages for each formula.

Substituting moringa leaf and tempeh flours in dim sum significantly increased iron content compared to the control (F0). The F3 formulation had the highest iron content, 4.63 mg, an increase of 82.28% compared to the control. Although the production cost for F3 increased by 3.82%, the cost-effectiveness of this formulation was the highest (21.55 mg/1%), showing that the increase in iron content was greater than the increase in production costs.

Compared to F1, which had the highest cost increase (4.88%) but only increased the iron content by 32.68%, the F3 formulation was more efficient in delivering additional iron at a relatively low cost. Meanwhile, F2 showed a balance between cost and iron increase, with a cost-effectiveness ratio of 17.76 mg/1%. Thus, the results of this study indicate that flour substitution can significantly increase iron content in dim sum, and the F3 formulation is the most cost-efficient in delivering additional iron with relatively low production costs.

This study aligns with previous research showing that moringa leaves and tempeh contain high iron levels and can be used as food alternatives to increase hemoglobin levels. A study showed that moringa leaf flour contains 28.2 mg of iron per 100 g, and tempeh is known to contain 4 mg of iron per 100 g (Gabriela, 2021). The high iron content in both ingredients makes them potential additives in food products to prevent anemia, especially in pregnant women who need higher iron intake. Combining them in the dim sum product is expected to increase the bioavailability of iron, making it easier for the body to absorb. This study showed that flour substitution significantly increases the iron content in dim sum products. From the analysis, F3 proved to be the best formula in this study. This formula had the highest increase in iron content, 82.28% compared to the control, with affordable production cost effectiveness. Although there was a slight increase in cost, this formulation still provides good economic value because its iron content is significantly higher than that of the other formulas. Therefore, F3 is the optimal formula to be developed as a high-nutrient dim sum product that can contribute to anemia prevention, especially for vulnerable groups such as pregnant women, while still considering production cost efficiency.

Alternative DimsTelor products for preventing anemia in pregnant women

The dim sum made with substitute flour developed in this study has a serving size of 100 g, equivalent to four pieces of dim sum, each weighing 25 g. According to the Ministry of Health Regulation No. 28 of 2019, the recommended nutrient intake (RNI) for iron during pregnancy for women aged 15 to 49 is 18 to 27 mg day^{-1} (Ministry of Health, 2019). The iron content of dim sum increases with the increase in substitute flour. The control formula (F0) contains 2.45 mg 100 g^{-1}, contributing 14.11 to 16.93% to the RNI. The F1 formula contains 3.37 mg 100 g^{-1} (18.72 to 22.47% of the RNI), F2 contains 3.81 mg 100 g^{-1} (21.17 to 25.4% of the RNI), and F3 has the highest content of 4.63 mg 100 g^{-1} (25.78 to 30.87% of the RNI). Based on the highest iron content obtained in the F3 group, consuming 3 to 4 portions of dim sum per day could fulfill the daily iron needs for pregnant women.

Table 2. Formula for DimsTelor product that enhances nutrient content while considering capital and expenditure aspects

Treatments	Iron (mg)	Price per portion (IDR)	Elevated price (%)	Elevated iron (%)	Effectiveness price (mg/1%)
F0 (control)	2.54	4,689	0	0	-
F1 (1:2)	3.37	4,918	4.88	32.68	6.69
F2 (1:1)	3.81	4,821	2.82	50.00	17.76
F3 (2:1)	4.63	4,868	3.82	82.28	21.55

Note: mg/1% = iron (mg) per 1% elevated price

The results show that the higher the iron content in the dim sum product, the greater its contribution to the RNI of pregnant women. The best formulation, with the highest ratio of moringa leaf flour, provides the highest iron content and has the potential to meet the iron needs of pregnant women (Ardana et al., 2024). Adding 10 g of tempeh flour and 10 g of moringa leaf puree to wet noodles increased the iron content from 78.7 to 89.5 mg kg^{-1} (Sari and Ismawati, 2023). This study is consistent with previous research, which found that substituting moringa leaf and tempeh flours in food products can increase iron content and serve as an alternative to support RNI in adolescent girls with anemia (Nugroho et al., 2023).

Dim sum containing moringa leaves can help increase hemoglobin levels in the blood. According to Indrasari and Agustina (2021) giving tempeh for 15 days can increase the hemoglobin levels of pregnant women from 9.43 to 10.71 g dl^{-1}. Oktavianis and Gusfiana (2023) stated that chicken dim sum combined with moringa leaf flour showed an average increase in hemoglobin levels from 12.37 to 13.93 g dl^{-1} after 30 days of intervention, showing significant results. Based on these findings, flour substitution in dim sum products has the potential to increase hemoglobin levels effectively. It is a functional alternative for anemia prevention, especially for pregnant women.

Susiyanti and Hartini (2021) stated that consuming moringa leaves in capsule form effectively increases hemoglobin levels in pregnant women. This research aligns with Sartika et al. (2023) which revealed that supplementing with moringa leaf extract for 2 weeks can improve hemoglobin levels during pregnancy with an average increase from 9.64 to 10.6 g dl^{-1}. However, other studies emphasize that increasing hemoglobin is more significant when moringa leaves are combined with iron supplements rather than consumed alone. This indicates that other supporting factors, such as diet and the intake of complementary nutrients, strongly influence the effectiveness of moringa leaves. Thus, it can be concluded that moringa leaves can be an effective nutritional source for increasing hemoglobin levels during pregnancy (Rotella et al., 2023; Rissa, 2024).

The increase in hemoglobin levels in pregnant women who consume moringa leaves is influenced by the content of iron, vitamin C, vitamin A, folic acid, and plant-based proteins, which play an essential role in the formation of red blood cells (Derbo and Debelew, 2023). Pregnant women are advised to consume foods rich in vitamin C alongside dim sum to enhance iron absorption. Vitamin C plays a role in converting non-heme iron into a form that is more easily absorbed by the body (Nugroho and Wardani, 2022). Additionally, pregnant women should avoid consuming tea and coffee during meals, as the tannin content in these beverages can inhibit iron absorption by up to 80%, increasing the risk of anemia during pregnancy.

Strengths and limitations of the study

This study has several strengths, including using local food ingredients such as moringa leaves and tempeh, which are easily accessible and rich in nutrients, particularly iron. Additionally, the simple formulation of the product, which is generally acceptable to consumer acceptance, makes this dim sum potentially suitable for further development as a functional food for pregnant women with anemia. The study is also supported by comparisons of the RNI and relevant studies, which enhance the validity of the results.

However, this study has some limitations. One of the main limitations is the lack of direct effectiveness testing on the increase in hemoglobin levels in pregnant women and the absence of acceptability testing. To address these shortcomings, the researchers recommend that the dim sum product be paired with a source of vitamin C to enhance iron absorption. Furthermore, future research should involve direct intervention with the target group, organoleptic testing, and exploration of other product forms to provide more variety and appeal.

CONCLUSIONS

The highest moringa leaf four ratio formulation has been proven to have the highest iron content and the most cost-efficient production, making it a potential primary recommendation for preventing anemia in pregnant women. This product has prospects for further development and opportunities as a functional food that can be integrated into national nutrition programs, such as supplementation programs for pregnant women. Thus, the product meets daily iron requirements

and has long-term potential in supporting community nutrition interventions.

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